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(Quality assured)
How Fascinating! An entrepreneurial learning initiative

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ABSTRACT
Entrepreneurial learning is being suggested as a valuable model for tertiary education in the 21st century. For those teaching Information Technology, the need to match the requirements of a rapidly changing workplace and technological environment to ensure graduate employability is not new. However, the application of these ideas to the pedagogy they use is less widely followed or understood. This paper describes how a traditional compulsory course within a Bachelor of Information Technology was transformed from a rather dry and uninspiring format to one which is enjoyable and engaging by applying many entrepreneurial techniques to its delivery and assessment. The approach employed was radical and risky but appears to have reaped a number of benefits which are discussed in some detail together with the underlying philosophy which allowed this experiment to progress.

Categories and Subject Descriptors
K.3.2 [Information Systems Education]

General Terms
Design

Keywords
Entrepreneurial education, assessment design

1. INTRODUCTION
Deriving initially from the notion of teaching entrepreneurial skills, the concept of ‘entrepreneurial learning’ may be a promising strategy for the rapidly changing environment of current education and educational institutions. At least one tertiary educational institute in New Zealand, Nelson Marlborough Institute of Technology (NMIT) is developing an entrepreneurial learning framework to guide future course development and delivery and to provide an aspirational target for creating authentic, relevant and engaging learning situations and experiences.

Since 2009, the Digital Technology teaching team at NMIT had supported the idea of ‘serious fun - serious learning’ [2] as the basis of their teaching philosophy. This had resulted in various initiatives including the very successful concept of IT Challenge Week which had always been intended to be a “starting point for re-thinking some of the more traditional educational activities” [1, p.28]. This paper details how a serendipitous blend of current staff thinking, a short term staff shortage and a compulsory but unpopular subject resulted in a fortuitous entrepreneurial learning approach to the design and delivery of a first year degree course.

2. BACKGROUND
For several years, an ongoing and lively conversation between the Digital Technologies teaching staff concerned ways in which learning situations could be developed and assessed which engaged and encouraged students, provided relevant and authentic learning experiences and which both students and staff found interesting, motivating and fun. The team believed and the success of Challenge Week had shown, that providing students with interesting, challenging and largely self-directed activities helped them to engage with important and necessary content and that this was the model of learning that we wanted our students to follow. However, in some respects the Challenge Weeks modelled the idea of ‘serious fun, serious learning’ too well. Some courses did not meet the expectation that was created and the staff felt a sense of frustration at not being able to maintain the same approach consistently throughout the year. While other educators (e.g. Seely Brown [10]) appeared to support the approach staff wished to take, including an increasing interest in both games and gamification in education, the notion of the ‘flipped classroom’ and the ubiquitous adoption of technology, there was little guidance on how to bring this together into a coherent and cohesive whole. Consequently, staff were inclined to trial different ideas and approaches in isolation but often retreated to more traditional methods of both delivery and assessment when faced with a shortage of time or other resources.

In 2012, NMIT introduced its commitment to entrepreneurial learning via its official Investment Plan 2013-201 saying “[w]e endorse a new learning paradigm aimed at developing the working capabilities of individuals and organisations, based on the concept of ‘entrepreneurial learning’ - breaking down the divisions between education, practice and work within ‘real world’ learning experiences” [9, p.8]. Among a number of possible strategies to achieve this NMIT suggests that they will encourage activities that “...take students further than technical skills alone by the development of creative and innovative capabilities...”, “...integrate innovative problem-solving, self-directed learning and enterprise principles within courses...” provide “training for the real world by learning in the real world” and “teach and test students on attributes other than technical skills”[9, p. 43].

However, as others have noted (e.g. Erdelyi [3]) “there is no consensus in the literature on how to define a single identifiable phenomenon called ‘entrepreneurial learning’.” While it is often seen as teaching entrepreneurs, for example by situating the education “within the actual workplace or simulated contexts that provide them with opportunities to apply what they have learned while taking action, to accumulate their first-hand experience and to reflect upon experience” [8, p.549] there is a growing recognition that teaching the skills of entrepreneurship (e.g. risk-taking, self-motivation, self-discipline, teamwork, perseverance) to all students is valuable in and of itself [11]. Partly in response

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to the economic difficulties in Europe, the European Union has been highlighting the importance of “developing ‘entrepreneurial mind-sets’ … in which education and training are the key drivers” [4, p.11]. There is also an emerging notion of applying an entrepreneurial approach to the pedagogy itself and it would appear that the NMIT commitment is attempting to cover all these interpretations.

The Digital Technologies teaching team at NMIT has been guided by many of the principles of entrepreneurial learning for some years. A student’s final year project is often an industry-based placement or client driven project, many course assessments are rooted in industry-based case studies or driven by industry training schemes, and several activities, such as support for the student computer network and laptops, require students to engage in ‘real world’ learning experiences. However, entrepreneurial learning is not just about ‘learning by doing’ or learning how entrepreneurs succeed, it is also about learning to take risks, learning by failing and learning by gradually achieving mastery over a set of skills. As any online gamer will attest, failure is an excellent way of promoting learning by encouraging innovation and determination to succeed but only when the consequences of that failure are manageable [5, slide 14], the motivation to succeed is high and the possibility of eventual success seems likely. As one blogger wrote, “we don’t get better to avoid failure, we fail in order to get better” [6, online]. Learning to embrace failure and learn from it promotes self-confidence and encourages the learner to act with “intelligent optimism” [12, online] rather than responding to their negative inner voice [13].

Creating the environment in which this kind of learning can take place is the primary challenge for aspiring ‘entrepreneurial educators’ but this alone is not enough. If there is a real desire to change the educational paradigm, it is essential that the means by which success is assessed and measured, also change. In an entrepreneurial educational environment, success can no longer be measured by striving for ‘perfect’ outcomes; the notion of a model answer is dead! Instead, success must be focussed not on the quality of the final outcome but on a student’s ability to develop and experiment with various strategies, learn from both their failures and successes and to reflect critically on both. Providing a safe environment in which students can fail at no cost is not enough. It is the practice of risk taking, the practice of failure, and in particular the practice of avoiding future failure through critical analysis of new knowledge which must be rewarded if students are to respond to the challenges of entrepreneurial learning.

Somewhat serendipitously, discussion around these issues and the continued redevelopment of a problematic first year degree course coincided with the viewing of an inspirational video of Benjamin Zander, the conductor of the Boston Philharmonic Orchestra [13]. In this talk, Zander relates how in one class that he teaches all students are awarded an A grade at the start if they write him a forward dated letter from their future selves explaining what they did to receive such a grade. A number of ideas flowed from this video including the notion of removing the negative inner voice, removing the anxiety about meeting some ill-defined measure of success, and the self-evident but usually ignored fact that levels of required attainment and the grades attached to them are essentially arbitrary and artificial. As a result, the Digital Technologies team agreed to experiment further with the course, to test both student and staff reactions to a new approach and to learn more about the potential of taking a more ‘agile’ approach to teaching and learning. With institutional support and approval, the team adopted the attitude that while the experiment might not achieve its intended goals, nevertheless useful lessons would be learned along the way.

3. THE PROBLEM

The introduction of a new degree programme in 2011 had resulted in a new course “Information Technology in Context” (ITC501) appearing as a compulsory first year paper for all students on the Bachelor of Information Technology. The rationale for the course was to create a context for IT study, particularly as some of the younger students would have had little experience of the world in which much of their IT work would eventually be situated. It had been agreed that students needed to have a grounding in professional practice, ethics and basic business practices in order to make sense of their learning in other classes. Although having a worthy intent, the course had proved to be something of a trial. For students, excited to be starting IT study it seemed dry and irrelevant and while staff understood the need for the course it was seen as a chore rather than an exciting opportunity.

Underlying the overt intentions of the course also lay a hidden agenda which addressed the nature of IT professional life, e.g. self-motivation, problem-solving, solution seeking, constant learning, information evaluating, appropriate communication, awareness of online dangers and affordances, and the nature of tertiary IT student life, e.g. taking responsibility for learning, rising to challenges, working alongside others in an open and honest way, deep learning rather than grade-driven superficial achievement.

As a compulsory first year, first semester course, ITC501 also potentially offered a way to continue the challenges of Challenge Week, something regarded as an important pathway by the team. The retention of new students in the first few weeks of their degree study was a primary focus and with an energised, interesting, engaging format it was believed that this course could provide a way of allowing students to both ‘find their feet’ and begin to appreciate the excitement of working in the IT area.

4. THE SOLUTIONS

The redesign of ITC501 currently falls into two phases. The redevelopment process had begun in 2012 when a temporary staff shortage resulted in there being no one available to teach the course. Consequently a new approach to both delivery and assessment was introduced. In 2013 the format was refined by a recognised awareness of the principles of entrepreneurial learning and the vision of Zander [13].

4.1 Year 1 - 2012

4.1.1 Delivery

With no staff member able to take full responsibility for the course, the team agreed to a work sharing arrangement. One person became the course facilitator and all staff members took responsibility for one or more topics lasting one or two weeks. In effect the teaching was crowd-sourced and staff from other related areas were also invited to participate. A long list of appropriate topics based on staff interest, including those deemed compulsory by the official learning outcomes of the course, was constructed. Each staff member chose one or more topics, agreed the duration of each topic (generally 1 or 2 hour sessions) and committed to providing (and eventually assessing) a short set of questions or activities that students would be required to complete.
4.1.2 Assessment
Each student was required to create a personal WordPress blog and a Google document. For each topic, the student detailed the relevant activities as one or more blog postings. Some of the posts were mandatory, i.e. those covering specific learning outcomes and others were optional. At the end of the semester, the student provided the URL of all the individual blog posts that they wished to be assessed in their Google document. Apart from the five required posts, they were asked to choose 3 additional ones that they felt were their best. The relevant staff then marked each post using a predefined rubric and the facilitator provided a mark of certain aspects such as regularity of posting. These marks were then totalled to provide an overall grade for the course.

4.1.3 Review - staff
In terms of delivery, staff were happy with this arrangement and welcomed the chance to engage and inspire students with a wide range of IT issues about which they were both knowledgeable and passionate. The topics ranged from Security to Social Media, from Digital Behaviour to Virtual Worlds and from Open Source Software to Copyright. Through these sessions, all staff had the opportunity to interact with both new and returning students and it fostered the sense of community which Challenge Week had initiated. The assessment format was less successful and the marking process was hard to organise and was not straightforward. It also came much too late in the semester to provide useful information to students and a number of students marginally failed who may well have succeeded with more timely feedback. There were others who fell between the cracks and although monitoring of the blogs should have provided a means of catching problems early, the approach was not sufficiently systematic or organised.

4.1.4 Review - students
Anecdotally, the students mostly welcomed the range of teaching styles and topics that the format provided and several remarked that they felt they now ‘knew’ the staff much better and would be better prepared when meeting them in subsequent courses. Some of them also commented in their blogs that the course was opening up their eyes to aspects of IT that they had never considered before and that this ‘taster’ of things to come was both interesting and motivating. However, the frequent change of staff and the different length of topics did produce some confusion at times and there was a perceived lack of continuity. Once again it was the assessment that proved problematic. One student remarked that as the assessment came at the end of the course only they were trying to hit a target that they couldn’t see. They had no reliable means of gauging what was needed to pass the course and as a result some students devoted far more time than was needed while others, of course, did too little. More consistent and timely feedback was definitely needed. The opportunity to exercise some control over what would be assessed was welcomed but encouraged some students to deliberately miss certain sessions and topics. Likewise, as directed work was set on a weekly basis, too many students came to rely on a mechanistic approach to meeting what they hoped would be a sufficient standard.

All in all, this offering of the course was certainly more successful than the previous, rather dry and uninspiring traditional version. However, there were certainly still a number of areas for improvement.

4.2 Year 2 - 2013
4.2.1 Delivery
In the second year, the notion of crowdsourcing the teaching was maintained although this time the course facilitation role was strengthened and one staff member took overall responsibility for the course in a way that hadn’t been possible before. Each week, the facilitator would take one 2 hour session while a team member took the other. This provided significantly more continuity for students as they knew they would see the course facilitator at least once a week and it allowed the facilitator to play a much more active role in monitoring students’ progress, providing timely feedback and encouraging and following up with students who appeared to be struggling. The topic areas were similar to the previous offering but restricted to one two hour session and once again staff provided direction on what should be covered in the student’s weekly blog post.

4.2.2 Assessment
The major difference in this offering was in the way in which the course was assessed and graded. Based on Zander’s inspiration, all students were told in the first class that they had received an A+ for the course. However, to have the A+ awarded they had to meet two requirements. Firstly, they had to write a formal letter to the facilitator dated six months ahead explaining what they had achieved to warrant this excellent grade and secondly, they had to complete 12 of 15 blog posts over the course of the semester to a standard acceptable to the staff member responsible for the topic. This required the student to make the posting within 3 days of the topic being presented and required the staff to read and respond to all the blog posts relevant to their topic within a short time-frame (usually 3 days). All the staff member had to do was to leave a comment indicating if the post was acceptable and if not, what needed to be done to bring it to the required level. In the following session, the facilitator would work through any issues from the topic, check the comments on the students’ blogs and assist them in taking any necessary remedial action.

4.2.3 Review - staff
In terms of delivery, this arrangement differed little from the previous year and much of the previous preparation was reusable. In general, each staff member was responsible for less sessions and the course facilitator took a much greater role on a weekly basis. The redesigned assessment however, required a different and more focused approach. It was important for the successful flow of the course that each week’s posts were read and responded to before the facilitator’s session in the following week. In practice that meant that a topic was delivered on a Friday, the student blog post had to be in place by the following Tuesday morning and the staff member had to record their comments on each blog by the Thursday morning. This could be quite a challenge for both staff and students at times! Nevertheless, the process worked reasonably smoothly with most able to work within these deadlines - some tolerance was shown to those who couldn’t although the facilitator did have to spend some time chasing those who fell behind. One advantage for topic staff was that their involvement in the course was largely over, once the blog posts had been assessed. No frantic last minute marking was required at the end of the semester.

For the facilitator, there was clearly an increased workload. Not only, did he now have the responsibility for ensuring that students stayed on track, often working with individuals in his class sessions but also ensuring that posts had been responded to.
Where a post was recorded as not of an acceptable standard, he was also responsible for ensuring that the additional work was completed and signed off. However, the final processing at the end of the semester was significantly easier and many students knew several weeks before the end that they had successfully completed and gained their A+.

4.2.4 Review - students

The new delivery schedule provided some advantages for students. There was increased clarity about the structure of the course and a clear continuity provided by the facilitation sessions. Attendance and engagement at the topic sessions was consistently high despite the Friday afternoon timeslot. The majority of students had little problem with managing the time commitment of regular blog posting and even for those students who did fall behind, catching up was possible. There was some disbelief and scepticism about the awarding of an A+ in Week 1 but after the initial excitement it no longer became an issue. The target was reasonably clear and became clearer each week as the students gained an understanding of what was considered acceptable. This allowed the highly motivated, grade-driven students to relax and enjoy the course while those who struggled could see that even if they didn’t always make the grade the first time they still had a reasonable chance of success. This was in keeping with the idea that if the motivation to succeed is high, failure will be learnt from and overcome if eventual success seems attainable.

Retention in the class was good with no withdrawals after the initial three weeks and with an 89% successful completion rate. Students had timely, formative feedback on their weekly posts and the opportunity to, in effect, resubmit their work. On most occasions this opportunity was taken when needed but as only 12 out of a possible 15 posts were required, students could decide to abandon one that was of less interest to them or one with which they had struggled. Students were also offered the option of providing an audio or video version of their post rather than a requiring a written one.

The notion of a post being ‘acceptable’ was an interesting one which actually represented an individual contract between the staff member and the student. No rubric was provided and staff were free to judge for themselves what they considered to be acceptable. Of course this was specific both to the staff member and to the topic but it was also determined to some extent by the student. Just over half the students on the course were completely free to judge for themselves what they considered to be acceptable. Of course this was specific both to the staff member and common business terminology.

The Digital Technologies teaching team understood and supported the purpose behind the approach. They had already experienced and enjoyed the results of a number of Challenge Weeks and had confidence that this kind of approach engendered a healthy and effective environment for, and attitude to, learning. There were clearly risks involved in adopting the approach (e.g. students not accepting the same grade philosophy, disagreement within the team about ‘acceptable’ standards) but it was considered that they could be mitigated by clearly managing students’ expectations of the course. This required an openness with both the students and the institution. Students were told that this was an experiment and that if it seemed to be failing, they would play an active part in helping to find an acceptable solution. Relevant academic committees and personnel were informed before the course began of the team’s intention and approval was given, if somewhat sceptically at times.

5. THE RESULT

Has the experiment been a success? This is hard to answer as the team did not draw up any particular criteria to measure success by. Clearly there were some obvious indicators including attendance, pass and retention rates, all of which would be a measure of student engagement with the course. However, there are also other measures which are far more difficult to quantify such as the impact on student learning in other concurrent classes, the development of self-directed learning skills, increased persistence and curiosity, a move to deep rather than superficial learning, an improvement in critical thinking and reflective skills and an increased recognition in the value of openly sharing learning through public writings. Many of these criteria emerged during the delivery of the course itself and no formal measurement had been put in place for them.

Due to changes in the recording of course statistics, it is difficult to provide a true comparison of pass and retention rates. However,
as far as can be ascertained, the pass rates have shown a significant improvement over the last three years. In 2011, when the original traditional course was offered the pass rate was approximately 62% with a very high number of withdrawals. In 2012, the first new offering yielded a pass rate of 72% and, while there were fewer withdrawals, there were still a number of students who dropped out before the end of the semester. In contrast, 2013 saw a pass rate of 89% and no withdrawals after the first three weeks. Even the small number of students who didn’t complete successfully only missed by a small number of posts. The 2013 offering also had very high attendance rates which would support the conclusion that the students both enjoyed the course and its delivery.

While there may be a number of additional topics that could be included and possible further refinement of the assessment process, the team believes that in essence, the format for the course is one which is worth reusing and it will be offered in a similar way in 2014. It would be useful to articulate more clearly the less tangible effects that the team are hoping to achieve and include a number of evaluation measures to establish whether it is meeting them. Plans are in place to consider the use of badges to reward the underlying skills and to provide a persistent record of learning over and above the required outcomes. It is also hoped that the experience of the course will provide both confidence and strategies for reworking the team’s approach to the more traditional courses within the programme.

6. CONCLUSION
It isn’t just the landscape of education that is changing, it is the entire topography. The traditional model of what we teach, how we teach and how we measure success is correctly being challenged.

While there is always some factual knowledge that is important to memorise (for convenience if nothing else), our almost immediate access to a global resource of knowledge makes much fact retention redundant. How we find the relevant knowledge, how we judge and evaluate it, how we relate the context of the found knowledge to the context in which we use it, and how we do all that efficiently and competently is much more important.

How we construct new knowledge is also changing. The trial and error approach of practical application has long been recognised as a successful learning mechanism, as has the more structured and guided approach to task completion by following a set of steps. In an educational context however, both of these have generally been teacher led or instigated. The concept of challenging students to find their own solutions and create their own new knowledge with little direction seems risky and failure prone. Yet the need to create knowledge, either new, or new to the individual, is now recognised in the value placed on life-long learning and is an essential component of it. There is also a growing recognition that learning is a social activity – that we learn best, not in isolation, but in learning with and from others. Collaboration and cooperation, acting within a team, connecting with others for mutual learning are all part of building this life-long learning community.

Coming to grips with these changes is not about how to use technology in the classroom or how to design online courses – it is about understanding that technology is bringing about a fundamental shift in the way we learn and in the way we construct and use knowledge. This understanding has to transform how we teach and even more importantly how we assess and reward the learning. We have to reassess what we value as educators and how we can assess that. There is little to be gained by changing how we provide learning experiences for students if we continue to reward memorisation, perfect outcomes and individual achievement. We need to reconsider and redesign our assessment and reward systems just as thoroughly as we do our teaching (Lane, 2013).

The notion of agile entrepreneurial learning provides one possible model for creating relevant, engaging and valuable education for 21st century learners for whom the prospect of ‘one life - one career’ may well be as antiquated as the 20th century schoolroom. In this period of educational transition, teachers have to experiment with such models and be given the freedom and permission, as they must in turn give their students, to fail, to reflect on, learn from and share those failures and to try again. In true entrepreneurial spirit and as Zander [13] suggests, failure needs to be met with the response of “How fascinating! What’s next?”

7. ACKNOWLEDGEMENTS
The author would like to acknowledge all members of the Digital Technologies teaching team at Nelson Marlborough Institute of Technology and those responsible for programme management for being prepared to take risks and to find setbacks and problems as fascinating!

8. REFERENCES
ABSTRACT
In this paper a process for incorporating core GIS principles into a database development course for level 6 students currently undertaking the Bachelor of Information and Communications Technology degree is described. This paper builds upon previous research and provides a description of how GIS principles were integrated into an existing database development curriculum as well as a set of practical instructions which were developed that utilised GIS and spatial data to enhance the teaching and learning of SQL and database concepts. Initial feedback from students indicates that the immediate visual feedback provided by the spatial data is viewed as beneficial.

Categories and Subject Descriptors
H.2.8 [Database Applications]: Spatial Databases and GIS.

General Terms
Theory, Documentation, Experimentation

Keywords
GIS, database, practical

1. INTRODUCTION
In today’s marketplace computing power is no longer restricted to desktop machines. More and more mobile computing devices (laptops, tablets, smart phones, etc.) are emerging with processing and storage capacities comparable to many desktop computing solutions. Most of these devices (whether desktop or mobile) have some form of Geographical Information System (GIS) capability and the uses of this technology are growing. Users can view the location of a particular restaurant, find their way to some destination from their current location, and even capture locations of other online users. The practical application of GIS is growing and the technology is being embraced by everyday consumers without the need for any type of specialised training. It can be argued that this ease of adoption is likely due to the natural form that GIS data takes, i.e. maps, locations, and directions, data which is easily understood by most people. It has also been suggested that utilising the easily understandable data could be beneficial when teaching database concepts [1].

Underlying every GIS is the storage, retrieval and manipulation of spatial data, actions which are now commonly supported by many of the major database management systems. These systems rely on the use of the Structured Query Language (SQL) for the manipulation of both normal relational and spatial data. The teaching and learning of SQL and fundamental database concepts is reasonably well covered within the literature [2, 5, 8]. Although a considerable amount of research exists in the field of GIS [6], it appears that little has been done regarding the utilisation of spatial data for SQL education [1].

Introducing and educating students in with the use of GIS and spatial data is dependent on many factors. GIS hardware and software must be available and accessible by the students and educators. The GIS content must be distilled into a form that suits a particular level of student learning, and the GIS content must also fit within the learning outcomes of an existing curriculum.

Accordingly the following sections will describe how GIS and spatial data has been introduced into a level 6 database development course within a Bachelor of Information and Communications Technology degree in order to enhance the teaching and learning of SQL and database concepts.

2. Background
In a previous study, Burt theorised that spatial database software could be used for teaching SQL [1]. Burt argued that the immediate visual feedback afforded by spatial data would be of great benefit to both students and teachers [1].

Burt provided ‘proof of concept’ examples that showcased the potential uses of GIS and spatial data within the context of SQL education. Specifically, the select statement, where clause, table joins, aggregate functions, and group by functions were demonstrated [1]. However, his study concluded that formal lesson plans needed to be developed (that expanded on his initial ideas) before the approach could be trialled with real students [1].

Accordingly, this paper builds on the work started by Burt and presents formal lessons that utilise GIS and spatial data for teaching SQL that have been developed for trial with real students.
and also presents how they have been integrated within the existing BICT curriculum.

3. METHODOLOGY
In order to introduce GIS and spatial data for the teaching of SQL to students, an analysis of the existing BICT curriculum was undertaken in order to determine the most appropriate level and fit for the content within the programme. The results of this analysis will be presented at the beginning of the following section.

Once a suitable course for the GIS content had been decided upon, a decision needed to be made regarding which GIS software package would be most suitable for the course.

Following from this, the next step was to analyse the existing SQL lesson plans in order to identify which lessons would be most appropriate for enhancement with spatial data and spatial database concepts.

The identified lesson plans were then updated in order to incorporate GIS and spatial data into the learning activities. Subsequently these lessons were trialled with students during 2012. Student feedback was collected via the lecturer acting as a participant observer. An overview of the development of GIS and spatial data SQL lessons and feedback will be presented in the following section.

Based on the successful outcome of the 2012 trial, further SQL lessons were identified and have also been updated in order to utilise GIS and spatial data. Although these new lessons have not yet been trialled with students, an overview will also be presented in the results section.

4. RESULTS AND DISCUSSION
In this section the results of the BICT SQL curriculum analysis are presented. This is followed by the development of initial GIS and spatial data SQL lessons trialled during 2012. Finally, additional GIS and spatial data SQL lessons that were developed subsequent to the 2012 trial are presented.

4.1 Course Analysis
Analysis of the BICT curriculum identified three potential courses in which GIS and spatial data could be potentially incorporated into the existing curriculum. A brief description of the three courses will be given below.

D111 Data Fundamentals was a level 5 course focused on providing students with an introduction to databases and database technologies. The main technology used within the course was Microsoft Access, although some SQL content was also included.

D211 Database Development was a level 6 course that focused primarily on SQL and utilised Microsoft SQL Server.

D311 Advanced Database Concepts was a level 7 course that had a primary focus on advanced data warehousing techniques.

Through the analysis of the three potential courses it was decided that the D211 Database Development course would be the most appropriate location for the GIS and spatial data content due to its main focus on generic SQL actions. It was felt that the D111 Data Fundamentals paper in its existing form was providing a worthwhile and appropriate introduction to database technologies through the use of Microsoft Access. Although the D111 course did include some SQL content, it was noted that it was only introduced towards the end of the course and that it would not provide enough time to adequately introduce GIS content. Furthermore, the initial exposure to SQL provided by the D111 level 5 was also seen as beneficial to level 6 students beginning the level 6 D211 course. Conversely, it was felt that the D311 Advanced Database Concepts course would not be suited to the spatial data content due to its more complex focus on specific data warehousing operations and the required prerequisite knowledge of fundamental SQL and database concepts.

Having decided upon the D211 Database Development course as the most suitable place for introducing the GIS and spatial data, the next step was to decide upon a specific software package. In his initial work Burt had suggested that both Microsoft SQL Server and PostGIS were viable candidates for GIS and spatial data education [1]. Using these suggestions as an initial filter, Microsoft SQL Server was selected as the software package to be used due to its existing role with the D211 Database Development course (i.e. it was what the course was already using). This also provided access to the SQL Server Management Studio (SSMS).

4.2 2012 Development and Trial
In 2012 a series of practical instructions were developed to provide students with the spatial data necessary to produce visual results in the form of maps and accompanied data associated with the results.

Initial data for the practical lessons was obtained in the form of shape files from [4]. The shape files were imported into Microsoft SQL Server 2008 using the Shape2SQL tool obtained from [7].

![Figure 2. The Shape2SQL tools main interface](image)

A diagram screenshot of the countries table was created for the students. Students would be required to use T-SQL (Transact-SQL, which is Microsoft’s specific dialect of SQL) to recreate the countries table based on the screenshot information. This would cause the shape files to be combined into a single table. The students would then be required to apply relational database normalisation. Students were able to create and join multiple tables using T-SQL, additionally they were able to apply renaming, creating, dropping and apply column constraints.
A combination of step by step instructions and exercises were developed for the students that required the practice of common database actions such as normalisation, and various other SQL Data Definition Language (DDL) table modifications. A model of the eventual database was provided from which table relationship constraints were established. Students would be required to perform SQL Data Manipulation Language (DML) techniques to populate the normalised tables from existing values. Additional DML practical exercises were provided to teach basic SQL select statements involving JOINS, the use of aggregate functions, the WHERE, GROUP BY, HAVING and ORDER BY clauses. In most cases the inclusion of the GEOMETRY spatial data type was required so a visual result in the form of a map representing countries, continents or regions was outputted.

The developed practical exercises resulted in a series of activities that allowed students to perform common SQL actions on spatial data. Students were able to undertake basic SQL SELECT queries using JOINS, the use of aggregate functions, the WHERE, GROUP BY, HAVING and ORDER BY clauses. Because of the inclusion of the GEOMETRY spatial data type within the countries table, visual results were produced in the form of map boundaries along with associated data to accompany the result. The visual feedback allowed students to quickly determine the accuracy of their SQL queries.

During the 2012 trial students were observed to actively engage with the GIS and spatial data database activities and exercises. Initial feedback from the students was positive and with many noting the immediate visual feedback as a highlight of the exercises. Due to this positive feedback, it was decided that it would be worthwhile to develop additional GIS and spatial data practical lessons for 2013.

4.3 2013 Development

In 2013 it was decided to extend the GIS component further by incorporating it into stored procedures and triggers (these are advanced database concepts that allow the reuse of collections of database commands). A brief introduction to GIS was added and included with each set of practical instructions to clarify some of the terminology. This included a brief history of the use of GIS including early manually developed systems used for monitoring the spread of disease.

For each practical, short descriptions were created describing key GIS terminology that was included in the lesson. This was done to introduce new concepts and to provide valid reasons for including this subject into the lesson.

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For each practical, short descriptions were created describing key GIS terminology that was included in the lesson. This was done to introduce new concepts and to provide valid reasons for including this subject into the lesson.
Lessons were created to demonstrate the three vector types POINT, POLYGON and LINESTRING. From these, complex outputs were created by combining them into collections. Initially the vectors were applied to database variables and outputted using SELECT statements on those variables. Students were then shown how to insert the vectors into the GEOMETRY data type field. Stored procedures were then introduced and students could then pass latitude and longitude values into the procedures to demonstrate parameters. Spatial functions were applied to the latitude and longitude values within the stored procedures to demonstrate core GIS principals.

Figure 8. The Spatial results tab of SSMS displaying in visual format; the result of a select query using polygon and point vectors which includes the STBuffer function.

The concept of T-SQL DATABASE, AFTER and INSTEAD OF triggers was then introduced. While the triggers did not act directly on the vector data, they enabled the ability to log the insert events and prevent the dropping of tables.

Students apply built-in spatial functions to the existing data such as STBuffer, STArea, STLength or STDistance to that data. The results can be viewed in tabular or the SSMS visual format.

The coordinate values are stored within a tables GEOMETRY field in hexadecimal format. By making use of the T-SQL ToString() function, spatial data was able to be converted from its stored hexadecimal format and viewed in its original form using SSMS.

It was decided to add the spatial data to existing KML (Keyhole Markup Language) files so that this could be imported into Google Maps or Google Earth and viewed as overlays. The KML files were first created within Google Maps and used as a template. This was achieved by creating a new map and adding simple vector shapes to it. The map was exported in the KML format and opened to examine the XML structure. Existing coordinate values were subsequently removed and replaced by values from within the database, this was then resaved. The KML file was then exported back into Google Maps and viewed as an entirely new layer.

Figure 9. A sample of a KML file showing coordinates and the result when viewed within Google Maps.

Ultimately this provided a way for students to apply the results of their database activities directly to Google Maps.

5. Conclusions

This paper set out to describe the incorporation of GIS and spatial data for the enhancement of SQL education into an existing database curriculum. In this instance, a level 6 database development course was identified as the most appropriate
location for the incorporation of GIS content. This was due to the courses focus on SQL combined with the fact that enrolled students would also have had some prerequisite SQL knowledge.

This study also presented the development and trial of various GIS and spatial data concepts for SQL education. The development of these lessons built on and enhanced proof on concept examples suggested in a previous study [1]. This study also extended the level of GIS and spatial data application to SQL through the incorporation of stored procedures and triggers. A method for integrating GIS data with Google Maps was also introduced.

Student feedback to the initial trial was positive and provided some confirmation that the immediate visual feedback was seen as beneficial by the students. However, as this result was only captured informally via participant observations on the part of the lecturer it would be premature to generalise this conclusion. The authors note this as a limiting factor within this study. However they are also confident that the developed GIS and spatial data lessons are an asset to student SQL learning.

Nevertheless, it would be worthwhile to conduct further research that could include a trial of the developed lessons with a specific focus on formally collecting student feedback via other data collection methods such as levels of academic achievement, student interviews, and student surveys in order to more accurately capture student perceptions of the lessons and the suggested benefit to student learning.

6. REFERENCES


Collaborative Development for Online Assessment

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ABSTRACT
In this paper, a multi-stakeholder case study is described in which an online examination for a second year undergraduate computing paper at a New Zealand tertiary institution was developed collaboratively with diverse stakeholders. Stakeholders included: the lecturer, learning centre advisors for both the learning management system (Moodle) and literacy, the undergraduate programme committee members, the examinations officer, examination supervisors, pre- and post- moderators, IT support staff members, IT engineers, and finally the students. Issues arising during the process have been analysed using Soft Systems Methodology.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education

General Terms
Human Factors

Keywords
Case study, collaborative development, online assessment

1. INTRODUCTION
This online examination was developed for a second year compulsory undergraduate paper (Information Gathering) in the Bachelor of Computing Systems at Institution X. The author felt that because students were studying computing, moving the examination online would align better with both the content and style of what they were learning. Students gain knowledge of information gathering, information analysis and content management solutions for different types of businesses and research situations.

Online assessment provides learning opportunities to students that are not available in traditional paper-based assessment methods, especially end-of-semester examinations. One of the findings from this study is that the regulatory systems for governing the conduct of end-of-semester examinations constrained possible learning benefits for students.

The structure of this paper is as follows: firstly, a literature review is presented in which the pedagogy of online assessment is explored as a multi-stakeholder activity. Next the study scope is described. This is followed by a description of soft systems methodology [2] and how it was used to in the present study. The paper concludes with discussion, reflection and directions for future research.

2. LITERATURE REVIEW
In this literature review, online assessment in its complexity, the additional benefits offered to students, preferences of computing students, barriers to the uptake of online assessment and advantages for a range of stakeholders are discussed.

2.1 Online Assessment
Buchan[1] reflects on snapshots in time that have led to a personal understanding of the complex integrated network of responsibility in online assessment that involves academics, ICT support services, educational designers and other divisions. This understanding has led to the formation of new frameworks for managing online assessment and, more broadly, online learning. These frameworks are contributing to on-going development of tools, processes, procedures and policy as her particular university absorbs the impact of increased access to online learning as the result of the introduction of a new, open source, learning management system. Whilst Buchan has identified the need for institutional frameworks for on-going development of online assessment, this paper concentrates on the involvement of multiple stakeholders in the development of online assessment, rather than policy and procedure formation.

Campbell [3] suggests that high stakes assessment can be successfully digitized from the capturing of authentic student performance, to high stakes comparative pairs marking. Campbell also claims that with current technology reliability, validity, manageability and scalability are as good as or better than current (non-digitized) practices. By high stakes assessment it is assumed that Campbell is discussing activities such as end-of-semester examinations. Campbell also suggests that the digitization of the assessment process offers the possibilities to drive learning and education in positive directions through the capture of authentic student work in both standard and non-standard forms, and to assess students more efficiently, reliably and in different ways. Traditional marking methods of assessment and specifically those of non-standard forms have been time-consuming and costly. Non-standard forms of assessment cover a variety of formats from PDF to videos that can capture authentic student work (performance). This recording and capturing in real-time of authentic student work introduces the possibility to view and assess the process and not just the product of the student work, and this can be over an extended time-period or a fixed time as in an exam situation.

Fluck, Pullen and Harper [4] discovered that the Bachelor’s degree students in their e-examination case study in Australia had no initial clear-cut preference for computer- or paper-based examinations. They suggest that further research could be undertaken to validate this finding for similar cohorts. They also discovered that the preference for examination medium appeared to be strongly related to successful prior student experience of online assessment. This finding suggests that if the first
experience of online assessment is positive, students are more likely to accept further online assessment. Fluck et al. [4] were preoccupied with security and collusion issues in exploring alternate means to gather examination scripts using non-networked solutions such as collecting scripts on CDs or USB drives.

2.2 Barriers to the Uptake of Online Assessment

Hannon [5] states that technological, organisational and discursive issues will all increase the likelihood of breakdowns in the acceptance of online assessment. Hannon’s analysis was based on a relational perspective drawn from actor network theory and discourse analysis. Adopting this view suggested that an innovation would be successful if all the actors (entities that performed actions) were able to form associations based on strong ties, and were brought to alignment and mobilised into a socio-technical assemblage. One question that arose from the two cases considered was how innovation, that is, transformative change, could occur in the context of mass teaching and learning, in light of the tension between innovation and standardised approaches to online teaching. At issue was the tendency of black boxes, such as a learning management system, to be totalising both as technologies and as discourses, and to set an institutional “standard” approach to online teaching which may be the antithesis of innovation. Hannon [5] also suggests that technologies and discourses need to be recognised as part of the assemblage of online teaching, but not stand for online teaching.

2.3 Advantages of Online Assessment

In summarising their study, Milne, Heinrich and Morrison [6] stated that there are strong advantages for student learning and staff workloads in using e-learning tools in support of assignment assessment. Milne et al. suggest that only a minority of academics exploits these advantages, and that a huge potential exists for further application of e-learning tools and approaches. McNeil, Gosper and Hedberg [7] also suggest that there is untapped potential for ICT supported learning – including learning from online assessment. McNeil et al. claim that the potential of technologies to support assessment of higher-order learning outcomes such as evaluation, creation and meta-cognition, is still largely untapped. For many of the technologies, the results suggest that rather than being transformative tools, their uses are predominantly limited to perpetuating traditional practices.

3. METHOD

Input from multiple stakeholders all contributed to the final outcome for this project. These inputs included considerations from the lecturer in charge of the second year undergraduate paper in which the study was conducted, learning centre advisors for both the learning management system used and for literacy, undergraduate programme committee members, the examinations officer, pre- and post- moderators, IT support staff members, IT engineers, and finally, students. All views and requirements were considered using Checkland and Scholes’ [2] 7-stage Soft Systems Methodology (SSM). An iterative process of development was utilized as changes were introduced.

SSM is a way of analysing a multi-stakeholder situation that considers the entirety of the system being considered as a single whole with emergent properties [2]. Central to SSM is the notion that a set of constructed abstractions can be compared to the perceived real world in order to learn more about the situation being studied (Figure 1).

The perceived real world is considered in stage 1, and expressed as a rich picture in stage 2 (Figure 2). These activities take place as perceptions of the real world as viewed by the actor. Stages 3 and 4 are conducted as systems thinking activities about the real world. In stage 3 root definitions are defined (see below), and in stage 4 conceptual models are derived from the root definitions. Comparisons of these conceptual models to the real world situation are conducted in stage 5. In stage 6 suggestions for change are made that are both systemically desirable and culturally feasible. The final stage (7) is where action to improve the situation is taken.

3.1 Problem situation considered

The problem situation considered problematic was the use of traditional paper-based examinations, with the considerable overhead entailed in tracking, monitoring and collecting marking. Other reasons for the conversion included alignment with the way in which computing students interact with IT, and that paperless systems are kinder on the environment. Moodle, the learning management system (LMS) being utilized by the institution, provided the capability for conducting online examinations. The decision was made therefore by the lecturer (actor in the case considered) to convert the paper-based examination to an online examination.

3.2 Problem situation expressed

Figure 2 shows that there are many stakeholders. These stakeholders each have defined roles within the system considered. The lecturer initiated the transformation from paper-based to online examination. Learning advisors (Moodle and literacy), acting as facilitators, provided necessary technical and literacy advice for the transformation to take place. The programme leader, programme committee and paper moderator provided the appropriate regulatory functions. The examinations officer facilitated the implementation changes required for the
online examination to take place and provided a changed set of instructions to the examination supervisors. The IT support staff and engineers made it possible for the online examination to run without IT system failure.

Figure 2 Rich picture of the problem expressed
3.3 Root definitions of relevant activity systems
The system analysed is the process of developing part of the assessment for a compulsory paper in the undergraduate computing degree at institution X in New Zealand.

Table 1. CATWOE definitions
(Based on Checkland & Scholes, 1999)

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
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<td>C</td>
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3.4 Conceptual models of the systems named in the root definitions
Each stakeholder identified in stage 2 (problem situation expressed) has a different role to play, and therefore is represented by a separate conceptual model.

3.4.1 Customers (students)
As the beneficiaries of the system being considered, students had the most to gain (or lose) by the transformation to an online examination, as final grades were dependent on successful implementation of the online examination.

3.4.2 Actor (lecturer)
Preparation and successful implementation of the online examination is the lecturer’s responsibility. In order to do this the lecturer was required to interact with all other stakeholders who acted in different roles (Figure 2).

3.4.3 Transformation process
Conversion of the traditional paper examination to an online examination was aided by learning advisors, facilitated by IT support and engineers, and regulated by programme leader and programme committee and paper moderator.

3.4.4 Worldviews
Each stakeholder involved in this study held different worldviews. It is interesting to note that all stakeholders (except students) were there to serve the students. Stakeholder roles as initiator, regulator or facilitator were instrumental in shaping worldviews held. For computing students, an online examination was more closely aligned to their technically enhanced worldview.

3.4.5 Owner
For this project, the owners of the system most directly affected were those with delegated regulatory power, programme leader and programme committee.

3.4.6 Environmental constraints
An assumed environmental constraint was that there would be sufficient students enrolled in this particular paper so that the transformation could go ahead.

3.5 Comparison of models and real world
In order to make this comparison, root definitions of the relevant activity systems need to be defined. Each root definition provides a particular perspective of the system under investigation. In general, a root definition should include the following information: what the purposeful activity carried out by the system is; who the ‘owner’ of the system is; who the beneficiaries/victims of the purposeful activity are; who will implement the activity; and what the constraints in its environment are that surround the system [1].

3.5.1 Actor (lecturer)
The initiator for this project was the lecturer, who could see that there were possible multiple benefits for students in creating and using an online examination.

3.5.2 Learning advisor (Moodle)
The Moodle learning advisor provided technical knowledge on structure, layout and correct implementation within the Moodle environment. The Moodle learning advisor also provided the lecturer with feedback on pedagogical style in using the online tools provided in Moodle. Advice was also given to the lecturer by the Moodle learning advisor about the most appropriate Windows environment to reduce access during the examination.

3.5.3 Learning advisor (literacy)
The literacy-learning advisor provided the lecturer with feedback on how students from multiple ethnic backgrounds could interpret the content of the online examination and changes were made to examination wording in a number of iterations.

3.5.4 Programme leader
The programme leader was responsible for the way in which the whole undergraduate programme in computing operated. The programme leader was the chairperson for the programme committee. The programme leader was in favour of this project taking place.

3.5.5 Programme committee
The programme committee provided debate on any modifications proposed within the undergraduate programme in computing and provided feedback and modification requests before any changes could be implemented. The programme committee proved to be an inhibitor for this project, with many objections to examination content, possible technical problems, fitting in with the existing examination system, which was paper-based, pre- and post- moderation process, supervision process, technical support required, extra cost, and laboratory availability.

3.5.6 Paper moderator
The paper moderator was responsible for checking that the assessment item satisfied programme requirements. In this case
the paper moderator could only check examination content and the extra technical requirements for a Moodle examination.

3.5.7 Examinations officer
The examinations officer was responsible for the conduct of all examinations for the department including the undergraduate degree in computing. The examinations officer could see no problems with the process and was reassured that the process would work smoothly. The only extra requirement was that the students have access to electronic copies of their own examination script during the post-exam viewing period. Creating pdf files that were placed on a central drive in the post-examination period accommodated this.

3.5.8 Examination supervisors
The examinations supervisors were responsible for the conduct of particular examinations. The examination supervisors were happy that their workload was reduced when the online examination was conducted as they did not have script books to collect, check and deliver.

3.5.9 IT support staff
The IT support staff members were responsible for all the required software and operating systems environments operating correctly during the online examination. The IT support staff provided the lecturer with support prior to the online examination by taking part in planning and contingency. IT support staff were also present or on call during the online examination.

3.5.10 IT engineers
The IT engineers were responsible for all computers in the laboratories being used for the online examination to be operating correctly. This required the IT engineers to reconfigure one laboratory in the 24-hour period prior to the online examination, as there was a network fault.

3.6 Changes: systemically desirable, culturally feasible
Checkland and Scholes [1] suggest that in considering a system holistically, technical, social and political issues need to be considered. In practice, such issues can be intermingled. For instance, the programme committee used political influence to insist on documentation for all aspects of the development. In some cases, members of the programme committee did not have the required technical knowledge and skills to judge the merits of implementing the online examination.

For the students, who were clients of the system, technical changes brought about by the safe browser not working required compliance from them in agreeing to stay within the online examination window during the exam period. This was made possible by engaging the students early in the development process and by the alignment of student attitudes to online engagement as opposed to traditional paper-based examinations.

From a technical perspective, the lecturer discovered that support was required from multiple stakeholders that would not have been required for a paper-based examination; and extra development time was required to learn how to set up an online examination. From a social perspective, extra interaction time was required because there were so many stakeholders involved in the process. From a political perspective, more time was required to satisfy the programme committee’s requests for extra documentation to support the changes requested in setting up an online examination.

From the examination officer’s point of view, the online examination was a desirable change because it reduced work both for her and for the examination supervisors.

From the programme committee point of view, there was reluctance to engage in the change process, and extra documentation and process steps were required to satisfy their regulatory requirements. Systemic changes are still required here to address the attitudinal barriers put in place.

From the IT support staff and IT engineers point of view, the online examination involved extra work to ensure that all IT hardware, networking and software were operational at the time of the online examination because laboratories that are operational are not required during paper-based examinations.

3.6.1 Benefits
A major benefit and an unexpected outcome for this project was the way in which the students became engaged with the project, and they appreciated their involvement and the opportunity to provide feedback during development. Rather than viewing the examination negatively, most students enjoyed the whole process and there was early ‘buy-in’ and little resistance to change.

Another benefit was that because the LMS was linked to the student management system used at this institution, students could not take part in the online examination if their enrolment status was not current. This required greater emphasis to be placed on correct enrolment status prior to the examination period.

The examination officer and supervisors were pleased that their tasks during the examination period were simplified because there were no paper examination scripts to collect, check and store.

Paperless examinations also contribute to environmental sustainability, and to reducing costs within the institution.

3.6.2 Outcomes
The commitment and ‘buy-in’ demonstrated by most stakeholders contributed to a successful outcome for this project, despite the barriers that were imposed in the guise of regulatory requirements. The computing students involved were keen to take part in this project. It is interesting to note that none of this particular group of students accessed paper materials in the library for any part of their studies during the semester.

4. DISCUSSION AND FINDINGS
Findings from this study suggest that having cooperation from all stakeholders is important. However, some stakeholders are more ‘important’ than others. If the ‘important’ stakeholders provide any sort of barrier to development, like, for instance programme committee objections, then the development process will take longer. Technical support from the IT team (both engineers and support staff) is vital for the online assessment to ‘run on the day’. Use of online assessment, especially examinations, requires commitment, dedication and ‘buy in’ from all stakeholders. Students can be prepared in advance about what to expect. Power relationships between and amongst stakeholders both contributed to and detracted from the collaborative process.

5. CONCLUSIONS
Experience from this project suggests that early and continuous consultation with facilitating stakeholders is required. There is a
time and skill commitment required to do this. There are also benefits for the lecturer in obtaining immediate results online during the examination. Unfortunately this benefit could not be shared with the students involved because this would have contravened current examination procedures.

Minimising the use of paper was both a benefit (from a sustainability and examination process point of view) and a risk in this project. The risk is that when all examination scripts are online with no paper backup there is no contingency plan in the event of technical failure.

‘Buy-in’ from the students was obtained early in the process by informing them of progress with online examination development, providing a trial examination as a tutorial exercise, and giving the students the opportunity to provide feedback.

On reflection, the author believes that developing and using online examinations is an evolving process, with one cycle feeding off the next. Doing more negotiation with the ‘powerful’ stakeholders on incorporating immediate feedback in releasing online examination results would enhance the learning experience for students.

The findings from this paper contribute to what is known about developing online assessment. Early and continuous consultation with facilitating stakeholders is required for such development work. Immediacy of online results is of value when time is critical, especially at the end of semester.

6. ACKNOWLEDGMENTS
Thanks to learning advisors, IT engineers, IT support staff members and examinations staff all of whom all helped to make this project possible.

7. REFERENCES
The Global Game Jam for Teaching and Learning

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ABSTRACT
The Global Game Jam (GGJ) is the world’s largest game development activity. Every year since 2009, thousands of computer game enthusiasts participate in this forty-eight hour challenge to make games around the same theme. While game jams, ‘hackathons’, and game festivals existed before the GGJ, and continue to proliferate, the GGJ 2009 was perhaps the first time such events were held in multiple physical spaces (23 countries) at the same time. In this paper, we track the growth of GGJ using multiple dimensions, and discuss the potential for research and teaching through this popular activity.

Categories and Subject Descriptors
K.8.0 [Personal Computing]: General – Games; K.3.2 [Computer and Information Science Education]: Computer science education

General Terms
Design, Experimentation, Human Factors, Languages.

Keywords
Global Game Jam, Game Design, Programming.

1. INTRODUCTION
The GGJ involves gatherings (game jams) of participants in more than 60 countries and over 300 locations (jam sites) [9]. The event brings together thousands of game enthusiasts with different skills to make games with a common theme and some optional diversifiers [11]. The global event is organised and managed by the Global Game Jam Committee, and the local events are organized by volunteers [1].

Game jams have the potential to provide an effective and focused experience and participants gain valuable skills in prototyping and collaboration [20]. The collaborative and community based environment that the GGJ provides supports creativity and learning and establishes spaces that support the independent game development ecosystem [8].

Initially the participants were from International Game Development Association (IGDA) chapters, Universities and small game development studios [27] but now also include participants from companies, computer clubs, training centres, Colleges, Polytechnics, and High Schools [15]. Some common elements can be observed in many game jams. These are [20]:

1. The goal is to develop small experimental games within a limited timeframe (for example 24 or 48 hours).
2. All games developed during the game jam must share a common theme, previously unknown to the participants.
3. These events are generally open to anyone who can contribute to the development of the game. However, some game jams include an age restriction or have school affiliation requirements.
4. Team formation prior to the event is discouraged, and the team size is usually constrained to less than five people.
5. The events encourage the development of games for any device and the teams can generally choose their own development platforms.
6. In some locations, there is a final presentation where the best games will be selected by other participants, an audience or a panel. However, the GGJ is not a competition the intention is for this event to be a collaborative, free flowing collaborative development process, in a similar way that musicians jam [27].

Although some jam sites include a competitive element for their local participants, the GGJ does not offer any rewards for the games developed during the game jam. Moreover, the games are not judged by a central expert panel, although no restrictions are made on local game jams that provide audience choice awards. When the jam is concluded the development teams are asked to upload their game to the GGJ website. This site enables other game jam participants and the general public to play these games, be inspired by them and support them. A rating system has been provided in the past. As the ratings are from other game jam participants and the general public, the rating system provides a very public feedback mechanism for the participants and can provide considerable motivation to make a product that is enjoyed by the end-user. This according to Shin et al. [27] can serve as a reflective learning experience for the developers of the game.

2. THE EVOLUTION OF THE GGJ
Game jams have existed for years. Of the earliest notable ones achieving significant publicity, are the: Indie Game Jam (IGJ0) which was held in March 2002 [13], Ludum Dare (LD0) in April 2002 [19], the inaugural Nordic Game Jam (NGJ) in January 2006 [21; 22; 27], and the Toronto Game Jam #1 (TOJJam) in May 2006 [28].

At the NGJ 2006, eight games were made by the forty participants who consisted of representatives from the local video game development industry and the students and faculty at the IT University, Copenhagen (ITU) [21].

Using primarily the Nordic Game Jam as a template, the GGJ was created by Susan Gold, Gorm Lai and Ian Schreiber in 2008 [11]. As with Ludum Dare, the participants are international. Unlike other jams, GGJ has a physical presence requirement and has been held in dozens of locations each year. The first GGJ was held in January 2009 and attracted 1650 participants in 23 countries. The next year (2010) the participation had grown to over 4300 participants from companies, computer clubs, training centres, Colleges, Polytechnics, and High Schools (27 countries) at the same time. In this paper, we track the growth of GGJ using multiple dimensions, and discuss the potential for research and teaching through this popular activity.

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In 2011, the GGJ attracted over 6,500 participants from 44 countries at 169 sites who created over 1500 games in total [3; 16]. GGJ organizers and participants are asked to complete a survey, usually after the game jam. From the 6,500 participants of GGJ 2011, 953 started the survey and 851 completed it (13%). The survey sought demographic information, the level of experience the participant had the tools used, team formation, the experience the participant had, and their perceptions of the 2011 GGJ.

In 2012, the GGJ attracted over 10,684 participants in 242 locations (47 countries). 2209 games were created. The GGJ set the Guinness record for the largest game jam in the world [11].

In 2013, the GGJ saw 16,705 participants from 319 jam sites in 63 countries produce 3248 games [6; 16], eclipsing the previous world record.

In general, it can be observed that the number of North American sites is becoming relatively fewer while the number of Western European and Asian sites is growing in relative numbers.

2.1 Learning

Piaget [23] asserts that we learn best when we learn through practical and applied learning experience. The GGJ, enables the participant to create their own meaning and context (through interpreting and adaptation of the theme), learn new skills that are needed, and encourage social interaction through collaborating with the people in their team and other developers participating in the game jam.

From a micro viewpoint the game jam can be broken down into eight known techniques [20]. These eight elements according to Musil et al. [20] are new product development, participatory design, lightweight construction, product value-focused, rapid experience prototyping, aesthetics and technology, concurrent development and are multidisciplinary.
From our research, we have found that one of the key motivations for attending the GGJ is to learn. This is further supported by the responses to our questions on learning in the GGJ (figure 4). Although, the results are close to being evenly split between yes and no, the data does demonstrate that almost half of those respondents (820 in 2011 and 920 in 2012) that answered this question indicated that they had learnt a new tool. Figure 5 suggests that the video game authoring tools or engines were the main tool learnt at the GGJ. Moreover, when asked about an overall improvement in skills the majority (96% in 2011 and 2012) of the respondents (848 in 2011 and 872 in 2012) that answered this question indicated that there had been an improvement of skills (figure 6).

The benefits of real-world practical experience are well documented (see for example Piaget [23]) and the GGJ provides both students and practitioners a very tangible and practical learning environment [24]. The GGJ provides a venue where participants need to develop an end product under immense time constraints [24]. The GGJ is inclusive; anyone can participate, regardless of their skill level [24]. The GGJ encourages team formation at the game jam (although our research indicates that this may not always be practiced).

Another learning opportunity within the GGJ is the chance to work in or with developers from other disciplines [24]. This co-development opportunity provides the participants the opportunity to learn how to cooperate with and learn from people from other disciplines [24].

3. THE SIGNIFICANCE OF THE GGJ

As spectators, participants, and organizers, we have considered the potential learning opportunity that the GGJ represents, a great opportunity to provide an applied and practical learning experience. Academics and the organizers of the GGJ identified the research potential of the game jam and established the GGJ Research Committee to promote, facilitate, organize, and conduct scientific and technical research activities related to innovation, experimentation and collaboration [12]. Further, the practical and applied nature of the GGJ makes it a potentially excellent venue to use for capstone projects for some institutions.

3.1 A New Kind of Research Platform

Due to its global nature, wide range of participants, and the active involvement of industrial and academic partners, the GGJ provides a unique opportunity for studying different professional, educational and cultural aspects of computer games [12]. Among potential areas of research that can be done within the context of the GGJ are [12]:

- Culture, motivation, and the skills sets of the young game enthusiasts who will be the future game developers.
- Communication, collaboration, development and management methods and tools for game projects.
- Effective experiential learning for skills required in game development projects including but not limited to programming, art, writing, management, testing, and communication.
- Regional and/or sub-culture variations in the game development industry with comparative or focused studies.
- Organizational studies for youth and/or volunteer-based activities and events.

Considering such a significant potential, and the limited studies done focusing and using the GGJ as research context, the GGJ Research Committee (GGJ-RC) has been established to promote, facilitate, organize and conduct scientific and technical research activities related to innovation, experimentation and collaboration, on behalf of the GGJ Executive Committee, in order to [12]:

- Promote the value of the GGJ as a global effort that can increase our knowledge of game-related topics and can lead to the development of new ideas and methods.
- Better understand the three P’s of game development (People, Process, Products) within the context of the GGJ.
• Use the GGJ as an example/experiment to study game development and education, and other related topics in the video game industry
• Use the GGJ as a global effort to study more general topics such as community building, group dynamics, and identity.
• Disseminate and promote the research findings to a wide audience through publications, workshops, conferences, etc.
• Work to create a better forum or conference for the above activities

The GGJ-RC helps researchers conduct their studies and publish the results by providing global surveys that include questions by approved research projects, inviting all GGJ participants to respond, collecting and passing the data to researchers, and finally organizing means of disseminating the research findings [12].

Researchers find access to thousands of jammers valuable. By consolidating the various electronic data collection efforts, and disseminating them in a uniform manner, the GGJ-RC hopes to support multiple on-going academic research investigations efficiently.

In 2012, the GGJ-RC sent out its first public Call for Proposals and approved three research studies [12]:
• Key success factors for developing a videogames industry in South America
• Learning Aspects of the Global Game Jam
• Music in Video Games

In 2013, this grew to eight approved proposals:
• Gender and Global Game Jam Participant Motivation
• Experiential Learning in a Game Jam
• The Latin American Independent Communities of Creators of Electronic Games compared to the Large-scale Industry
• Team Dynamics and Development Processes of the Global Game Jam
• Level Up
• Investigating the Lack of Accessibility in Game Design
• Game Design Processes in Rapid Game Development
• Enhancing Experience with Digital Design and Production Tools in High-pressure Rapid Prototyping Environments.

In 2013, the GGJ-RC organised the inaugural workshop on the Global Game Jam at the 8th International Conference on the Foundations of Digital Games in Chania, Crete, Greece [10]. This workshop resulted in the publication of five papers on the Global Game Jam [10]. These include:
• The Evolution and Significance of the Global Game
• The Motivational Power of Game Communities - Engaged through Game Jamming
• Promoting Game Accessibility: Experiencing an Induction on Inclusive Design Practice at the Global Games Jam
• Game Conceptualization and Development Processes in the Global Game Jam
• Adaptability of the Global Game Jam: A Case Study in Japan

This workshop resulted in the first formal gathering of researchers to discuss the potential of the GGJ. Due to the success of this inaugural event, it was agreed by organisers to make this an annual event.

3.2 Survey of the Literature

While game jams have been around for some time and is growing in worldwide acceptance, the idea of using game jams to systematically improve community and learning is fairly new.

Shin et al. [27] review the potential of a collaborative learning process and suggest some design ideas for Jam organizers to set up events. The suggestions cover topics such as process, observation, testing, team development and localization, and aim at promoting collaborative development. Their work is within the context of a local game jam site in Fukushima, Japan. Musil et al. [20] suggest that game jams provide an effective and focused experience and that participants gain valuable skills in prototyping and collaboration. They study game jams as “composition of design and development strategies: new product development, participatory design, lightweight construction, rapid experience prototyping, product-value focusing, aesthetics and technology, concurrent development and multidisciplinary.” They propose that “although game jams are normally used for rapid prototyping of small computer games, the constellation of the mentioned elements provides a powerful technique for rapidly prototyping new product ideas and disruptive innovations” [20].

It is possible to utilize games and game jam events to foster creative thinking and innovation and expand computational thinking among participants. Not only do participants brainstorm many game designs during the initial hours of a game jam, there has been research done that shows creativity can be enhanced through idea generation games such as GameSpace [18]. In fact, this technique of idea generation has been used specifically at the Finnish GGJ venues in 2010 and 2011 [17].

Preston et al. [24] demonstrated that there was a positive correlation between game jam participation and formal academic performance in courses within the first two years of students’ studies. Students who do not attend game jams have a lower GPA than the average GPA of their peers [24]. Arya et al. [4] used the results of the GGJ 2012 participants’ survey to show a strong learning aspect in the game jam experience particularly with respect to the process familiarity and confidence improvement. They also link certain process decisions such as brainstorming and forming teams with new people to the levels of satisfaction with results and satisfaction with the overall experience.

Reng et al. [27] focused their study on what motivates participants to engage in the GGJ. Through their study of the 2013 Nordic Game Jam (NGJ) they found that the main motivators were to make games and to meet people who share common interests. They concluded that the social aspect of the game jam helps fulfill the desire to learn more about making games or specific game development disciplines (for example, programming).

Zook and Riedl [28] investigated how participants conceptualised the game and the development process that went into making the final product. The limited time available (48 hours) in the GGJ provides a challenging constraint for most beginners. Therefore, the conceptualisation and development process is more important. Zook and Riedl [28] found that the participants typically over scoped the project and as a result over 49% (n=278) cut some of the features initially planned.

Yamane [29] reported on the impact of the Global Game Jam on a specific region. According to Yamane [29], the core elements
game jams; participatory design and prototyping was not widespread in Japan. However, through GGJ, Japanese game developers ‘discovered’ the benefits of participatory design and the game development community have adopted this practice [29].

3.3 2013 Research Survey

The GGJ 2013 participant’s survey was conducted after extensive communication with researchers with approved proposals who submitted their required survey questions. The survey was organized in three parts: Pre-event (including the questions that needed to be answered before the event), Post-event (including the questions that had to be answered after the event and were requested by more than one research group) and Extended (the rest of the post-event questions). The total number of participants who responded to the survey was:

- Post 1,257
- Extended 418
- Pre 878

Table 2 shows some of the questions asked in the survey. While various research projects have been approved and are aimed at studying the 2013 participant’s survey, some initial results are shown in Table 3.

Table 2. Sample Survey Questions

<table>
<thead>
<tr>
<th>Pre-event (total 20 questions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Email address for linking to post-event survey</td>
</tr>
<tr>
<td>- Age, Education and Employment status</td>
</tr>
<tr>
<td>- Gender (Male, Female, Male (transgender), Female (transgender), Genderqueer/Neither, Do not want to answer)</td>
</tr>
<tr>
<td>- Skill Levels and years of experience at various positions (2D or 3D Artist, Sound Designer, Programmer, Game Designer, Writer, UI Designer, QA/Play Tester, IT Support, Project Manager, Producer, Business/Legal, Executive)</td>
</tr>
<tr>
<td>- Frequency of playing games and platforms</td>
</tr>
<tr>
<td>- History and motivation for attending the Global Game Jam</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post-event (total 36 questions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Email address for linking to pre-event survey</td>
</tr>
<tr>
<td>- GGJ attendance information (site and project, motivations for attending again if any)</td>
</tr>
<tr>
<td>- GGJ experience (satisfaction with various aspects including final result)</td>
</tr>
<tr>
<td>- Skill levels on various positions AFTER the Jam</td>
</tr>
<tr>
<td>- What was learnt during the Jam, if anything</td>
</tr>
<tr>
<td>- Process elements used (brainstorming, iterative models, frequent reviews, etc.)</td>
</tr>
<tr>
<td>- Team formation (Who, when, how)</td>
</tr>
<tr>
<td>- Collaboration and communication methods and tools used</td>
</tr>
<tr>
<td>- Development tools used</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extended (total 57 questions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Email address for linking to pre-event survey</td>
</tr>
<tr>
<td>- Initial goals and ideas</td>
</tr>
<tr>
<td>- Problems encountered</td>
</tr>
<tr>
<td>- Decision-making and inter-team behaviours</td>
</tr>
</tbody>
</table>

Table 3. Initial Results

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>18-20</td>
<td>23.97%</td>
</tr>
<tr>
<td>21-29</td>
<td>56.51%</td>
</tr>
<tr>
<td>30-39</td>
<td>15.64%</td>
</tr>
<tr>
<td>40-49</td>
<td>2.40%</td>
</tr>
<tr>
<td>50-59</td>
<td>1.14%</td>
</tr>
<tr>
<td>60 or older</td>
<td>0.34%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>85.97%</td>
</tr>
<tr>
<td>Female</td>
<td>12.54%</td>
</tr>
<tr>
<td>Male (transgender)</td>
<td>0%</td>
</tr>
<tr>
<td>Female (transgender)</td>
<td>0.23%</td>
</tr>
<tr>
<td>Genderqueer/Neither</td>
<td>0.68%</td>
</tr>
<tr>
<td>Do not want to answer</td>
<td>0.57%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than high school degree</td>
<td>2.41%</td>
</tr>
<tr>
<td>High school qualification</td>
<td>19.93%</td>
</tr>
<tr>
<td>Some college but no degree</td>
<td>29.21%</td>
</tr>
<tr>
<td>Associate degree</td>
<td>6.64%</td>
</tr>
<tr>
<td>Bachelor degree</td>
<td>30.93%</td>
</tr>
</tbody>
</table>
3.3 Capstone Projects
To facilitate an applied and practical learning experience, several educational institutions include a final year project in a degree program (a capstone project). In our experience, these capstone projects require students to create a product and solve (or research) a particular technical or business problem.

This can provide students with a meaningful learning opportunity and in some cases a potential employment opportunity, as well as an opportunity to consolidate the learning from their formal education. Capstone projects also allow students to learn skills that are often not included in traditional course-work [5]. We have found that students learn soft-skills (team-work, communication skills, customer awareness), a lot easier when delivered through a practical and applied program [14].

However, we have found it difficult to find capstone projects for students undertaking a degree with a major in game design. The process of making a video game usually extends well beyond a single academic term and development is typically undertaken by a team (or in many cases several teams) of developers. Therefore, this makes it very difficult to provide the student with a tangible and meaningful project where it is possible to identify or demonstrate to faculty what has been produced and what the student has learned. In addition, many engineering oriented programs put great emphasis on customer interaction and requirements engineering, things that are typically underemphasized in the practical, rapid-prototyping environment of the GGJ.

The GGJ provides an opportunity for students to join an existing team or form their own team. These teams are frequently multi-disciplinary, and this enables students from a variety of backgrounds and skills to make a valuable contribution [5]. Further, the time constraint ensures rapid development and project completion [5]. More importantly, because this is a non-commercial enterprise, there is no commercial risk if the project is not completed or does not meet a commercially acceptable standard.

There are a few risks associated with allowing students to undertake team based projects [2]. One concern is the problem with team members not contributing to the project equally (free-riders) [2]. In the video game industry if a team member does not contribute to a project as needed, these team members typically are asked to find another team or another employer. However, our experience has shown that with student projects, this is not always practical as exclusion from a team can mean that the student may not graduate in that given year. Because the GGJ is limited to just one weekend, if a student is not able to contribute to or participate in a team, there is usually adequate time to find a meaningful project for them to complete before the end of the academic year.

3.4 Independent study and class projects
Independent study credits are a natural fit for GGJ activity. In one case at the California Polytechnic State University, one unit of independent study credit was offered to students who both participated in GGJ, and later agreed to improve their game the rest of the term according to the instructor’s feedback [25]. Interestingly, even though the GGJ is a single weekend, more hours could be spent on that project than would otherwise be spent on a 10-13-week long course and provide the opportunity to assess the learning outcomes.

Similarly, GGJ-based class projects in appropriate game courses are an option for educators. The challenge here is the timing and the theme of the event. Both the timing and the theme must be compatible with the course for this to work. Attempts to pre-constrain the GGJ experience by confirming the activity to course requirements are not likely to succeed.

In New Zealand the Global Game Jam has been held in Auckland, Hamilton, Rotorua, Wellington, Christchurch, and Dunedin which has provided students throughout the country to participate in this global event. Furthermore, the Global Game Jam organisers in New Zealand and throughout the world welcome applications from additional sites as required.

4. CONCLUSIONS
In its fifth year, the Global Game Jam is a relatively young activity, but one with tremendous community support and enthusiasm. It is clear this community is growing and becoming more diverse and less US-centric.

We explore the benefits the GGJ can provide for research and teaching activities. With a unified data-gathering mechanism the GGJ-RC hopes to accommodate more projects and more jammer interaction for the benefit of the research projects. We also discuss some methods where this predominantly extracurricular activity, can augment the classroom experience in various forms.

In conclusion, the continued growth and popularity of the GGJ makes it an ideal vehicle for game-based research and education, combining the classroom theory with the practical experience and constraints of the GGJ.

5. ACKNOWLEDGEMENTS
This research was conducted under the auspices of the Waiariki Institute of Technology Research Committee ethical standards. The authors would like to thank the reviewers and Global Game Jam, Inc. for their support.

6. REFERENCES
1 About Global Game Jam. 2012 Retrieved from
Data provided courtesy of Global Game Jam, Inc.


GGJ 2009 Games: http://archive.globalgamejam.org/game_browser


http://globalgamejam.org/about

http://globalgamejam.org/research


Private communication with Professor Foad Khosmood at Cal Poly Computer Science department. 3/2013.


Technology-Rich Learning Environments in New Zealand ITPs

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ABSTRACT
This paper considers the technology-rich learning environments of students doing computer courses in Institutes of Technology and Polytechnics in New Zealand. In this study, the students’ perceptions of their actual and preferred learning environments are investigated along with the gender differences. Quantitative data is collected using Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) from student volunteers of six institutions. Quantitative analysis of the data reveals that the students possess their own preferred environments, to the actually perceived ones and also reveal that there are no significant differences between the genders. Also, significant correlations exist among the responses to the questionnaire scales. The findings can be applied in teaching and learning tertiary computer courses in technology-rich learning environments. This study expects to benefit educators and future researchers, who are interested in carrying out further research and attempts to contribute to the field of technology education in New Zealand.

Categories and Subject Descriptors
K.3.1 [Computers and Education]:

General Terms
Measurement, Human Factors.

Keywords
TROFLEI, technology-rich learning environments, perceptions, gender

1. INTRODUCTION
According to Bergland and Lister [1], “Teaching and learning in higher education are inextricably and elaborately linked. To teach is to make assumptions about what and how the student learns; therefore, to teach well implies learning about students’ learning”. This study is extended from the previous researchers’ reviews of technology-rich computer learning environments. The study is focused around teaching and learning of computer courses in Institutes of Technology (ITPs) and Polytechnics in New Zealand thus critiquing the pedagogical implications. The students in a cohort perceive their computer learning environments differently. This paper presents and analyses the students’ perceptions of their computer learning environments. Furthermore, it explores the differences in the perceptions of their actual and preferred environments. The findings of this paper reveal aspects that are noteworthy to educators which could help improve student outcomes.

ITPs and the polytechnics in New Zealand are considered to be comprised of technology rich learning environments. Do the educators consider students’ preferred learning environments over the students’ perceived learning environments? Do they attempt to deliver the courses according to the students’ preferences? It is questionable whether the ICT educators are considering the various aspects that impact students’ learning in these environments when they teach in such environments.

Most of the students’ learning time is spent in classrooms or computer laboratory learning environments. Past researchers have found that the classroom environments play a major role in students’ learning approaches. Fraser [4, 5, 6] has stated that individual students perceive classroom environments differently thus affecting their academic achievement, resulting in a considerable amount of variance in the learning outcomes within a class. Also, research also has revealed that educators around the world generally pay more attention to student achievement and little attention to their learning environments [7].

The rapid advancement of technology has resulted in constantly changing technology based learning environments [16]. Present day students favour learning by experience in technology-rich learning environments and prefer to be exposed to practical applications [14]. Zandvliet [17] established that the satisfaction of students’ learning in technology-based learning environments depends on a combination of physical and psychological factors influenced by the use of technology in class rooms. Supporting this, Newby and Fisher [13] articulated that, these factors affected student attitudes, satisfaction and achievements, which are applicable to students studying computer courses in computer laboratory environments.

Past researchers found that assessing learning environments were essential [5]. Research on learning environments began in the 1960s, initiated by Herbert Walberg and Rudolf Moos, and was later extended towards major research programs all over the world. Walberg developed the popular Learning Environment Inventory (LEI) for learning environment research and was widely used at that time (Walberg & Anderson, 1968, as cited in Fraser [6]). Furthermore, instruments for assessing elementary to tertiary education learning environments were developed [3]. This was followed by the development of instruments to suit different cultural backgrounds in Europe and Asia [8]. Subsequently, questionnaires were developed by researchers to incorporate students’ actually perceived views and their individually preferred views of their learning environments. The findings revealed that, there is a significant variance between the outcomes of ‘Actual’ and ‘Preferred’ views [6]. Thus, Fraser [6] articulates that, the
same classroom can be perceived differently by students of different genders, abilities and ethnic backgrounds.

2. BACKGROUND
This study involves six Institutes of Technology and Polytechnics across New Zealand. The learning environments of these institutions are considered technology-rich and outcomes focused. The participants of this study are students who in diploma and bachelor degree computer programmes in these institutions. The classes are comprised of students from to diverse backgrounds, ethnicities and age groups. Furthermore, these classes consist of a fewer number of females than the number of males. Hence, the student cohort within one classroom shows diverse learning approaches, attitudes and expectations. It is also noted that there are obvious challenges faced by the educators in teaching in these learning environments besides advancing technology.

The quantitative method was used to collect and analyse data. Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI), which had been previously developed and validated in similar learning environments, was found suitable to the objectives of this study, thus chosen to collect data.

3. OBJECTIVES
The following objectives were introduced to fulfill the aim of this study.

2. To establish the reliabilities of the TROFLEI in tertiary classrooms in New Zealand.
3. To investigate students’ perceptions of their actual and preferred learning environments.
4. To investigate any significant differences that existed between the actual and preferred learning environments of students.
5. To investigate if there were any differences between the genders to the responses of the questionnaire.

4. RESEARCH DESIGN
“Quantitative research is an organised method for combining deductive logic with precise empirical observations of individual behaviour in order to discover and confirm a set of probabilistic causal laws that can be used to predict general patterns of human activity.” (Newman 1997, as cited in Cavana et al.[2]).

The quantitative method is selected as the research design in this study. Standardized information from or about the subjects being studied is gathered using the quantitative research method. These subjects can be individuals, groups of individuals, organizations, and communities etc., which are referred to the ‘population’ or a ‘sample’ for the research purpose and surveys are used to gather information about characteristics, actions, or opinions of a population in this method [15].

Various types of questionnaires developed for a particular research are used in the quantitative research method. These questionnaires are tested for reliability and validity in a particular study. Also they have to be tested in similar environments before they can be reused.

5. METHODOLOGY
5.1 Sample and data collection
Three hundred and twenty two volunteering students from levels 5, 6 and 7 studying computer courses in six ITPs and Polytechnics in New Zealand participated in this study (2011- 2012). There were 248 males, 49 Females and 25 students who didn’t declare their gender who participated in the data collection. TROFLEI was administered to the students at agreed times during the semester. Ethical approvals were obtained from each participating institution to collect data. The data collection was administered by a lecturer or an administrator of the institution. A participant information sheet was provided to each volunteering student and the aims of the research were explained, prior to collecting the data.

The descriptive statistics of the sample is displayed in Table 1.

Table 1. Descriptive statistics of the sample

<table>
<thead>
<tr>
<th>Institution</th>
<th>L5</th>
<th>L6</th>
<th>L7</th>
<th>Tot</th>
<th>M</th>
<th>F</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>64</td>
<td>46</td>
<td>40</td>
<td>150</td>
<td>104</td>
<td>27</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>11</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>11</td>
<td>9</td>
<td>20</td>
<td>17</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>17</td>
<td>14</td>
<td>59</td>
<td>52</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>23</td>
<td>13</td>
<td>23</td>
<td>59</td>
<td>44</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>16</td>
<td>5</td>
<td>21</td>
<td>20</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Tot</td>
<td>128</td>
<td>103</td>
<td>91</td>
<td>322</td>
<td>248</td>
<td>49</td>
<td>25</td>
</tr>
</tbody>
</table>

M = Male, F= Female, U = Unknown

5.2 Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI)
TROFLEI is a widely-applicable instrument, which measures the impact on student learning environments on their learning outcomes, which is suitable for carrying out investigations in ICT-rich learning environment in higher level education. TROFLEI was developed by Aldridge and Fraser, and proven validity and reliability in similar educational environments.

TROFLEI consists of 80 items. All the items were written to have positive scorings and contained no negative items. The items belonged to ten scales and each item contained an ‘Actual’ and a ‘Preferred’ column. The student’s view of how often each practice actually takes place in the classroom is described by the ‘Actual’ column while, the student’s view of how often the practice actually takes place in the classroom is described by the ‘Preferred’ column. Items are responded to, on a five point scale; Almost Never, Seldom, Sometimes, Often, and Almost Always. The responses to items scored 1, 2, 3, 4 and 5 respectively on a scale of 5.

Table 2 displays the descriptive information of the TROFLEI.
6. RESULTS AND DISCUSSION

6.1 Data Entry and Analysis
Data collected using the questionnaire were entered into SPSS statistical software and analysed using the appropriate statistical tests.

6.2 Internal Consistency (Alpha Reliability) for the TROFLEI scales
The internal consistency of the actual and preferred scales of TROFLEI was tested using Cronbach’s Alpha reliability test, on the student responses to both the actual and preferred scales. Cronbach’s Alpha values between 0.73 and 0.94 were yielded, proving satisfactory internal consistency for both the actual and the preferred scales of TROFLEI. This indicates that the instrument is appropriate for use in the New Zealand tertiary environment.

The results of the reliability tests are displayed in Table 3.

Table 3. Alpha Reliability (Internal consistency) for Actual and Preferred scales of the TROFLEI

<table>
<thead>
<tr>
<th>Scale</th>
<th>No of items</th>
<th>Version</th>
<th>Alpha Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Cohesiveness</td>
<td>8</td>
<td>Actual</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
<td>0.87</td>
</tr>
<tr>
<td>Teacher Support</td>
<td>8</td>
<td>Actual</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
<td>0.90</td>
</tr>
<tr>
<td>Involvement</td>
<td>8</td>
<td>Actual</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
<td>0.92</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>8</td>
<td>Actual</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
<td>0.87</td>
</tr>
<tr>
<td>Investigation</td>
<td>8</td>
<td>Actual</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
<td>0.93</td>
</tr>
<tr>
<td>Cooperation</td>
<td>8</td>
<td>Actual</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
<td>0.81</td>
</tr>
<tr>
<td>Equity</td>
<td>8</td>
<td>Actual</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
<td>0.94</td>
</tr>
<tr>
<td>Differentiation</td>
<td>8</td>
<td>Actual</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
<td>0.81</td>
</tr>
<tr>
<td>Computer Usage</td>
<td>8</td>
<td>Actual</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
<td>0.86</td>
</tr>
<tr>
<td>Young Adult Ethos</td>
<td>8</td>
<td>Actual</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
<td>0.91</td>
</tr>
</tbody>
</table>

6.3 Validity of the TROFLEI
The discriminant validity and the mean correlations tests are performed on the ‘Actual’ scales of the TROFLEI in order to test the validity of the instrument. The results show reasonably high mean scores, which prove that the TROFLEI for use in the New Zealand environment under this study.

The results of the reliability tests are displayed in Table 4.
6.4 Interpretation of the correlations among TROFLEI scales (Actual)

Table 4 displays that the variances in correlations for all the scales of TROFLEI range from 0.12 to 0.62 indicating that the scales of TROFLEI instrument measure distinct elements in this study. The highest mean correlations are shown in A-Involvement (0.46), A-Task-Orientation (0.44) and A-Corporation (0.42), indicating that the above three scales have a noteworthy impact on the rest of the TROFLEI scales. The lowest mean correlation is shown in A-Differentiation (0.28) revealing that this scale has the least impact on the rest of the TROFLEI scales.

6.5 Correlations of TROFLEI scales

Table 5 displays correlations of the TROFLEI scales. The results reveal that, all the scales of the TROFLEI had significant inter-correlations.

### Table 4. Discriminant validity and Mean correlations of TROFLEI scales

<table>
<thead>
<tr>
<th>Scale (Actual)</th>
<th>Correlations</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-Corporation/A-Task-Orientaion</td>
<td>0.55**</td>
<td>a)</td>
</tr>
<tr>
<td>A-Corporation/A-Student Cohesiveness</td>
<td>0.57**</td>
<td></td>
</tr>
<tr>
<td>A-Equity/A-Task-Orientaion</td>
<td>0.53**</td>
<td></td>
</tr>
<tr>
<td>A-Equity/A-Teacher Support</td>
<td>0.46**</td>
<td></td>
</tr>
<tr>
<td>A-Equity/A-Young Adult Ethos</td>
<td>0.49**</td>
<td></td>
</tr>
<tr>
<td>A-Involvement/A-Student Cohesiveness</td>
<td>0.47**</td>
<td></td>
</tr>
<tr>
<td>A-Involvement/A-Teacher Support</td>
<td>0.50**</td>
<td></td>
</tr>
<tr>
<td>A-Involvement/A-Task-Orientaion</td>
<td>0.56**</td>
<td></td>
</tr>
<tr>
<td>A-Involvement/A-Investigation</td>
<td>0.62**</td>
<td></td>
</tr>
<tr>
<td>A-Young Adult Ethos/A-Differentiation</td>
<td>0.12** (lowest)</td>
<td></td>
</tr>
</tbody>
</table>

N= 322

6.6 Interpretations of the correlations of the scales displayed in Table 5

a) A-Corporation, A-task Orientation, A-Student Cohesiveness:

The value of the correlations of these scales can be interpreted as that discussions and collaborations with peers are influenced when the students corporate and collaborate adequately with each other and the tutor. This improves student-cohesiveness and task-orientation.

b) A-Equity, A-task Orientation, A-Teacher Support, A-Young Adult Ethos:

The value of the correlations of these scales can be interpreted as that the teachers are extending fair support which facilitates negotiations of the students’ abilities. Also, the students feel that they are treated equally within the classroom. They also believe that they get equal opportunities to express their views and to participate in class discussions. The students feel that the support of the teacher is essential towards getting their tasks done. The students have an affirmative sense towards equity according to the correlation results. Equity is considered imperative to the students as young adults, to gain autonomous learning.

c) A-Involvement, A-Student Cohesiveness, A-Task-Orientaion, A-Investigation:

The results in table 5 for the above scales indicate that the students demonstrate cohesiveness in doing the tasks related to their lessons that improved involvement with peer students. This helps the students to acquire new knowledge. Teacher support is perceived important to influence in involvement in student group activities that help them share knowledge among the peer students. This improves students’
individual investigations and brings about additional knowledge. Also, teacher support is observed important to students towards achieving their goals and the outcomes.

d) A-Young Adult Ethos, A-Differentiation

The students who are subjected to the learning environments under this study differ in age substantially. Their ages can vary from 18 to 40 years and they are supposed to be engaged in collaborative learning. However, student responses reveal that they expect further recognition as young adults who brought prior knowledge to these learning environments. They also preferred to be given different tasks according to their abilities.

Table 6. Descriptive statistics for Actual and Preferred Learning Environments of the TROFLEI

<table>
<thead>
<tr>
<th>Scale</th>
<th>Version</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>t-value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>A</td>
<td>3.75</td>
<td>0.68</td>
<td>-</td>
<td>0.000</td>
</tr>
<tr>
<td>Cohesiveness</td>
<td>P</td>
<td>4.07</td>
<td>0.70</td>
<td>10.542</td>
<td>0.000</td>
</tr>
<tr>
<td>Teacher</td>
<td>A</td>
<td>3.43</td>
<td>0.75</td>
<td>-</td>
<td>0.000</td>
</tr>
<tr>
<td>Support</td>
<td>P</td>
<td>3.85</td>
<td>0.78</td>
<td>11.080</td>
<td>0.000</td>
</tr>
<tr>
<td>Involvement</td>
<td>P</td>
<td>3.15</td>
<td>0.75</td>
<td>10.934</td>
<td>0.000</td>
</tr>
<tr>
<td>Task</td>
<td>A</td>
<td>4.00</td>
<td>0.73</td>
<td>-</td>
<td>0.000</td>
</tr>
<tr>
<td>Orientation</td>
<td>P</td>
<td>4.46</td>
<td>0.80</td>
<td>13.209</td>
<td>0.000</td>
</tr>
<tr>
<td>Investigation</td>
<td>A</td>
<td>3.24</td>
<td>0.86</td>
<td>-</td>
<td>0.000</td>
</tr>
<tr>
<td>Cooperation</td>
<td>P</td>
<td>3.78</td>
<td>0.93</td>
<td>13.204</td>
<td>0.000</td>
</tr>
<tr>
<td>Equity</td>
<td>A</td>
<td>4.00</td>
<td>0.81</td>
<td>-6.670</td>
<td>0.000</td>
</tr>
<tr>
<td>Differentiation</td>
<td>A</td>
<td>3.06</td>
<td>0.67</td>
<td>-8.462</td>
<td>0.000</td>
</tr>
<tr>
<td>Computer</td>
<td>P</td>
<td>3.55</td>
<td>0.82</td>
<td>-5.437</td>
<td>0.000</td>
</tr>
<tr>
<td>Usage</td>
<td>P</td>
<td>4.12</td>
<td>0.76</td>
<td>-4.121</td>
<td>0.000</td>
</tr>
<tr>
<td>Young Adult</td>
<td>A</td>
<td>4.15</td>
<td>0.73</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Ethos</td>
<td>P</td>
<td>4.27</td>
<td>0.85</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

A = Actual, P = Preferred

The lowest negative differences of the $t$-values are displayed in Equity, Computer Usage and Young Adult Ethos. These values reveal that the students are somewhat satisfied with their actually perceived learning environments around these scales.

6.7.2 Standard deviations

The standard deviations for the actual and the preferred versions of the TROFLEI scales indicate that there is a considerable variation in the responses to all the scales. These results indicate that the individual students have their own perceptions of their actual and preferred learning environments. There is a noteworthy variation of this factor among individual students.

Low standard deviation values indicate that the data responses lean towards the mean. High standard deviation values indicate that the data responses are spread out over a large range of values (see Table 6).

The standard deviations for the preferred columns are higher than that of the actual columns. These prove that the students have their own preferred learning environments to the currently perceived actual environments in all the scales.

6.7.3 Mean values

Mean values of Table 6 reveal that significant differences exist between the responses to all the actual and the preferred scales of TROFLEI. The overall mean values for the preferred columns show higher values than the actual column in all the scales (see Figure 1). These indicate that the students always prefer more favourable learning environments than their currently perceived ones.

![Figure 1. Mean values for Actual & Preferred learning environments of the sample](image)

6.7.4 Gender differences for the questionnaire scale responses

No major differences in the responses are found between the males and females to the scales of the two questionnaires revealing that over all there were no significant differences between males and females, in the way they perceived their technology-rich learning environments (see Table 7).

However, Table 7 indicates that, in Computer Usage ($M = 3.90$, $F = 4.12$) and Task Orientation ($M = 3.98$, $F = 4.11$), females scored higher means than the males. These values indicate that the female students prefer to be involved in course related computer tasks such as doing assignments, online communication with peers and the teacher and to find further information online more.
than the male students. Also, the results reveal that the awareness of the female students about the importance of their classes, goal setting, be attentive during their lessons the class and getting their work done on time, were noteworthy compared to male students.

Usefulness of Computers, Enjoyment, A-Equity and A-Young Adult Ethos display high mean scores all above 4.0 for both genders. These values indicate that there are no differences between the genders of their perceptions to these scale (see Table 7).

### Table 7. Means and Standard Deviations for gender differences

<table>
<thead>
<tr>
<th>Scale</th>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Std Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usefulness of Course</td>
<td>M</td>
<td>233</td>
<td>3.62</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>53</td>
<td>3.52</td>
<td>0.49</td>
</tr>
<tr>
<td>Anxiety</td>
<td>M</td>
<td>233</td>
<td>3.99</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>53</td>
<td>3.83</td>
<td>1.01</td>
</tr>
<tr>
<td>Usefulness of Computers</td>
<td>M</td>
<td>233</td>
<td>4.12</td>
<td>0.56</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>53</td>
<td>4.12</td>
<td>0.54</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>M</td>
<td>233</td>
<td>4.12</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>53</td>
<td>4.12</td>
<td>0.60</td>
</tr>
<tr>
<td>A-Student</td>
<td>M</td>
<td>242</td>
<td>3.76</td>
<td>0.67</td>
</tr>
<tr>
<td>Cohesiveness</td>
<td>F</td>
<td>55</td>
<td>3.67</td>
<td>0.73</td>
</tr>
<tr>
<td>A-Teacher</td>
<td>M</td>
<td>242</td>
<td>3.42</td>
<td>0.73</td>
</tr>
<tr>
<td>Support</td>
<td>F</td>
<td>55</td>
<td>3.44</td>
<td>0.86</td>
</tr>
<tr>
<td>A-Involve</td>
<td>M</td>
<td>240</td>
<td>3.16</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>55</td>
<td>3.03</td>
<td>0.91</td>
</tr>
<tr>
<td>A-Task</td>
<td>M</td>
<td>240</td>
<td>3.98</td>
<td>0.73</td>
</tr>
<tr>
<td>Orientation</td>
<td>F</td>
<td>55</td>
<td>4.11</td>
<td>0.77</td>
</tr>
<tr>
<td>A-Investigation</td>
<td>M</td>
<td>239</td>
<td>3.21</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>55</td>
<td>3.24</td>
<td>0.83</td>
</tr>
<tr>
<td>A-Cooperation</td>
<td>M</td>
<td>241</td>
<td>3.72</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>55</td>
<td>3.80</td>
<td>0.72</td>
</tr>
<tr>
<td>A-Equity</td>
<td>M</td>
<td>239</td>
<td>4.00</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>55</td>
<td>4.02</td>
<td>0.77</td>
</tr>
<tr>
<td>A-Differentiation</td>
<td>M</td>
<td>223</td>
<td>3.07</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>54</td>
<td>3.02</td>
<td>0.66</td>
</tr>
<tr>
<td>A-Computer</td>
<td>M</td>
<td>239</td>
<td>3.90</td>
<td>0.72</td>
</tr>
<tr>
<td>Usage</td>
<td>F</td>
<td>55</td>
<td>4.12</td>
<td>0.62</td>
</tr>
<tr>
<td>A-Young Adult Ethos</td>
<td>M</td>
<td>236</td>
<td>4.14</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>55</td>
<td>4.12</td>
<td>0.62</td>
</tr>
</tbody>
</table>

Whilst this paper has identified the student perceptions in technology-rich, outcomes-focused learning environments, it has not covered ways to address these challenges faced by educators teaching in these environments. However, the findings of this paper would facilitate identifying the challenges faced by the educators when teaching in such learning environments.

The paper does not attempt to propose a possible teaching framework to suit these learning environments in response to students’ perceptions of their learning environments. Also, implications for teaching, and issues concerning implementations were not covered in this study and are left for future research.

### 8. ACKNOWLEDGMENTS

My thanks to the Heads of Department at Manukau Institute of Technology, Nelson Marlborough Institute of Technology, Bay Of Plenty Polytechnic, Eastern Institute of Technology, Wellington Institute of Technology and Waikato Institute of Technology in New Zealand, for the approval of ethics applications, for organizing the students to participate in the data collection and for all the support extended towards this study.

### 9. REFERENCES

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Analysis of Prerequisites: Methodology and a Case Study
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ABSTRACT
It is well known that it is dangerous to infer causation from correlation. However, the mantra that correlation does not imply causation can lead to some researchers believing that formal inference is never possible from a correlational study. This paper presents a theoretical framework, a conceptual framework and a methodology for establishing formal inference from the analysis of prerequisites in an educational context. This is important in education because some prior knowledge is often required for success in any topic or course. The method is illustrated with a case study that investigates the effectiveness of a level four certificate as preparation for further study. The case study identified the unique contribution to subsequent performance made by individual courses in the certificate. It also identified the specific courses in subsequent study which were most affected by the certificate courses. We conclude that the approach can indeed enable formal inference from a correlational study.

Categories and Subject Descriptors
K.3.2 [Computer and Information Science Education]

General Terms
Measurement

Keywords
Correlation and causation, causal inference, prerequisite analysis.

1. INTRODUCTION
At an early stage in their career, researchers encounter the mantra: correlation does not imply causation. Indeed, naively attributing causation is subject to at least two logical fallacies. The first, known as cum hoc ergo propter hoc, (with this, therefore because of this), arises when the assumption is made that when two events co-occur, one must cause the other. The second, known as post hoc ergo propter hoc (after this, therefore because of this) arises when the assumption is made that an event that follows another is necessarily a consequence of the first event.

Given these potential logical fallacies, several schools of thought arise. The first is that causation can only be asserted when there is an experimental study design, which is carried out under controlled conditions, and in which the causative variable is manipulated experimentally. There is no doubt that this can give good evidence of causation. However, it also precludes studying causation in such diverse scientific fields as meteorology, oceanography, cosmology or neuroscience, in which experimental manipulation under controlled conditions is not possible. These have to be studied “in the wild”, as it were. The second school of thought is concerned with investigating causation in this context. The essence of this school of thought is the use of a theory driven approach. A theory is constructed which includes causative mechanisms and explains the observations. This theory is then put to the test. Theories that survive testing are regarded as plausible until disconfirmed and they gain credibility as further tests are carried out [17]. Examples of this paradigm are Hawking radiation from black holes, predicted in 1974 [7] and partially confirmed in 2012 [10] or the search for the Higgs Boson, predicted in 1964 [8] and tentatively confirmed in 2012 [5]. Few would disagree that these researches were scientific endeavours.

The third school of thought arises when researchers, aware of the difficulties of causal inference, claim to be studying associations rather than causation. Inevitably, though, we are usually interested in explanation and causation rather than just associations. As Michael Rutter notes:

Researchers tend to fall into one of two camps with respect to how they react to the problem. First, there are those who are careful to use language that avoids any direct claim for causation, and yet, in the discussion section of their papers, they imply that the findings do indeed mean causation. Second, there are those that completely accept the inability to make a causal inference on the basis of simple correlation or association and, instead, take refuge in the claim that they are studying only associations and not causation. This second, “‘pure’” approach sounds safer, but it is disingenuous because it is difficult to see why anyone would be interested in statistical associations or correlations if the findings were not in some way relevant to an understanding of causative mechanisms. [19, p. 377]

In education, ethical considerations usually preclude the use of experimental study designs. We have a duty of care to our students and therefore cannot deliberately expose students to experimental conditions that we believe might be less than optimal for their learning. Moreover, ethical approval for any research is likely to involve the fundamental principles of informed consent and no deception. It is difficult to conceive of any meaningful educational intervention or treatment that could be studied in a way that preserves the double-blind nature essential to the validity of experiments. This is essential to control common threats to validity such as the Hawthorne effect [20]. It follows that correlational studies are a natural choice for educational research. In a sense, we have to carry out our studies “in the wild” even though this brings in many possible confounding factors. Despite the problems, there are however, some benefits of this approach. For example, such studies have greater ecological validity and they keep research findings close to practice.

This quality assured paper appeared at the 4th annual conference of Computing and Information Technology Research and Education New Zealand (CITRENZ2013) incorporating the 26th Annual Conference of the National Advisory Committee on Computing Qualifications, Hamilton, New Zealand, October 6-9, 2013. Mike Lopez and Michael Verhaart, (Eds).
In designing such a study, assessment data are a natural source of objective evidence. Using these data avoids the additional burden placed on students by gathering extra research data. Moreover, these data are often the best quality data available to educators because most institutions invest substantial resources in the quality control of these data, typically using formal moderation procedures both before and after administration of the assessment. Moreover, as Timperley and Parr [22] note, educators:

... spend a great deal of time assessing students more formally and recording and reporting the results, but research seems to reflect that this information is not necessarily used to inform teaching decisions. [22, p.12]

From this perspective, it is important to make use of such data, wherever possible, to inform our teaching. However, given the potential logical fallacies, it is clearly important to tread carefully when building inference from a correlational study. Figure 1 illustrates one of the difficulties with subtle humour.

Of course, it is easy and entertaining to poke fun at such inference and to create contrived examples to point out the logical fallacies. Figure 2 shows a plot of the global average temperature against an approximate estimate of the number of pirates in the world.

Choosing plausible options from such possible explanations of causation is often complex and potentially challenging, but need not be impossible. For example, if event B always follows event A in time, as is typically the case with a prerequisite relationship, then it is reasonably to exclude the possibility that the later event B is a cause of A. In practice, however, such logical analysis can only take us so far and it is usually difficult to distinguish between the cases where A is a cause of B, and where both A and B are the consequence of some other, possibly unknown, factor C. Thus, moving our knowledge forward requires the development and testing of theory that can explain the causal mechanisms underpinning observed correlations.

Our method follows the second school of thought we have set out: that of theory driven exploration. In education, we often arrange learning opportunities in a way that successive material builds on what has been learned before. Typically, we do this in two ways. First, within a course, we organise and sequence material in a way that builds skills and knowledge progressively. Second, a course may assume skills and knowledge from a previous course, often as a formal prerequisite. In essence then, our tacit theory is that knowledge, both knowing what and knowing how, can be built progressively on prior understandings. This is nothing new. Indeed, the very use of the term prerequisite implies such a theory underpinning our practice. The important point is that we can make such a theory explicit and derive testable propositions that arise from the theory. This allows us to put such a theory to the test. For this paper, we will call our theory: the theory of progressive knowledge building.

Within a course, we usually have multiple assessments covering multiple topics and multiple items for each topic. It is therefore possible to derive from this a topic by topic performance analysis. Between courses the final outcome grades serve a similar purpose. These data allow us to test our theory of progressive knowledge building, either disconfirming it, or raising our confidence in its generality [17]. The essential point of this approach is that statistical methods do not, and cannot, explain phenomena. Theories provide explanations and statistical methods put theories to the test.

In summary, the idea of prerequisites is pervasive in education. We organise and present our learning experiences in a way that successive material progressively builds on what has been learned before. Our research question is: How can we evaluate the effectiveness of such a prerequisite? Because ethical reasons preclude experimental approaches, we are left with observational approaches. This leads us to ask how we can answer such a question from a correlational study. Our approach is to posit a theory of progressive knowledge building and then put this theory to the test.

The remainder of this paper is organised as follows. We present the theoretical framework for the analysis in section 2 and our conceptual model in section 3. We describe our method in section 4 and then illustrate the method by presenting a case study in section 5. Finally, in section 6, we present our conclusions.
2. THEORETICAL FRAMEWORK
Although, following Stevens [21], many researchers simply assign scores as numerals and assume that they are linear measurements, nevertheless at best scores only form an ordinal scale [23]. However, ordinal scores may be converted to linear measurements under mild and verifiable assumptions [2,11,18], or simply treated as linear to isolate a main effect where this is believed to provide sufficient information compared to a full model [1]. However, merely assigning numbers does not make an attribute quantifiable [14]. A formal framework for the scientific task of establishing that an attribute is quantifiable is given by Luce and Tukey [12], and tests for this are given by Karabatsos [9] and Lopez [11].

Taken together, the foregoing work allows linear measurement to be constructed or assumed, and all assumptions verified. Once linear measurement has been established, analysis can proceed under the general linear model. A standard approach is to use multiple-regression to investigate the extent to which a set of predictors explains the variability of a criterion variable, together with a decomposition that estimates the unique contribution of each predictor, and any commonality shared among the predictors.

3. CONCEPTUAL MODEL
In education, many factors contribute to success in a course. We can identify three broad sets of factors that contribute to performance. The first set relates to the nature of the topic itself, including the skills and knowledge needed. The second relates to the teacher: how the material and learning is organised and how the teacher engages with the class. The third comprises the personal attributes of the student, such as the degree of effort they make to learn, their approach to studying, self-management, health, and many other elements.

In the context of studying prerequisites, we can group these factors into those shared across topics and those unique to topics. Figure 3 summarises this conceptual model.

![Figure 3: Conceptual model](image)

One effect of using multiple-regression is that any linear transformation of criterion or predictor variables leads to the same result. This gives a natural statistical control of several aspects of the data; variability of performance is analysed rather than any absolute level. We can expect students’ personal attributes to contribute to performance in all the predictors as well as to performance in the criterion. There is therefore a natural statistical control of these attributes. Similarly, there is an automatic statistical control of aspects such as the leniency or severity of marking in a course. Where the events measured by the criterion variable occur at a different time from those of the predictors, there may also be a time-related effect. In particular, the criterion events usually occur later and so, the student will have engaged in more learning (or have forgotten material) by this time. However, there is, again, a natural statistical control of this.

The skills and knowledge required in a topic can be decomposed into two sets: those unique to the topic and those shared across topics. Similarly, the effect of the teacher can be decomposed into effects unique to the topic and effects shared across topics.

In summary, the above points give the following decomposition. The commonality comprises skills and knowledge shared across the topics, together with any teacher characteristics shared among the teaching team. The unique topic contribution comprises the unique skills and knowledge employed in the topic, together with any unique contribution of the teacher to the topic. Student attributes, marking leniency or severity, and elapsed time effects are automatically controlled statistically.

It should be noted that for both the unique contributions and the commonality, teacher characteristics are confounded with the skills and knowledge intrinsic to a topic. One obvious refinement would be to decompose these so as to isolate the unique effects of the teacher from skills and knowledge. However, we believe that this would not be useful, and might indeed be misleading, for the following reasons. First, how the teacher engages with the class is likely to depend as much on how the teacher relates to the topic as on intrinsic teacher attributes. Isolating the latter would still leave a substantial component which is confounded with intrinsic skills and knowledge. Second, attempting to isolate intrinsic teacher characteristics would require sampling a larger set of courses with which the teacher engaged, thus limiting the applicability of the method. Third, the analysis could be readily misinterpreted as controlling for teacher effects, whereas there would still a substantial component that remains confounded. With these points in mind, and particularly with regard to the possibility of misinterpretation, we do not recommend attempting to isolate teacher effects.

4. METHOD
Although the underlying logic is the same, we present below separately the logic for investigating the relationships among topics within a course and the relationship between courses for which a formal prerequisite relationship exists or an informal relationship is assumed.

To investigate topics in a course, we assume that the course has several assessments, that each assessment covers a range of topics, and that at least some topics are assessed in more than one assessment. It is then possible, for at least some topics, to estimate performance in the topic on at least two occasions by using separate scales formed for each occasion. If the theory of progressive knowledge building is correct, there should be a stronger association between occasions for a topic, than between different topics and this can be readily tested.

For prerequisite relationships between courses, the final outcome grades can be used. It is assumed that the analysis includes both courses with a known or expected strong prerequisite relationship and others with for which the relationship is weaker or expected to be absent. This will enable the separation of performance
intrinsic to a specific prerequisite course from commonalities and thus enable testing of the theory of progressive knowledge development.

In both cases, there is likely to be significant confounding of any cause and, accordingly, careful analysis is needed to unpick the causal mechanisms and interpret any findings.

5. CASE STUDY

To illustrate the method, we present here a case study of the analysis of courses in a certificate programme which also serves as a preparatory course for further study in degree or diploma courses. For this purpose, a course is equivalent to a topic as discussed above. Our working research question was: How does the CICT prepare students for further study?

5.1 Courses

The Certificate in Information and Communication Technologies (CICT) consists of four courses at level four in the NZQA framework [16]. Some students complete their CICT and then leave; others progress to further study. We were interested in those students who continued their study in the Bachelor of Information and Communication Technologies (BICT) or in the Diploma of Information and Communication Technologies (Dip/ICT). Both of these programmes share a common set of papers in their first year. We focused on those courses which are only those diploma and degree students who had previously completed the CICT. We selected three cohorts of students as shown in Table 2. These were the most recent cohorts available at the time of writing this paper.

Table 1: Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>CICT400</td>
<td>Introduction to IT</td>
</tr>
<tr>
<td>CICT410</td>
<td>Practical skills in IT</td>
</tr>
<tr>
<td>CICT420</td>
<td>Information and Communication Skills</td>
</tr>
<tr>
<td>CICT430</td>
<td>Problem Solving in ICT</td>
</tr>
<tr>
<td>CS153</td>
<td>Computer Architecture</td>
</tr>
<tr>
<td>IT181</td>
<td>Information Technology Concepts &amp; Tools</td>
</tr>
<tr>
<td>PR109</td>
<td>Programming Precepts</td>
</tr>
<tr>
<td>SE101</td>
<td>Software Engineering IA</td>
</tr>
</tbody>
</table>

Note: a) CICT b) BICT or Dip/ICT

5.2 Sample and Data

Our source data were taken from our institution’s student management system. We included only those CICT students who subsequently chose the further study in the degree or diploma, and only those diploma and degree students who had previously completed the CICT. We selected three cohorts of students as shown in Table 2. These were the most recent cohorts available at the time of writing this paper.

Table 2: Source data

<table>
<thead>
<tr>
<th></th>
<th>Cohort 1</th>
<th>Cohort 2</th>
<th>Cohort 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CICT</td>
<td>2011 Sem 1</td>
<td>2011 Sem 2</td>
<td>2012 Sem1</td>
</tr>
<tr>
<td>Further study</td>
<td>2011 Sem 2</td>
<td>2012 Sem1</td>
<td>2012 Sem2</td>
</tr>
</tbody>
</table>

For each cohort of students, we collected their grades in the CICT programme and their grades in the first four papers of their subsequent study in the degree or diploma. The data used were the mark, student identifier, course and cohort.

5.3 Analysis

For screening purposes, all data were processed using a formal measurement model [11] for two scales: CICT and further study. This screening allowed all of the measurement assumptions to be tested formally. Both scales met all measurement assumptions with the exception of local dependence and differential item functioning (DIF) [25] by cohort. Neither is critical because the measurement software can detect and correct for these. Nevertheless, we note that the detected DIF indicates that the criteria for CICT400, CICT430 and CS153 changed significantly across the cohorts. Local dependence was detected among all the CICT courses and between CS153 and IT181. Moreover, local dependence was detected among seven students in CICT. Discussion of the impact of local dependence is outside the scope of this paper. Interested readers can get more information in Lopez [11]. Nevertheless, such diagnostics are illustrative of the extensive information provided to researchers by the use of a formal measurement model.

Overall, we deemed the scales suitable for analysis. The reliability of the scales is shown in Table 3.

Table 3: Reliability of scales

<table>
<thead>
<tr>
<th>Scale</th>
<th>Alpha</th>
<th>PSR</th>
<th>ISR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CICT</td>
<td>.716</td>
<td>.817</td>
<td>.980</td>
</tr>
<tr>
<td>Further Study</td>
<td>.854</td>
<td>.874</td>
<td>.971</td>
</tr>
</tbody>
</table>

Note: Alpha is Cronbach’s alpha, PSR is the Rasch person separation reliability, ISR is the Rasch item separation reliability.

In statistics, reliability is defined as the variance of the true score (T) expressed as a proportion of observed variance (X). This can be stated as a formula: r = T/X. Essentially, it expresses the accuracy of measurement. Using an analogy from electrical engineering, a reliability of .9 represents 90% signal and 10% noise, or a signal-to-noise ratio of 9:1. Because the true score is unknown, reliability must be estimated from the sample. Cronbach’s alpha is a widely used estimate of reliability [4]. The main weakness of this measure is that it assumes that scores are linear and distributed normally. However, scores are not linear [23] and marks are rarely distributed normally in practice. Broadly speaking, the effect of this is to underestimate the strength of a relationship because the maximum value of the correlation coefficient cannot be reached if these assumptions are not met. The Rasch person separation reliability [24] provides a better estimate because it is calculated in a linear metric and is free from distributional assumptions.

It can be noted that person separation reliability was higher than Cronbach’s alpha in both scales. This suggests that it would be preferable to use a formal measurement model for the analysis. Nevertheless, since this case study is intended to illustrate the broad method, we proceeded by using the raw scores and treating these as linear measurements. We did this because we believe this makes the method accessible to a wider range of researchers. We give a more formal justification of this decision as follows. The correlation between the linear and raw CICT scales was .935; between the linear and raw further study scales was .964. These are both well above 0.9. Thus, the raw scales clearly capture most of the available information in the datasets, with less than a 10% loss of information. Following Agresti [1], it is reasonable to

3 Although widely termed Cronbach’s alpha, this was originally derived by Louis Guttman [6] who termed it $\lambda_3$. 
expect that a linear model applied to scores would lead to similar conclusions as a full model. The logic in this study does not require an accurate estimate of absolute effect size, but rather relative estimates. We conclude that the simpler approach is not only more accessible, but would lead to similar conclusions.

5.4 RESULTS

We begin by presenting the mean raw scores of each course across the cohorts in Table 4.

Table 4: Mean scores across all cohorts

<table>
<thead>
<tr>
<th>Course</th>
<th>Mean</th>
<th>Std. error</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>CICT400</td>
<td>84%</td>
<td>1.3%</td>
<td>112</td>
</tr>
<tr>
<td>CICT410</td>
<td>71%</td>
<td>1.5%</td>
<td>98</td>
</tr>
<tr>
<td>CICT420</td>
<td>76%</td>
<td>1.9%</td>
<td>114</td>
</tr>
<tr>
<td>CICT430</td>
<td>69%</td>
<td>1.2%</td>
<td>121</td>
</tr>
<tr>
<td>CS153</td>
<td>62%</td>
<td>2.5%</td>
<td>115</td>
</tr>
<tr>
<td>IT181</td>
<td>64%</td>
<td>3.6%</td>
<td>48</td>
</tr>
<tr>
<td>PR109</td>
<td>49%</td>
<td>4.2%</td>
<td>37</td>
</tr>
<tr>
<td>SE101</td>
<td>69%</td>
<td>4.6%</td>
<td>48</td>
</tr>
</tbody>
</table>

As can be seen in this table, all scores are in the range 60% to 85% with the exception of PR109 which historically has had a low mean score and pass rate. It can also be noted that although the number of students in CS153 is comparable to the CICT numbers, the students in the remaining further study courses are considerably lower. This is because only CS153 is compulsory for the DICT courses, whereas all four are compulsory for the BICT.

We conducted a standard multiple-regression analysis of the contribution of each of the CICT courses to performance as measured by the further study scale. A path diagram of the results is presented in Figure 4.

As can be seen, overall, 49% of the variability of marks in further study courses can be explained by overall success in the CICT. Moreover, CICT410 and CICT430 make a unique contribution over and above the commonality of 15% and 11% respectively. We then carried out a multiple regression of the CICT courses as predictors of each of the further study courses. Space does not allow presenting the findings of each course and, thus, we present a composite summary of the results in Figure 5.

Figure 5: Significant course to course relationships

From this diagram, it can be seen that CICT410 is a strong predictor of success in CS153. Thus CICT410 is, in a sense, the most important course for students who progress to the DICT since this is the only course among those we have researched that is compulsory for the DICT. For the remaining courses, IT181, PR109 and SE101, CICT430 is the only significant predictor among the CICT courses. This suggests that, for students who progress to the BICT, CICT410 and CICT430 are the most important courses from the perspective of preparation for further study.

However, it would be wrong to conclude that there is little value in the remaining courses and we would like to stress the need for care in interpreting results as we mentioned earlier. First, it is important to remember that a programme such as the CICT has purposes beyond the preparation of students and is an exit qualification in its own right. It is reasonable to expect that only some of the skills and knowledge developed will be for preparation for further study and that others will be targeted towards developing the graduate profile for a meaningful exit.

Moreover, we can look at such relationships in two ways. Taking, for example, CICT420 (Information and Communication Skills), we note that this is a professional practice paper which encompasses skills that are essential for everyone in the ICT profession. Thus we should ask, not just how well this prepares students for their next courses in further study, but to what extent these subsequent courses build on the skills and knowledge developed in CICT420.
5.5 CASE STUDY DISCUSSION

This case study investigated and quantified relationships between performance in courses in a level four certificate and performance in courses in two higher level programmes taken subsequently by those completing the earlier certificate. We found that two of the level four courses were strong predictors of subsequent performance, but the other two were not. These findings could be used as an input to any review of the level four CICT to evaluate if they are consistent with the aims of the programme or whether any changes to courses should be considered. Similarly, these findings should be considered by those teaching the later courses from the perspective of asking whether the courses build appropriately on the skills and knowledge established in the earlier programme.

At this point, it is worth taking stock of what has been achieved so far. After controlling statistically for student attributes, marking leniency or severity, commonalities among programs, and elapsed time effects, we have partitioned observed variance into commonalities and unique predictors. This partition has established that two CICT courses are important unique predictors of subsequent performance, whereas the remaining two are not. Any plausible theory must account for why this is so. The review discussed above will produce evidence that either supports the theory of progressive knowledge building or disconfirms it. Either outcome will contribute further to our understanding.

In the introduction, we promised to give a framework for disentangling causal relationships. A cursory review would suggest that there might be other explanations for the pattern observed here. For example, perhaps there is common content between the predictor courses and the criterion. Perhaps students have an aptitude for some topics and it is this that explains the observed relationships. It is at this point that most correlational studies conclude, suggesting that further investigation is needed. However, it is also at this point that the power of the theory-driven approach we are advocating is evident. Such alternative explanations should be expressed as theories and put to the test. For the sake of discussion, we will refer to these theories as the theory of common content and the theory of student aptitude, respectively.

We start with the theory of common content. This can be put to the test in the review we have recommended above. Such a review will either confirm the plausibility of the theory or reject it. In this case, we would expect this theory to be rejected, but the outcome does not matter for the argument we are making. Either outcome will advance our knowledge and is likely to lead to constructive change in how we organise our courses. Testing the theory of student aptitude is more subtle and will be discussed in the next section.

Broadly speaking, we would expect that, from the findings of any individual study, some theories will be rejected and others will remain plausible. This takes our knowledge forward and we have begun to disentangle the possible chains of causation.

6. DISCUSSION AND CONCLUSION

We now address the theory of student aptitude mentioned in the last section. Disentangling causation in this case requires knowledge of the specific courses concerned. As a concrete example, we will suppose that a programme has several programming courses (programming 1, programming 2, etc.) and several networking courses (networking 1, networking 2, etc.). Further, we will assume that programming 1 is a pre-requisite for networking courses. If the theory of student aptitude is correct, we would expect to see strong predictor relationships among the programming courses and among the networking courses, but a weaker relationship between programming 1 and the networking courses. If the theory of progressive knowledge building is correct, we would expect to see a stronger relationship between programming 1 and networking. This difference allows us to put the theories to the test and further disentangle the relationships.

In this paper, we have set out the argument that inference from a correlational study requires a theory-driven approach. However such theory need not be a grand theory of everything. Indeed, the theory can simply be an articulation of experience and tacit knowledge. We have set out here a theory of learning which states that learning happens by building on one’s prior experience and, in addition, that successful learning involves three major sets of factors comprising the personal attributes of the learner, the content of a course, and the context set by a teacher. Such a theory seems plausible to us and can be used as the basis for inference. Given such a theory, we can put predicted consequences to the test in a correlational study, thus either disconfirming the theory, or building confidence in its generality. The approach set out in this paper provides one way of putting such a theory to the test.

We have illustrated the approach with a case study. We believe that we have demonstrated in this case study that formal inference from a correlational study is not only possible, but may be useful. However, there are many potential threats to validity in a correlational study such as this. For instance, we make the assumption that performance is accurately captured by the assessment regime. In particular, we note that assessment is likely to be tied to specified learning outcomes and these may not capture the full range of capabilities developed in a course. Such unspecified generic capabilities are likely to relate, in the main, to commonalities between topics (or courses) and, as a consequence, commonality between topics is likely to be underestimated. Nevertheless, because of extensive moderation procedures, we believe that assessment data represent some of the highest quality data available to an educational researcher.

Timperley and Parr [22], challenged us to find ways of making use of available data to inform our teaching decisions and improve our educational performance. Most institutions have a rich source of data available in their assessment regimes but make little use of that data beyond assessment purposes. We have set out a framework in which those data can be used to analyse prerequisite relationships and thus lead to changes which will enhance the student learning experience. Using such naturally occurring data inevitably leads to a correlational approach. Making formal inferences from correlational studies poses significant challenges and requires careful interpretation. However, we believe that the challenges posed by inference from correlational studies should not be used as an excuse for inaction. Accordingly, we advocate wider use of such assessment data in educational research.

7. REFERENCES

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Staff and student perceptions of NZQA level expectations

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ABSTRACT
In this cross-sectional study, we surveyed 89 students from four courses to elicit their expectations of the nature of the skills and knowledge, and the degree of self-management and collaboration, which was required for their courses. We compared their responses to the expectations set out in the New Zealand Qualifications Framework. We also sampled a small number (6) of lecturers and compared their expectations to those of students and the framework. We found significant differences between student and framework expectations, with student expectations noticeably lower than the framework. Moreover, student expectations remained at a low level, even in higher level courses, and the gap was wider at the higher levels. We also found significant differences between student and lecturer expectations. Lecturer expectations were broadly between those of students and the framework, which suggests that lecturer expectations are a compromise between both of these. Any misalignment of expectations poses a challenge for educators. We suggest practical measures for aligning these expectations.

Categories and Subject Descriptors
K.3.2 [Computer and Information Science Education]

General Terms
Human Factors

Keywords
Student expectations, lecturer expectations, accreditation expectations.

1. INTRODUCTION
The premise underpinning this study is that learning happens best when there is a close alignment between the expectations of students, educators and other stakeholders. In New Zealand, accreditation of University courses is overseen by the Academic Quality Agency (AQA). Courses from all other providers come under the auspices of the New Zealand Qualifications Authority (NZQA) Zealand [15]. The NZQA publishes the New Zealand Qualifications Framework (NZQF), which is a comprehensive list of all quality assured qualifications in New Zealand. Similar frameworks exist in Australia [1] and the UK [21].

The New Zealand framework is organized into ten levels. Broadly speaking, levels one to three map to school years. For example, New Zealand’s National Certificates of Educational Achievement (NCEA) are national qualifications for secondary school students at levels one to three. Levels four to ten typically relate to post-secondary qualifications. Levels four to six are usually certificates and diplomas, although it is also possible to have these at all levels from one to eight. Undergraduate degrees are at level seven. Post-graduate certificates and diplomas are at level eight, master’s degrees are at level nine, and doctoral degrees are at level ten.

For each of the levels, the framework sets out clear expectations of the nature of skills, knowledge, student self-management, and how a student should interact with others. Given the central role of the framework in accreditation, one might expect to find a close alignment between the expectations of NZQA, and those of educators and students. However, we had reason to believe some differences might be found. For example, Nunn and colleagues investigated student perceptions of desirable graduate characteristics [16] and found considerable differences from academic and employer perceptions. Consequently, it seemed reasonable to expect that we too might find some differences.

Any misalignment poses a challenge for educators. With the ongoing consumerisation of education, students are seen more and more as consumers of a service [14] – as customers. Somehow, educators need to achieve the stated educational goals while also meeting student expectations. This study aims to answer the underlying question: How closely aligned are the expectations of students, lecturers and the NZQA?

The remainder of this paper is organized as follows. Section two discusses related work in the literature. Section three describes our approach to the study and methodology. Section four presents our findings. Section five discusses the implications of the findings for teaching. Finally section six discusses the limitations of the approach and identifies areas where further work is required.

2. RELATED WORK
In the literature, a number of researchers have used external frameworks to analyse courses. In computing, several researchers have investigated the mapping of courses to Bloom’s taxonomy [3]. Bloom’s taxonomy is widely used in educational contexts to give an approximate indication of the cognitive depth needed for a task. Sanders and Mueller argued [19] that courses in the early stages of a degree should be targeted at the lower Bloom’s levels, whereas later courses should be targeted at the higher levels. Lister used the taxonomy to formulate course objectives for a sequence of programming courses [9]. Howard and colleagues carried out a lesson-by-lesson analysis of depth in a CS2 course [7]. Oliver and colleagues carried out a lecturer evaluation [17] of the cognitive difficulty of a number of computing courses. Most of this work is grounded in the programming area and underpinning most of this work is the assumption that in teaching programming “we have traditionally focused on the higher levels of the taxonomy and ignored the lower levels” [10].
Another widely used framework is the SOLO taxonomy [2]. In particular, SOLO has been used to map the cognitive complexity in programming. For example, Brabrand and Dahl [4,5] used SOLO to analyse over 5000 intended learning outcomes, comparing those in in Computer Science to those in Mathematics and natural science. Thompson [22] used SOLO to develop assessment criteria for programming assignments. Sheard and colleagues [20] used SOLO to explore the programming knowledge of novices. Lister and associates [11] used SOLO to describe differences in the way students and educators solve small code reading exercises. Whalley and colleagues [24] used SOLO and Bloom’s taxonomies to develop a question set for novice programmers. There are other less widely used taxonomies. For example, Fuller and associates carried out a literature review of the use of Bloom’s and SOLO taxonomies and proposed a two-dimensional matrix taxonomy [6].

Both SOLO and Bloom’s taxonomies have been widely used as a conceptual framework to analyse cognitive complexity in computer science. However, all of the studies cited represent an educator’s perspective, rather than that of a student.

To elicit a student perspective, we have to turn to the general tertiary education literature. However, research on student expectations is still sparse within this literature. Lowden and colleagues [12] investigated employer perceptions of the employability of new graduates and Weligamage and Sienthai [23] compared student and employer perceptions. Round [18] investigated broad student expectations of University in the context of understanding and enhancing student retention.

Other than these few examples, we found that, overall, student and lecturer expectations of course levels remain underexplored in the tertiary education literature. The framework descriptors seem to be used for communication between providers and the accreditation authority rather than with students. Indeed Kemmis and associates note:

Student expectations and the broader set of expectations that flavour VET and HE are often quite different and are often implicitly embedded in subjects and courses. The process of making these differences explicit is left to the student making the transition. [8]

We believe that it is important that expectations are shared between students and educators, and not just be left to the student. Our study aims to identify the extent to which student and lecturer expectations are aligned to each other and the level descriptors.

3. METHOD
In this cross sectional study, we used an anonymous questionnaire to survey lecturers and students. Lecturers were supplied with participant information sheets and paper questionnaires and were invited by email to participate. Students were recruited in selected classes (convenience) sample with permission of the lecturers of those classes. They also were supplied with participant information sheets and paper questionnaires. Participation in both cases was voluntary.

3.1 Instrument
We used a custom questionnaire for the survey. In the questionnaire, we used four questions to investigate characteristics of the levels relating to self-management, working in groups, skills and knowledge. We took the wording for the questions from the level descriptors in the NZQA accreditation document [15]. To align our questions with the wording used in the NZQA document, we prefaced each student question with the stem: In this course, it is reasonable to expect that a student will ... For the lecturer questions, we asked lecturers to answer the question for a number of programmes and levels and used the stem: For a course in this program/level, it is reasonable to expect a student to: ...

We then presented the participant with a list of the exact wording used to characterise the levels in the NZQA document and asked the participants to indicate which they felt was closest.

As an example, Question 2 in the student questionnaire is shown in Figure 1:

For this course, it is reasonable to expect that a student will:
- Not interact with others – students should work independently.
- Interact with others
- Collaborate with others
- Contribute to group performance and adapt own behaviour when interacting with others
- ... and so on

Figure 1: Question 2 in Student questionnaire

Note that, for completeness, we added the first of these options (not interact with others) as a notional level zero. The framework starts with level 1 (interact with others).

3.2 Sample
The questionnaire was administered to 89 students and six lecturers. All lecturers in the authors’ department were invited to participate. Of 32 possible lecturers, six (19%) chose to participate. The student sample was a convenience sample in which students in four courses were invited to participate. Of 107 possible students, 89 (83%) chose to participate. The sample characteristics are shown in Table 1.

<table>
<thead>
<tr>
<th>Level</th>
<th>N</th>
<th>Response rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>22</td>
<td>96%</td>
</tr>
<tr>
<td>6</td>
<td>52</td>
<td>78%</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>88%</td>
</tr>
<tr>
<td>All</td>
<td>89</td>
<td>83%</td>
</tr>
<tr>
<td>All lecturers</td>
<td>6</td>
<td>19%</td>
</tr>
</tbody>
</table>

Because of the low number of lecturer participants, it is unlikely that the views captured are fully representative of the department. Nevertheless, we were pleasantly surprised that, despite the low numbers, effect sizes were large enough that statistically significant results were found in many cases.

3.3 Analysis
For descriptive statistics, we use the mode and mean. For statistical inference, we were interested in the question: how likely are these data if we are sampling randomly from a population with a mean of the expected NZQF level? Thus, our data are slightly unusual inasmuch as the population mean is known a-priori. The variance however is still estimated from the sample. To accommodate this, when comparing to the framework levels, we base inference on the standard error of the mean (SEM) and use a z-test for inference rather than the popular t-test. We used t-
tests to compare student and lecturer expectations since the means of both of these were estimated from the sample.

4. RESULTS

Expectations are clearly defined by the qualifications framework. Consequently, one might expect the expectations of students and lecturers to be closely aligned with the framework and, thus, that the expected level description from the framework would be chosen in most cases. However, this was not the case. We begin this section with student expectations and then present lecturer expectations. Table 2 shows, by level and question, the proportion of students who chose the expected level according to the framework.

Table 2: Proportion choosing the expected NQF level

<table>
<thead>
<tr>
<th>Level</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>41%</td>
<td>5%</td>
<td>9%</td>
<td>9%</td>
<td>16%</td>
</tr>
<tr>
<td>6</td>
<td>2%</td>
<td>0%</td>
<td>8%</td>
<td>21%</td>
<td>8%</td>
</tr>
<tr>
<td>7</td>
<td>0%</td>
<td>7%</td>
<td>7%</td>
<td>13%</td>
<td>7%</td>
</tr>
<tr>
<td>Overall</td>
<td>11%</td>
<td>2%</td>
<td>8%</td>
<td>17%</td>
<td>10%</td>
</tr>
</tbody>
</table>

As can be seen, only 10% of the overall student choices were at the expected level, and a strong preference for the expected level is only visible for question one among the level four cohort of students. The most prevalent choices made (i.e. the mode) are shown in Table 3.

Table 3: Modal level chosen

<table>
<thead>
<tr>
<th>Level</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

However, none of these modal choices represented the majority of students in the cohort. The implications for teaching of the lack of dominant modal expectations are discussed in section 5.

To give a view of the progression of students’ level expectations as they continue with their study, we present the mean expectation level across all questions (Table 4).

Table 4: Mean expectation by level across all questions

<table>
<thead>
<tr>
<th>Level</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3.4</td>
<td>0.20</td>
<td>.001</td>
</tr>
<tr>
<td>6</td>
<td>3.7</td>
<td>0.09</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>7</td>
<td>3.5</td>
<td>0.20</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Combined</td>
<td>3.6</td>
<td>0.12</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

As can be seen, students’ expectations were significantly below NZQA expectations at all levels sampled. Moreover, the mean expectation of each higher level cohort was also significantly below level 4 and there was no significant increase in expectations at the higher levels. Although the means of the level six and seven cohorts were slightly higher than the level four cohort, the difference was within the range expected from sampling variation. Overall, the mean expectation was 3.6. Thus, the mean expectations of these students can be characterised as between level three and level four, regardless of the level of the courses studied.

The overall findings for lecturers are presented in Table 5. All lecturer expectations were also significantly below those of the NZQF at all levels. However, there is a clear increasing trend and the gap between lecturer and NZQF expectations narrows at the higher levels.

Table 5: Mean Lecturer Expectation by Level

<table>
<thead>
<tr>
<th>Level</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2.5</td>
<td>0.48</td>
<td>.002</td>
</tr>
<tr>
<td>5</td>
<td>3.5</td>
<td>0.39</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>6</td>
<td>4.5</td>
<td>0.46</td>
<td>.001</td>
</tr>
<tr>
<td>7</td>
<td>6.3</td>
<td>0.31</td>
<td>.028</td>
</tr>
<tr>
<td>8</td>
<td>7.3</td>
<td>0.32</td>
<td>.020</td>
</tr>
</tbody>
</table>

Note: Sig is the probability of observing a mean this low in a random sample drawn from a population with the expected mean.

The next four sections present an analysis of the responses to the individual questions.

4.1 Question 1: Self-management

This question asked about the degree of self-management that a student could be expected to show. Table 6 shows the mean level of student expectation by cohort.

Table 6: Mean student expectations of self-management

<table>
<thead>
<tr>
<th>Level</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3.6</td>
<td>0.31</td>
<td>n.s.</td>
</tr>
<tr>
<td>6</td>
<td>3.2</td>
<td>0.14</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>7</td>
<td>3.1</td>
<td>0.31</td>
<td>.002</td>
</tr>
</tbody>
</table>

Note: Sig is the probability of observing a mean this low in a random sample drawn from a population with the expected mean.

As can be seen, the mean expectation at level four is consistent with the framework expectation. However, expectations at levels six and seven are not only below those of the framework, but are also significantly below level four expectations. Moreover, there is an apparent fall in student expectations as they progress through the levels with their study. Overall, the mean student expectation can be characterised as between level three (requiring major responsibility for own learning and performance) and level four (self-management of learning and performance under broad guidance).

Lecturer expectations of self-management are shown in Table 7.

Table 7: Mean lecturer expectations of self-management

<table>
<thead>
<tr>
<th>Level</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2.0</td>
<td>0.58</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>5</td>
<td>3.1</td>
<td>0.43</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>6</td>
<td>4.3</td>
<td>0.37</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>7</td>
<td>5.3</td>
<td>0.24</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>8</td>
<td>6.0</td>
<td>1.0</td>
<td>.046</td>
</tr>
</tbody>
</table>

Note: Sig is the probability of observing a mean this low in a random sample drawn from a population with mean of the expected level.

From this table, it can be seen that lecturer expectations are significantly below the NZQF framework expectations at all levels. However, there is a clear increasing pattern of expectations and the data suggest that lecturer expectations are lower than those of students at level four, but higher at levels six and seven.
Individual t-tests confirm these differences between student and lecturer expectations. At level four, the mean lecturers’ expectation of 2.0 is significantly lower than the student expectation of 3.6 (p=.041). At level six, the mean lecturers’ expectation of 4.3 is significantly higher than the mean of 3.2 for students (p=.022). At level seven, the mean lecturer expectation of 5.3 was significantly higher than the mean of 3.1 for students (p=.003).

### 4.2 Question 2: Collaboration

This question related to the degree to which a student could be expected to collaborate with others. Table 8 shows the mean level of student expectation of collaboration by cohort.

<table>
<thead>
<tr>
<th>Level</th>
<th>Mean</th>
<th>Std. Err</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3.1</td>
<td>0.38</td>
<td>.018</td>
</tr>
<tr>
<td>6</td>
<td>2.8</td>
<td>0.15</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>7</td>
<td>2.6</td>
<td>0.39</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Table 8: Mean student expectations of collaboration

As can be seen, the mean expectation at all levels is significantly below the framework expectation. Moreover, expectations at levels six and seven are not only below those of the framework, but are also significantly below level four expectations. There is a clear falling pattern of expectations as students carry on with their study to higher levels. Overall, mean student expectations can be characterised as between level two (collaborate with others) and level three (contribute to group performance and adapt own behaviour when interacting with others). The expectation is significantly below level four (demonstrate some responsibility for the performance of others) at all levels, even at levels six and seven.

Lecturer expectations of collaboration are shown in Table 9.

<table>
<thead>
<tr>
<th>Level</th>
<th>Mean</th>
<th>Std. Err</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2.7</td>
<td>0.49</td>
<td>.007</td>
</tr>
<tr>
<td>5</td>
<td>3.3</td>
<td>0.41</td>
<td>.001</td>
</tr>
<tr>
<td>6</td>
<td>4.0</td>
<td>0.46</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>7</td>
<td>5.0</td>
<td>0.58</td>
<td>.001</td>
</tr>
<tr>
<td>8</td>
<td>5.7</td>
<td>0.33</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Table 9: Mean lecturer expectations of collaboration

As can be seen, the mean expectation is significantly below the framework expectation at all levels. There is a clear rising pattern across the levels, although the low rate of increase means that the gap between lecturer and framework expectations increases at the higher levels.

There are also differences between student and lecturer expectations. At level four, the mean lecturer expectation is not significantly different from that of students. At level six, the mean lecturer expectation of 4.0 is significantly higher than the mean of 2.8 for students (p= 0.036). At level seven, the mean lecturer expectation of 5.0 is significantly higher than the mean of 2.6 for students (p=.032). Overall, the gap between student expectations and lecturer expectations increases at the higher levels.

### 4.3 Question 3: Knowledge

Question three asked about the nature of knowledge. Table 10 shows the mean expectations of students by level. It can be seen that mean student expectations are significantly below the framework at all levels.

<table>
<thead>
<tr>
<th>Level</th>
<th>Mean</th>
<th>Std. Err</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2.8</td>
<td>0.46</td>
<td>.008</td>
</tr>
<tr>
<td>6</td>
<td>3.8</td>
<td>0.28</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>7</td>
<td>3.7</td>
<td>0.58</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Table 10: Student expectations of knowledge by level

Overall, the mean expectation can be characterised as between level 3 (some operational and theoretical knowledge in a field of work or study) and level 4 (broad operational and theoretical knowledge in a field of work or study). In particular, we note that both level six and level seven student samples had mean expectations well below the NQF expectation for level 6 (specialised technical or theoretical knowledge with depth in a field of work or study). Lecturer expectations of knowledge are shown in Table 11.

<table>
<thead>
<tr>
<th>Level</th>
<th>Mean</th>
<th>Std. Err</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2.7</td>
<td>0.67</td>
<td>.046</td>
</tr>
<tr>
<td>5</td>
<td>4.1</td>
<td>0.46</td>
<td>n. s. (.050)</td>
</tr>
<tr>
<td>6</td>
<td>5.2</td>
<td>0.52</td>
<td>n. s. (.136)</td>
</tr>
<tr>
<td>7</td>
<td>4.8</td>
<td>1.88</td>
<td>n. s. (.250)</td>
</tr>
<tr>
<td>8</td>
<td>5.5</td>
<td>2.14</td>
<td>n. s. (.242)</td>
</tr>
</tbody>
</table>

Table 11: Mean lecturer expectations of knowledge

As can be seen, the mean expectation is significantly below the framework expectation at levels four. It is also lower at the higher levels, but is within sampling error limits due to the large standard error associated with a small sample.

### 4.4 Question 4: Skills

The fourth question was about the nature of skills. Table 12 shows the mean student expectation by level.

<table>
<thead>
<tr>
<th>Level</th>
<th>Mean</th>
<th>Std. Err</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3.9</td>
<td>0.46</td>
<td>n.s.</td>
</tr>
<tr>
<td>6</td>
<td>4.6</td>
<td>0.25</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>7</td>
<td>4.9</td>
<td>0.43</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Table 12: Mean student expectations of skills demonstrated

As can be seen, the mean expectation is significantly below the framework expectation at levels four. It is also lower at the higher levels, but is within sampling error limits due to the large standard error associated with a small sample.
problems). In particular, we note that, the mean expectations at levels six and seven were both significantly below the framework expectation at level six (analyse and generate solutions to familiar and unfamiliar problems).

Mean lecturer expectations of skills are shown in Table 13.

**Table 13: Mean Lecturer Expectations of Skills**

<table>
<thead>
<tr>
<th>Level</th>
<th>Mean</th>
<th>Std. Err</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1.9</td>
<td>0.49</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>5</td>
<td>3.7</td>
<td>0.42</td>
<td>.002</td>
</tr>
<tr>
<td>6</td>
<td>5.0</td>
<td>0.44</td>
<td>.023</td>
</tr>
<tr>
<td>7</td>
<td>4.5</td>
<td>1.75</td>
<td>n. s. (.154)</td>
</tr>
<tr>
<td>8</td>
<td>5.3</td>
<td>2.09</td>
<td>n. s. (.202)</td>
</tr>
</tbody>
</table>

Note: Sig is the probability of observing a mean this low in a random sample drawn from a population with the expected mean.

As can be seen, the mean expectation is significantly below the framework expectation at levels four to six. It is also lower at the higher levels, but is within sampling error limits due to the large standard error associated with a small sample.

**4.5 Comparing Lecturers to Students**

The results presented in the previous sections suggest that lecturer’s expectations, although below the framework levels, rise more rapidly than students’ expectations. To give a clearer picture of this, Figure 2 shows the overall mean expectations of students and lecturers, compared to the framework levels.

![Figure 2: Comparison of Student and Lecturer Expectations](image)

From this figure, it can be seen that overall student expectations remain relatively stable at between three and four across all cohorts. Conversely, lecturer expectations, although starting somewhat lower at 2.5, increase steadily across the levels, getting closer to, but not reaching, the framework expectations at the higher levels.

**4.6 Comparing Degree to Diploma Courses**

The framework expectations for any level do not vary across programmes. However, curiously, we found that lecturers’ expectations of diploma courses were significantly lower than their expectations for degree courses of the same level. Table 14 shows lecturer expectation by programme and level.

**Table 14: Lecturer expectations by programme/level**

<table>
<thead>
<tr>
<th>Level</th>
<th>Programme</th>
<th>Mean</th>
<th>Std. Err</th>
<th>CI-L</th>
<th>CI-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Diploma</td>
<td>3.05</td>
<td>0.10</td>
<td>2.85</td>
<td>3.24</td>
</tr>
<tr>
<td></td>
<td>Degree</td>
<td>3.78</td>
<td>0.06</td>
<td>3.66</td>
<td>3.90</td>
</tr>
<tr>
<td>6</td>
<td>Diploma</td>
<td>3.99</td>
<td>0.10</td>
<td>3.80</td>
<td>4.18</td>
</tr>
<tr>
<td></td>
<td>Degree</td>
<td>5.03</td>
<td>0.05</td>
<td>4.92</td>
<td>5.14</td>
</tr>
</tbody>
</table>

Note: CI-L is the lower bound of a 95% confidence interval; CI-H is the corresponding upper bound.

In this table, the confidence intervals for the expectations in each programme in a level do not overlap and thus there is a clear difference in expectations by programme. On average, diploma courses were rated lower than degree courses by 0.89 of a level. In this dataset, we did not have the necessary data to determine whether this also held for students.

**5. DISCUSSION**

In this section, we discuss the implications of our findings for teaching. First, as shown in Table 2, very few students chose the category expected by the framework. Moreover, in no case did the modal category represent the majority of students (Table 3). This poses a challenge for lecturers because there is no simple solution to the problem of what level to target for student activities.

Second, we note that student expectations remain broadly stable between levels three and four across all cohorts. This suggests that students do not expect the nature of skills, knowledge, self-management and group work to change as they progress through the levels. To improve alignment, educators should consider carefully the nature of coursework and learning activities to ensure that these are closely aligned with the framework. It is especially important to consider feedback mechanisms such as assessment in this regard.

Third, we note (see Figure 1) that, apart from starting somewhat lower at level four, lecturer expectations progress steadily through the levels. Broadly, they are between framework and student expectations at the higher levels. This pattern can be readily understood in the context of extant feedback mechanisms to lecturers. In these days of the consumerisation of education [14], most institutions use student surveys to evaluate the quality of teaching. This feedback mechanism will tend to bias lecturer expectations towards those of the student cohort if this is away from the framework. Such feedback mechanisms are unlikely to change in the near future, so educators should consider fostering appropriate student-educator conversations to improve alignment.

Fourth, we note that the pattern of students' expectations for self-management is low at level four and falls progressively at the higher levels. At level seven, it was significantly below the framework objective at level four: “self-management of learning and performance under broad guidance”. In this context, we note that the Ministry of Education states:

Given the significant investment the Government makes in students both through tuition subsidies and student support, students are expected to take responsibility for their own performance. [13]

Changing student expectations of self-management is likely to require the whole teaching team to take a consistent approach and actively promote expectations of self-management and the associated benefits to students. Some practical measures could be wider use of self and peer assessment and involving students in...
setting appropriate framework-related learning activities and assessment criteria.

Fifth, as with self-management, students’ expectations of collaboration show a low and falling pattern across the levels with expectations of the level seven cohort below level three. It is interesting to note the objective at level four: “demonstrate some responsibility for the performance of others”. From our own teaching experience, it seems likely that students reject the validity of this, even though employers place a high value on working effectively in a team. This suggests that one way of modifying these expectations would be to expose students more to the values articulated by employers.

Sixth, although there is some evidence of an increasing trend, students’ expectations of the nature of knowledge are low and remain below level four, even for the students in the cohort at level seven. At level four, the expectation is: “broad operational and theoretical knowledge in a field of work or study”. In contrast, the expectation at level seven is “specialised technical or theoretical knowledge with depth in one or more fields of work or study”. From our own experience, we believe that students are too ready to carry out an internet search and copy and paste findings, considering this acceptable as knowledge. Activities that may be useful to effect change include requiring paraphrasing and summarising of material found, essay-type activities with compare and contrast, and embedding taxonomies such as SOLO [2] into assessment rubrics. However, changing students’ expectations of the nature of knowledge will require a substantial “whole of team” approach.

Seventh, in contrast to the foregoing areas, students’ expectations of skills demonstrated appropriate expectations at level four and an increasing pattern at higher levels. However, these expectations were still below the framework expectations. Remedying this would require greater use in course work of unfamiliar and complex problems, and some unpredictable problems.

Overall, we believe that a concerted “whole of team” approach should be taken to align student expectations, and thus indirectly lecturer expectations, with those articulated in the framework. One way of achieving this would be to include a perspective of framework levels into regular course reviews. Learning activities, and especially assessed activities, should be mapped to framework levels to ensure alignment. It will be important to carry this out progressively, starting from lower levels, so that a student is presented with a coherent evolution of expectations as they progress with their study through the levels.

6. CONCLUSION
This study aimed to investigate the alignment of the expectations of students, lecturers and the NZQA. We carried out a small scale survey using an anonymous questionnaire to determine these expectations. We have presented our findings above. We summarise these findings in section 6.1 and then discuss threats to validity in section 6.2 and discuss our plans for further work in section 6.3.

6.1 Main findings
Overall, we found that students’ expectations were significantly below the expectations set out in the qualifications framework. Moreover, they did not increase significantly as students progressed with their study to higher levels. Lecturer expectations were also below framework expectations, but exhibited an increasing pattern across the levels. Since lecturer expectations are necessarily a compromise between framework and student expectations, we believe that addressing the misalignment between student and framework expectations will indirectly result in a better alignment of lecturer expectations to the framework.

6.2 Threats to Validity
Although the lecturer sample size is sufficient to indicate that in many cases, there is a systematic difference between lecturer expectations and that of the framework, the sample size is too small to be considered fully representative of lecturer views. Furthermore, the resulting confidence intervals are too large to give a good estimate of mean lecturer expectations.

The student sample size is adequate for our purposes, but there are still two related issues. First, the sample was a convenience sample, which raises concerns about generalisation of the findings. Second, our sample did not include any students from level five courses. Including these students in our sample would enable a clearer picture to emerge of how student expectations develop.

6.3 Further work
We plan to extend this study with further cohorts of students, including, in particular, students in level 5 courses. We will also carry out a more systematic sampling of students. We also aim to solicit additional lecturer expectations to help get a more representative sample of the lecturer perspective. If the findings suggested from this study are replicated, we would like to develop an action research framework to address the misalignment and monitor the effect of any initiatives.

7. REFERENCES


11 Lister, R, Simon, B, Thompson, E, Whalley, J, and Prasad, C. Not seeing the forest for the trees: novice programmers and the SOLO taxonomy. In *Proceedings of the 11th annual SIGCSE conference on Innovation and technology in computer science education (ITiCSE ’06)* (Bologna, Italy 2006).


Students’ perceptions of work quality in a cooperative learning environment

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ABSTRACT
This study investigates students’ perceptions of their own work and that of others, and how these change as students work cooperatively in small groups in an active learning environment. We incorporated formal feedback into a learning cycle in which students researched topics and presented their findings to peers in small groups. We then used custom computer software to capture this feedback and students’ perceptions of the work and record these in a database. We then analysed these data to investigate students’ perception of the quality of the work, its usefulness, and the extent to which they trusted the accuracy of its findings. We found that student self-assessment and peer assessment were similar and both were relatively lenient compared to a tutor assessment. However, students with higher achievement were more severe in their self-assessment than those at lower achievement levels. We also found that perceptions did not change as the course progressed. This last finding was surprising and suggests that the students were not reflecting on the feedback they received and then acting on it to modify their approach to future researches.

Categories and Subject Descriptors
K.3.2 [Computer and Information Science Education]

General Terms
Human Factors

Keywords
Group work, collaborative learning, cooperative learning, self-assessment, peer assessment, EDSD.

1. INTRODUCTION
With an active learning approach, rather than conceptualising learning as the transmission of knowledge from expert to novice, students are actively engaged in the process of discovering and interpreting knowledge. In a collaborative learning environment, students can work in small groups to research topics and share their findings [22]. However, some students may doubt whether they can trust the findings of other students.

This study investigates students’ perceptions of their own work and that of others, and how these change as students work cooperatively in small groups in an active learning environment. We predicted that we would see some changes as students became familiar with the learning approach and continued to work week by week with the others in their group.

Feedback is central to learning [18] and we embedded feedback into the learning cycle of our course. In the learning cycle, students researched topics and presented their findings to their peers in small groups. After each presentation students were asked to self-evaluate their presentation and the others in the group were asked to carry out a peer evaluation. We used custom computer software to capture this feedback and students’ perceptions of the work.

Our main research questions were:
• How much do students trust other students’ research?
• How useful do they find such research?
• What is their evaluation of the quality of the work?

We were also interested in how these changed over the week as the students gained familiarity with this way of working. We expected to find a complex pattern of student perceptions across the time-series in which, at the early stages, students would rate each other’s work highly without regard to the nature of the work. As students gained confidence, we predicted that more realistic judgements would prevail with a consequent fall in the level of ratings. We also believed that the ratings would then rise slowly as students gained confidence in the approach and took on board the feedback they received. Both of these matter because they relate to professional judgement and learning. First, self-assessment and peer assessment lay a solid foundation for building good judgement of the quality of work which is essential in most professions [5,6,7]. Second, reacting effectively to feedback is the most powerful predictor of learning [17].

The remainder of this paper is organised as follows. We review related work in section two. We discuss our research approach and method in section three. We present our findings in section four and discuss implications for teaching in section five. Finally we present our conclusions in section six.

2. RELATED WORK
In an educational context, collaboration is defined as an approach involving joint intellectual efforts between students, or between students and instructors [25]. Collaborative learning in small groups is reported to promote deep learning [10] and develop communication skills [14]. Cooperative learning tasks in which students help others to learn by explaining topics to each other have been correlated with academic achievement [13]. Girard and colleagues [15] investigated the perception of students from two universities towards class presentation and concluded that 80 percent of students perceived the presentations as beneficial to their learning. Liu and Carless [21] investigated the role of peer
feedback in the learning process and suggested that it develops critical judgment and listening skills and promotes learning through meta-processes such as reflection.

Computer professionals are often required to apply critical judgment in solving their problems. This requires that professionals learn continuously as they work. Very often learning is informal from their peers. To prepare them for their professional practice, our students should have the opportunity to use and practise collaborative learning early [19,23]. The ability to learn collaboratively, and to reflect and improve collaborative learning should be fostered during their study. Girard, Pinar, and Trapp investigated hiring criteria and suggested that the most important criteria for many professionals were communication skill, speaking ability and writing skill [15].

Many authors have investigated collaborative learning. Stump and colleagues [27], Kalonji [20], and Dana [11] stated that traditional education methods such as lectures, laboratories and homework were inadequate as preparation of students for the collaborative partnership expected of practising professionals. Dana also reported that the benefits of collaborative learning, as compared to traditional, include: higher student achievement and greater use of higher level of reasoning and critical thinking skills, as well as better interpersonal relationship among students and instructor. Stane and associates [26] reported that cooperation promotes higher motor skills performance than individual efforts or competition. Hattie [16] confirmed these findings in his meta-analysis of 800 cases for cooperative learning across the curriculum.

Girard et al [15] suggested that student presentations, as part of collaborative learning, were good contributors to improvement of student’s communications skill as well as their listening skills and the ability to identify the key elements of the presentations. He suggested that to engage the non-presenting students actively they should use peer evaluation. These findings confirmed findings by Boud [4] and Falchikov and Goldfinch [12] that peer assessment promotes active learning by engaging students.

Slavin [24] recommended that cooperative learning should play a central role in 21st century and asserted that it is easy and inexpensive to implement. Timperley and Parr [28] recommend the use of formal evidence to evaluate educational practice.

3. METHOD

This is an observational study that captured students’ perceptions of work quality in a time-series over a five week period in a course that used an active approach to learning in a collaborative learning environment. All students engaged in this learning approach, but participation in this research was voluntary and not all students participated. We describe the sample in section 3.1, our research instrument in section 3.2, and our approach to analysis in section 3.3.

3.1 Sample

The context of our study was a level seven course on testing and quality assurance in a three year undergraduate computing degree. There were 37 students in the course. All students in the course were invited to participate in our study. Each participant was given a participation information sheet and signed a consent form to indicate that they were willing to participate. 30 students (81%) chose to participate. Our data were taken from five consecutive weeks of the course from week two to week six. Because this was a convenience sample, we caution that it may not be possible to generalise our findings to other contexts.

3.2 Instrument

We used custom software to collect and manage feedback on the students’ presentations. After each presentation, those listening to the presentation were asked to give feedback to the presenter. The presenter was also asked to self-evaluate their presentation.

There were two broad qualitative questions. The first was: *What did you like best about the presentation?* The second was: *How could the research or presentation be improved?* The response format for these was open ended text.

Participants were also asked three quantitative questions: The first question was: *How confident are you in the facts presented?* Possible response categories were: not at all confident, little confidence, somewhat confident, mostly confident, and highly confident. The second question was: *How useful was the information presented?* Possible response categories were: not at all useful, not much use, somewhat useful, mostly useful, and very useful. The third question was: *How do you think a tutor would classify this work with SOLO?* Possible response categories were: pre-structural, unistructural, multi-structural, relational, and abstract. In this course, all marking rubrics were structured according to the SOLO (Structure of the Observed Learning Outcome) taxonomy [3]. Thus, we used SOLO as a measure of work quality.

All responses were stored in a database for subsequent analysis.

3.3 Approach to Analysis

Detailed analysis of the qualitative data is out of the scope of this paper. However, some indicative examples of the feedback is given in section 4.4. For this study, we were mainly interested in the quantitative data on perceived confidence, usefulness and SOLO rating. For consistency of reporting, we standardised each response to a percentage, with 0% representing responses in the lowest category and 100% responses in the highest category. To get an overview of responses, we used the mean and calculated the standard error of the mean (SEM). All analysis was carried out with Excel. We used Excel’s t-test to compare means.

4. RESULTS

Because the data were validated by the computer software at point of data entry, there were no invalid ratings. There were, however, some missing data. Not all students submitted all the requested ratings. Although all of the 30 participating students submitted at least some peer evaluations, only 22 submitted any self-evaluation. There is thus the possibility of a systematic bias in the results. In total, there were 826 usable ratings, representing approximately 62% of the potential maximum. We begin our analysis with the week by week variation of the ratings.

4.1 Overall ratings

The mean confidence ratings for each week are shown in Table 1.

<table>
<thead>
<tr>
<th>Week</th>
<th>Mean</th>
<th>SEM</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>77%</td>
<td>1.9%</td>
<td>62</td>
</tr>
<tr>
<td>2</td>
<td>79%</td>
<td>2.3%</td>
<td>64</td>
</tr>
<tr>
<td>3</td>
<td>78%</td>
<td>2.1%</td>
<td>71</td>
</tr>
<tr>
<td>4</td>
<td>78%</td>
<td>1.7%</td>
<td>62</td>
</tr>
<tr>
<td>5</td>
<td>82%</td>
<td>3.6%</td>
<td>17</td>
</tr>
<tr>
<td>Overall</td>
<td>78%</td>
<td>0.97%</td>
<td>275</td>
</tr>
</tbody>
</table>

Table 1: Mean confidence ratings by week
In this table, N is the number of ratings, and SEM the standard error of the mean. The overall mean level of 78% corresponds to the response category “Mostly confident”. As can been seen from the table, the confidence intervals of each week include this value. This is confirmed by appropriate t-tests. We conclude that there was no significant change in average rating across these weeks. The mean usefulness ratings for each week are shown in Table 2.

Table 2: Mean usefulness ratings by week

<table>
<thead>
<tr>
<th>Week</th>
<th>Mean</th>
<th>SEM</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>74%</td>
<td>2.5%</td>
<td>62</td>
</tr>
<tr>
<td>2</td>
<td>74%</td>
<td>2.2%</td>
<td>64</td>
</tr>
<tr>
<td>3</td>
<td>73%</td>
<td>2.3%</td>
<td>71</td>
</tr>
<tr>
<td>4</td>
<td>76%</td>
<td>1.8%</td>
<td>62</td>
</tr>
<tr>
<td>5</td>
<td>78%</td>
<td>4.5%</td>
<td>6</td>
</tr>
<tr>
<td>Overall</td>
<td>74%</td>
<td>1.1%</td>
<td>275</td>
</tr>
</tbody>
</table>

The mean level of 74% corresponds to the response category “Mostly useful”. As with the previous question, the confidence intervals of each week include this value. This is confirmed by appropriate t-tests. We conclude that there was no significant change in average rating across these weeks. The mean SOLO ratings for each week are shown in Table 3.

Table 3: Mean SOLO rating by week

<table>
<thead>
<tr>
<th>Week</th>
<th>Mean</th>
<th>SEM</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>74%</td>
<td>1.9%</td>
<td>63</td>
</tr>
<tr>
<td>2</td>
<td>73%</td>
<td>2.1%</td>
<td>64</td>
</tr>
<tr>
<td>3</td>
<td>72%</td>
<td>1.9%</td>
<td>71</td>
</tr>
<tr>
<td>4</td>
<td>69%</td>
<td>1.9%</td>
<td>62</td>
</tr>
<tr>
<td>5</td>
<td>73%</td>
<td>2.9%</td>
<td>17</td>
</tr>
<tr>
<td>Overall</td>
<td>72%</td>
<td>1.0%</td>
<td>276</td>
</tr>
</tbody>
</table>

The overall mean rating of 72% corresponds to a classification between “Multi-structural” and “Relational”. As previous two questions, the confidence intervals of each week include this values and this is confirmed by appropriate t-tests. We conclude that there was no significant change in average rating across these weeks.

A combined plot of all three of these ratings is shown in Figure 1.

Figure 1: Variation of ratings by week

It can be seen that there is little variation from week to week in the ratings, nor any clear trend. This confirms the results of the statistical tests that there is no significant change from week to week. It should be noted that there were relatively few ratings in the last week and thus there is a larger margin of error for this week. Consequently, the slight visible rise in week 5 is probably just expected sample variation. However, it is also possible that there is a systematic bias here whereby those with lower ratings in the earlier weeks did not submit ratings.

4.2 Accuracy of self and peer assessment

In this course, marking rubrics are based on the SOLO taxonomy, so students can be expected to be reasonably familiar with judging work against this taxonomy. To get a feeling for the accuracy of students’ ratings, one of the authors of this paper marked selected presentations using SOLO. On average, tutor ratings were 16% lower than those of students. A t-test confirms that the difference is statistically significant (p=.013).

4.3 Severity of Self-Assessment

To investigate how self-assessment ratings compared to peer assessment ratings, we defined self-marking severity as the self-assessed rating less the mean peer assessed rating. Overall, we found no significant difference between mean self-assessed ratings and mean peer-assessed ratings; mean severity was 1% with a standard error of 1%. However, we found an interesting interaction effect as shown in Figure 2.

Figure 2: Severity of self-assessment v. peer judgement

In this figure, the horizontal axis represents the peer rating awarded, relative to the overall mean peer rating; the vertical axis represents the severity of each self-assessed rating, relative to the mean peer rating of the work. It can be seen that there is a very strong relationship (r=.816, \( R^2 = 0.6626 \), p<.001) between the relative peer rating and the level of self-assessment severity. This relationship accounts for about two thirds of the variability. Those with high peer ratings (i.e. presumable those producing better work) were likely to be more severe in their self-assessment of their work than their peers, whereas those with lower peer marks were likely to be more lenient in their self-assessment than their peers.

4.4 Qualitative

A detailed analysis of the qualitative nature of the feedback is outside the scope of this study, but an indication of the range of feedback is given in this section. To capture this range, we ranked...
students according to their peer ratings and allocated them to three
terciles: lower, middle and upper.

Table 4 presents indicative feedback from the lower tercile.

Table 4: Indicative comments from the lower tercile

<table>
<thead>
<tr>
<th>Good points</th>
<th>Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useful</td>
<td>Fast and short.</td>
</tr>
<tr>
<td>McCall’s Model Tree</td>
<td>Use bright colour for ppt.</td>
</tr>
<tr>
<td></td>
<td>Otherwise all good</td>
</tr>
<tr>
<td>Good explanation with pretty</td>
<td>Use more examples</td>
</tr>
<tr>
<td>presentation</td>
<td></td>
</tr>
<tr>
<td>Had simple points that were</td>
<td>Lacking in colour/images</td>
</tr>
<tr>
<td>well explained and easy to understand</td>
<td></td>
</tr>
</tbody>
</table>

Some of these comments seem more concerned with superficial aspects of the presentation such as colour. There is also some ambiguity about the first improvement suggested: fast and short. Is the feedback giver saying it is so, or that it should be made so? A visual inspection of all the feedback comments suggests that such ambiguity, and a focus on surface features, is widespread in this lower tercile. In contrast, Table 5 shows indicative comments from the upper tercile.

Table 5: Indicative comments from the upper tercile

<table>
<thead>
<tr>
<th>Good points</th>
<th>Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good coverage of McCall’s model</td>
<td>Perhaps some discussion of challenges/alternatives/iterations of/to the model.</td>
</tr>
<tr>
<td>Good examples and discussion of the pros and cons of the types of use case and application.</td>
<td>Eye contact would be nice. Perhaps a little more decomposition of the diagrams.</td>
</tr>
<tr>
<td>Good layout with contrasting approaches side by side.</td>
<td>Spreading out the points across more screens would be more effective to deliver each point</td>
</tr>
</tbody>
</table>

The suggestions for improvement in this group seem more focussed on addressing specific actionable ideas to improve the research. An overall inspection of all the comments in this group confirms this, but suggests that there is still an excessive focus on the manner and delivery of the presenter, and too little on the findings of the research.

5. DISCUSSION

Our main research questions for this study were to investigate how much students trusted other students’ research, how useful they found such research, and how they evaluated the quality of the work. We were also interested in how these changed over the weeks as the students gained familiarity with this way of working.

Overall, we found that students did trust others’ work; the mean rating was “mostly confident”. We also found that they believed the research was useful; the mean rating was “mostly useful”. For the quality of the work, the mean rating was 72%; this corresponds to an average mark of 72% and a rating between “Multi-structural” and “Relational”. Broadly, we conclude that participants found the quality of work acceptable.

We were surprised to find no significant variation of any of the ratings from week to week. A micro level analysis suggests that students indeed did not change their approach. Essentially, higher performing students started with a high standard and maintained this; lower performing students started with a lower standard and continued with this lower standard.

These findings suggest that students were not reflecting on the feedback they received and using the feedback to improve their future researches. Neither did they seem to modify their judgement of what constitutes good work. Overall, we conclude that students were satisfied with the quality of their work and that of their peers and saw little reason to change how they conducted their research.

There was a clear interaction between the standard of research and severity of self-assessment. In comparison to peer rating of their work, those who produced work to a higher standard were more severe in their self-assessment, whereas those with a lower standard were more lenient. In a similar manner, students’ ratings of work were lower than a tutor’s rating. Both of these can be understood in terms of the breadth of knowledge of the person carrying out the assessment. Assessors with a wider range of knowledge are likely to see more possibilities in any research investigation and evaluate the work from more perspectives. Thus, any given specific investigation will be seen as relatively narrow in its scope and limited in its perspectives. This underlines the importance of using a formal framework, such as SOLO, to anchor judgements.

Our course was at level seven and was, consequently, taken by students late in their programme of study. However, for many of the students, this was their first experience of active learning in a collaborative environment. There was an overall reluctance to engage in this active learning approach. Indeed, many students openly espoused the view that “the teacher should teach”, rather than expecting students to take responsibility for their learning. This was perhaps because students’ expectations of learning were well established by this late stage of their studies. Moreover, no course marks were allocated to the specific learning activities. Thus, students’ engagement in the activities was determined mainly by intrinsic motivational factors.

This leads us to conclude that simply adding an active collaborative learning approach to a course is unlikely to lead to success. The approach needs to be embedded in a course and used throughout the programme of study. In particular, it is important to start in the early courses and build on this in later courses. It is also important to make sure there is a constructive alignment [9,2,1] between learning objectives, learning activities, and assessment.

6. CONCLUSION

This study aimed to investigate students’ perceptions of the quality of their work and that of their peers.

We found that students were satisfied with the quality of their work and that of their peers. However, the mean level of quality was lower than tutor assessments. We found that, at the overall level, the severity of student self-assessment was not significantly different from peer assessment. However, students with higher achievement were more severe in their self-assessment that those at lower achievement levels. In essence: the more students know, the more they realise they don’t know and the more severe they are in self-assessment. This is consistent with the finding that overall judgements show less severity than tutor assessment.

We also found that perceptions did not change over the weeks. This suggests that students were satisfied with the quality of their work and did not act on feedback to improve the quality.
However, our study was based on a single cohort of students and these students had limited prior experience with active learning, collaborative learning or peer and self-assessment. We urge caution before generalising our findings to other contexts.

We plan to repeat this work with students who are at an earlier stage in their study since students’ expectations are probably set early in their study and are unlikely to change [8].

7. REFERENCES
Videos Used To Supplement Student Learning: Does The Approach Matter?
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ABSTRACT
Using videos to support students’ learning has attracted the attention of a large number of researchers. In this paper the results of a study into using short video recordings to cover key concepts of a tutorial are presented. The purpose of this study was twofold; firstly the study determined the perception of students in relation to these videos. The second was to determine the effect of how the videos are integrated into the course and whether this made a significant difference to their perceptions of these videos. Twelve videos were created to supplement the teaching of a Project Management course. The videos contained short explanation of the main points of the week’s tutorial. These videos were integrated into two offerings of this course (run over 2012-2013). The videos were made available each week on the course learning management system. The results showed a very positive perception to these videos with students identifying a wide number of benefits to their learning. These benefits were increased when adopting a “flipped” approach to integrating the videos into the course. However this approach did result in the need for a cultural change to how students learnt for these benefits to be realised.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education – collaborative learning, computer-assisted instruction (CAI), computer-managed instruction (CMI).

Keywords
Video recordings, flipped classroom, technology integrated learning.

1. INTRODUCTION
The use of videos to supplement student learning have been the subject of a number of studies in higher education. The purpose of this paper is to present the results of a study into the perceived effectiveness of using video to supplement student learning and determine the best way that these videos can be integrated into the teaching process. By combining these two aspects, this paper provides a unique perspective on current literature. Most studies typically only addressed the effectiveness of integrating videos and do not consider the impact of how they are integrated.

Twelve videos, one per week, were created to supplement the teaching of Project Management. These videos were integrated into two offerings of Project Management over two years (2012-2013). These videos were accessible via the course’s learning management system (LMS) where students were able to view and download these videos. The videos contained short explanation of the main points of the week’s tutorial.

The approach taken to integrate these videos into the course was changed between the two offerings of the course. In the first offering, students were required to view the videos before the week’s tutorial. And in the tutorial it was assumed that all the students had viewed the week’s video. This approach is typically referred to as ‘flipping the classroom’ in current teaching literature [2]. In the next offering, the students were not required to view the videos before the tutorials; rather students could view the videos anytime during the course duration. The tutorials therefore did not assume existing background knowledge.

Student’s opinions were collected at the end of each of the two courses to gain feedback on how useful students found these videos. Opinions were compared to see whether the different approaches to integrating the videos made a significant difference to how the students’ perceived the usefulness of the videos.

A literature review covering some aspects of the use of video recordings in educational contexts is presented. This is followed by an outline of the methodology followed in the paper and a description of how the videos were used in each offering of the course. The results from a survey of students enrolled in the courses are then presented. This is followed by an analysis and discussion after which conclusions pertaining to the success of the study are drawn.

2. LITERATURE REVIEW
2.1 Using video to support students learning
Technology has given educators an opportunity to support learners in more effective and efficient ways. Learning management systems can provide a repository of resources that can cater towards students with different learning styles and needs. In particular technologies, such as mobile devices, the Internet and digital sound and imaging, have made it easier for educators to support their diverse student population [8].

Video recording in particular can be utilised to provide improved communication as it is a permanent record and may be viewed a number of times. Also the nature of the multimedia delivery can help students better retain learning concepts, compared to just verbal communication [6]. Video recordings, as an educational tool, has been found to support rich descriptions of concepts and help articulate tacit information and knowledge that may be difficult to achieve through text or verbally [4].

2.2 The different ways that videos are used in teaching
The use of video recordings in the educational context has been varied. These recordings can be anything from recordings of full lectures to short informational recordings of demonstrations or concepts [10]. These recordings can be then released to students.
The concept of the flipped classroom is to shift the focus of the classroom. These videos recordings have also been integrated into the teaching context to cover different educational aims. For example these videos can be used to introduce a topic, reinforce a concept discussed in class or provide students further background after a class. The approach taken will vary depending on the aim of the videos. Each approach has various benefits and will depend on the aim of the educator.

2.3 The flipped classroom approach

A recent approach taken by some educators is to provide video recording to students before the class. These videos are used to introduce new topics or concepts. Students are required to view these videos before the class. The classes then focus on discussing the concepts introduced in the video rather than introducing the concepts themselves. This approach is called “flipping the classroom”.

The concept of the flipped classroom is to shift the focus of the class from the teacher to the learner. Therefore the educator’s role is no longer “sage on the stage” but rather “guide by the side” [9]. The aim being that by using the videos the educator is able to reduce the amount of time spent in class on lecturing, opening up class time for the use of active learning strategies.

The key benefits of this approach have been identified [1] as:

- Educators can focus more on understanding and application than on recall of facts, while not sacrificing presentation of factual base.
- It provides students with more control over their own learning.
- Students are given a greater sense of responsibility for their learning.
- It provides students with more opportunities to learn from their peers.

Successfully flipping a class however can be challenging for educators to achieve successfully. This approach requires a new student culture as students are required to do work before class. The success of the approach relies on students coming to class prepared and having watched the video. If students have not watching the videos before the class it would undermine the whole approach.

2.4 The challenges of flipping the classroom

To successfully implement the flipped classroom approach a change is needed to the existing traditional teaching approach. These changes have been conceptualised by Hamdan et.al. [3] into four important elements referred to as four Pillars of F-L-I-P.

2.4.1 F: Flipped learning requires flexible environments.

Educators need to develop a teaching environment that allows students to choose when and where they learn. Students are able to choose when and where they watch the videos including the device the use to view the videos. The in-class environment will also be more flexible. Students will direct the in-class learning in terms of the discussions and pace rather than this being teacher led.

2.4.2 L: Flipped learning requires a shift in learning culture

The flipped classroom requires educators to develop a student-centred approach. In-class teaching time is now meant for students to explore topics in greater depth and creating richer learning opportunities. Students need to take ownership for their own learning. The students also need to be self-directed to survive the student-centred approach. The aim of the educators is now to help students explore topics in greater depth using student-centred pedagogies aimed at their individual understanding and readiness level, where they are challenged but not so much so that they are demoralized [12].

2.4.3 I: Flipped learning requires intentional content

Educators’ need to carefully select the content of their teaching and what they get students to explore outside the classroom on their own. Educators need to arrange the content of the classroom teaching so that it supports active learning strategies, peer instruction, problem-based learning, or mastery.

2.4.4 P: Flipped learning requires professional educators

The role of the educator is vital to support this new approach. If educators are developing the videos themselves they need to be skilled in audio and visual editing. So to in class the educators need to be able to observe their students, provide them with feedback relevant in the moment, and continuously assess their work.

3. USE OF VIDEOS IN THE COURSE

In the first offering of the Project Management course in 2012, every week a new video would be uploaded to the LMS. Students were then required to view the video before the tutorial for that week. In class the lecturer would briefly reflect on the video but mainly concentrate on applying the concepts into practical exercises.

In the second offering (2013) the “flipped” concept was dropped. The reason for this was the lecturer found that it was becoming very difficult to maintain the “flipped” process of requiring the student to view the video before class. As the semester progressed more and more students had not watched the video and the lecturer was finding that she was covering the video in more and more depth. It therefore resulted in the key benefit of the “flipped” philosophy being lost. The second offering did not require the students to view the video before the class however were directed to the video before the tutorial but not required to view.

4. THE SURVEY

4.1 The respondents and survey questions

A survey was undertaken to gauge students’ perceptions of the videos. The survey was made available via the courses’ LMS at the end of the both offerings of this course. The questionnaire was divided into three main sections:

- The frequency they watched the videos. Students were asked to self-report on how often they watched the videos. This scale was based on a 5 point scale where 1: Never, 2: Seldom, 3: Sometimes, 4: Often and 5: Almost always.
- Open ended question: Why they may not have watched the videos.
• Their perceptions of the videos. This section was split into two parts, 6 statements asked students to rate on a 5 point likert scale (1: strongly disagrees and 5: strongly agree) their opinions (see table 1). The second section was an open ended question asking the students to state what the biggest advantage of the videos.

The course that was evaluated was a level 6 Project Management course. This paper comprised of students from Computing, Business, Sport and Wine Science degrees. Some students were also enrolled in the Diploma of Business. Of the 38 students enrolled in the first offering, in 2012, 33 students responded to the survey, resulting in an 87% response rate. In the second offering, in 2013, 40 students from the 48 enrolled responded to the survey, also resulting in an 87% response rate.

Of the two groups of students, the first offering had 37% female (n=14) compared to 48% (n=22) female in the second offering. The average age in the first offering was 26 year old compared to 27 years old in the second offering.

5. RESULTS

5.1 The frequency they watched the videos
Students were asked to self-report on the frequency they watched the videos uploaded for the Project Management course. Based on the philosophy of the flipped classroom adopted in the first offering only, students were asked to watch the videos before class. However it became clear that not all students were watching the videos before class. This was reflected in the self-reported frequencies where the flipped class students watched the videos “often” (mean=3.63, SD=1.362). However this was substantially higher than the second offering, were students were not required to watch the videos before class. They rated their frequency as “seldom” (mean=2.43, SD=1.174).

5.2 Open ended question: Why they did not watch the videos
The second question in the survey asked student for a reason why they did not watch the videos. This was an open ended question. This question was asked of both offerings. Even though the first offering required students to view the videos as indicated some students did not actually watch the videos before every class.

In the first offering (the flipped class) the reasons provided by students fell into four main categories 1) I forgot, 2) I didn’t have time, 3) I didn’t think it was necessary and 4) technical issues. Most respondents stated that either they didn’t have time to watch the videos (6 responses) or forgot to watch them (9 responses). Other excuses included that they didn’t think the videos were necessary as they either had a good grasp of the topic under discussion or it repeated what was discussed in the lecture (4 responses). Another excuse given for not watching the videos was technical difficulties:

• “[the videos] did not work the first time and would take a few attempts to open.”.
• “I had ran out of internet data and was on a slow speed”
• “maybe the videos is too big or somewhere cannot download”

The second offering (the non-flipped group) gave fewer reasons for not watching the videos (13 responses compared to 19 in the first offering). In this group the majority (11 responses) of the answers stated that they didn’t watch the videos as they felt they were unnecessary. Responses included:

• “I found I could just as easily pass the course without the need for the videos”
• “I did not watch the videos because in my experience I retain more information by reading and making notes and then applying what I have learnt. With media such as audio and visual I find I keep having to rewind/pause a lot of the time which I find frustrating.”
• “I wrote down notes in every class and understood the material that was discussed so I didn’t need to look at the videos.”

Only one student said they didn’t have time to watch the videos and two students stated they were not aware there were any videos to watch.

5.3 Students’ perceptions of the videos
Students’ were asked to rate their perceptions of the videos on 5 point Likert scale (1: strongly disagrees and 5: strongly agree). Six questions were asked. To compare whether there is significant difference between the attitudes of the first offering (the flipped-group) and second offering (the non-flipped-group) a two-tailed, unequal variances assumed t-test was carried out. Though this study does not undertake random sampling the adoption of statistical analysis is still considered appropriate due to the high response rate. T-testing is a statistical test that enables the testing of the statistical difference between two or more means [7]. An independent t-test was appropriate for testing whether there was a significant difference between two different groups of students and their perceptions of the videos. Since multiple tests were conducted, it was important to avoid a type 1 error (a false-positive). Therefore the Bonferroni correction value of 0.00833 was used. From these results it can be seen that there were no significant differences between the flipped and non-flipped classes.

<table>
<thead>
<tr>
<th>Question</th>
<th>First Offering (2012) – Flipped class (n=33)</th>
<th>Second Offering (2012) – Non-flipped class (n=27)</th>
<th>T-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>I found the videos were easy to understand and explained the content well</td>
<td>Mean=3.88 SD=0.545</td>
<td>Mean=4.00 SD=0.480</td>
<td>.903</td>
</tr>
<tr>
<td>I think other courses should have introduction videos for their tutorials/lecturers</td>
<td>Mean=3.79 SD=1.219</td>
<td>Mean=4.11 SD=0.875</td>
<td>1.156</td>
</tr>
<tr>
<td>I found the videos valuable to my learning</td>
<td>Mean=3.67 SD=0.854</td>
<td>Mean=3.96 SD=0.598</td>
<td>1.494</td>
</tr>
<tr>
<td>The videos were appropriate length</td>
<td>Mean=3.64 SD=0.8223</td>
<td>Mean=3.81 SD=0.557</td>
<td>.961</td>
</tr>
</tbody>
</table>

63
Overall the results indicate that on average, students had a very positive attitude and perception of the videos developed for this course. It also shows that these perceptions did not change when integrated differently into the course.

In addition to the rating scale students were asked to comment on the benefits of these videos.

For the flipped class a number of students commented that the videos were beneficial as they gave an insight into what was coming up in the tutorials (12 responses). For example one student commented that; “[the videos were] time saving because we know before entering in the class what we will learn today”. Another student stated; “It added discipline of preparing for lectures, and meant it wasn’t the first time some of info was received”. Another said; “Prep for class and everyone has a basic grasp of what the lecture will be about. + teacher have more time working with students.”.

In addition to the responses that related to the benefits of the videos used to “flip” the classroom, a number of comments were made in general about videos benefits:

- “[The videos provided] extra info available for the course”
- “Being able to pause and write notes and rewind if did not understand”
- “Explains information in an easy to understand way”

A number of students also stated that these videos were beneficial as they could also be referred to after the tutorial as they formed as great revision tool (8 responses). In particular, one student stated “Allows an introduction to the topic, so when in class we are hearing the info for the second time and it sticks.” Students also stated that it was a good tool for those that missed class so that they could catch up on what was missed (4 responses).

For the second intake, comments related primarily to the benefits of these videos for supporting revision (21 responses). A large number of respondents stated that the videos were an excellent resource to refer back to help reinforce concepts covered in class. Another benefit cited by students (n=6) was that the videos could be used to overview topics when students missed classes. Three students also highlighted the benefit of the nature of the videos being visual and not just audio. For example “[I found the videos beneficial as I could] just sit back and watch and listen… it offered an alternative learning style”.

6. DISCUSSION AND CONCLUSION

From the results of this study we can see that though the perceptions of the students’ did not change significantly when compared, the way that the videos were integrated did make a difference.

Firstly and most obviously the number and frequency that the students viewed the material differed. The “flipped” group viewed the videos more often compared to the “non-flipped” group. Though students did not always view the videos in “flipped” group it did mean that more student watched the videos. It seemed that when it was not made a focus of the course it was less likely students would actually view the videos. This was further illustrated in the students’ feedback in the second offering. Whereby, a small number of students said that they were not even aware of the videos and therefore did not watch them. By continually referring students to the videos in the first offering students were also made aware of the videos.

An additional interesting point, when comparing reasons for not viewing the videos, more students in the second offering stated that they did not find the videos useful. It may be assumed that by not making the videos a core compulsory part of the course it also made students perceived them as less important and therefore less useful.

Overall the results indicate a wide variety of benefits to using videos to support student learning. These videos were partially good for recapping and reinforcing concepts (this was indicated in both offerings). However, the videos were also great for covering concepts before class, however the issue seemed to be ensuring that student would actually view the videos. The flipped concept did seem to be beneficial, however in practicality it did not work if all students did not view the videos. The study therefore reinforces the need for a strong student culture where students are prepared to consistently view the videos before class. However if this culture change is not possible the benefits of the videos would not be lost.

Overall, it can be concluded that the videos themselves are a great tool for supporting students learning. And integrating these videos to support a flipped classroom approach has additional benefits however does require significant effort on the part of the lecturer to ensure that students are aware of the requirements and on the students to be diligent enough to view the videos beforehand.

7. LIMITATIONS AND FUTURE STUDY

The study aimed at determining the impact the approach taken to integrate videos into a class impacts on the perception of the student. The study comprised of a voluntary convenience sample therefore some caution may be needed in interpretation the results. However a large-scale study would be needed to confirm the results of this study. Future work will be to replicate this study with a larger group in other subject areas.

8. REFERENCES


Software Implementation - Lessons to be learnt from the Novopay project

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ABSTRACT
Successful implementation of large software projects is, unfortunately, not common. Too often they exceed time and budget, lack desired functionalities, contain bugs, affect the users and usability, and fail to deliver the desired goal. This is a global issue for the ICT community, and New Zealand is not immune to it. This paper looks at the recent implementation of the Novopay payroll system for the New Zealand Ministry of Education in light of established principles for software development and implementation, knowledge management and organisational absorption capacity. It discusses the implementation process and analyses how the entire process became erroneous which led to the systemic failure of the Novopay payroll project. This research identifies a number of failure points, such as failure to follow the standard IS project management processes, failure to understand the complexities of a large IS project, failure to correctly define and initiate the project, failure to follow the project plan, failure to confront the external pressure for implementation, and failure to recognize the implications of critical test failures. However, we observe that lack of knowledge management and organisational absorptive capacity are the meta issue of these failures. We, therefore, argue to establish a centre for Central Absorptive Capacity (CAC) management as a remedial measure for future large IS/IT projects in the public sector.

Categories and Subject Descriptors
Management, Measurement, Documentation, Performance

Keywords
Software project management, knowledge management, knowledge absorption, software implementation

1. INTRODUCTION
The New Zealand Education Service Payroll (ESP) is one of the largest and complex payroll systems in New Zealand, involving fortnightly payments of up to 110,000 staff of 2,457 primary and secondary schools. It manages a turnover of approximately 40,000 staff at the end and beginning of each year. Each school has a payroll administrator, who may be a full- or part-time and is responsible for entering payroll data and checking their correctness before each pay period. School principals use the system for various management activities such as approval of staff leave applications. More than 6,000 users need to understand and use the payroll system. The key difficulty lies in the employment structure of the New Zealand school workforce. Approximately 30% of them are employed in flexible positions, and several thousand of them work at more than one school. A staff member may have more than one employer as each school is a separate employer. The payroll system processes all payments due to an individual by their employers, using one pay slip, which sums all their hours and appropriate allowances, across all the schools for which they work. Further details of the payroll system can be seen in the Ministerial enquiry [18].

Although the Ministry of Education (MoE) is not the employer of school staff, it is responsible for managing the payroll service. Under a business process outsource (BPO) agreement, Datacom, an IT service provider, administered the payroll system during the period 1996-2012. This payroll system involved many manual processes. The MoE engaged Talent2, a software company, in 2008 to provide a cut down scoped payroll service scheduled to start in 2010 with a budget of NZD 30 million. Talent2 agreed to customize and implement a sophisticated and automated web-enabled payroll system ‘Novopay’ [18] for delivering the payroll services. According to the agreement, the MoE did not purchase or lease IT systems or hardware and Talent2 was not required to comply with some New Zealand Government IT standards [20].

The payroll service definition document was highly abstracted. The end user requirement was neither defined clearly nor understood by both the MoE and Talent2. The MoE was not aware of the service requirement and complexities as the last payroll services were fully administered by Datacom without much involvement or input from the MoE. Therefore, both the MoE and Talent2 could not comprehend the extent of the complexity of the payroll process, especially the consequences of withdrawing the human-intervention process and the introduction of an automated online business process. Obviously, Talent2 failed to deliver services in time and within budget. Since Novopay went live on 20 August 2012 [5], with hundreds of bugs, thousands of teachers and staff from 90% of the schools were underpaid, overpaid or not paid. Talent2 scrambled to fix the problems [6]. Three months after Go-Live, 70% of the schools continued to experience incorrect payroll services [26] and the budget crept up to NZD 100 million. In February 2012, NZD 5 million was injected for a remediation plan, and an additional NZD 6 million was given to the schools for additional person-hours required to use Novopay. A year after the implementation of the payroll system, Talent2 is still fixing bugs and Novopay is still a long way from being a complete system.

The New Zealand Government has undertaken several technical, and non-technical reviews and the findings have been made available online [19]. These reviews critically analyse failure and success points from various perspectives such as,
shortcomings in service purchase process, failures in project lifecycle management, and failures during and after Go-live. Most of these discussions encompass failure to follow standard IT/IS project management guidelines. Therefore, the purpose of this paper is not to scrutinize Talent2 services using an IT project management methodological approach. It also does neither investigate the shortcomings of the Talent2 payroll services nor the technical issues of the Novopay system.

From this investigation, we observe that a number of similar projects have also been failed in education, health and police sectors, and many reviews have been conducted such as the first Teachers Pay project [29], INCIS [21, 24]. The government departments have been repeating similar mistakes. Are these problems and issues repetitive or totally different? Have they learned from these reviews? The key weakness of these reviews in that they failed to identify factors beyond project management. For example, the project failure may be caused from the lack of an organisational knowledge transfer process and organisational knowledge absorptive capacity [7]. This paper explores the issues of organisational knowledge management and proposes to a solution for rendering expert knowledge transfer services for future IT projects.

The following section provides a brief review of software project management literature with a focus on the failure and success issues of IT and IS projects, and the importance of knowledge management and organisational absorptive capacity. We then briefly discuss the research method, and analysis and findings. We conclude with the presentation of a high level model of a centre for Central Absorptive Capacity (CAC) for ensuring success of future large IT projects.

2. SOFTWARE PROJECT MANAGEMENT

The successes and failures of large software projects have been extensively investigated in information systems and project management literature, yet organisations are still beset with high implementation failure rates [9, 11, 27]. Software projects are seemingly plagued by technical and managerial problems. One cannot predict with certainty when software is likely to cause problems due to the intangible nature of software and endless variations in business processes. Large software projects are inherently complex and unpredictable, and their success particularly depends on how they are managed. In their model of ICT failure, empirically grounded from the case studies of the New Zealand government sector for large software development and implementation projects, Gauld and Goldfinch [12] state, “the processes involved in information system (IS) developments are not fully understood, that their complexity makes them difficult if not impossible to control and that large IS developments are likely to fail” (p. 133). Similarly, Nickson [23] observed that two-thirds of all IT projects exceeded budgets and timetables and up to a third of projects failed. Projects over $10 million budget are less likely to be successful [12] (p.11), and the larger projects are more prone to be unsuccessful.

While it is difficult to obtain statistics on the actual frequency of IT failures, various sources indicate that at least half of all IT projects are not as successful as we would like them to be [13, 15]. While there are undoubtedly many different modes of IT failure, one pattern of failure that has been observed, but rarely studied, is the IT project that seems to take on a life of its own, “continuing to absorb valuable resources without ever reaching its objective” [12, 14-16]. Eventually, these projects are abandoned (or significantly redirected), but the cost of having funded them can be a tremendous waste of organisational resources [14]. Major modes of software project failure are late delivery or never completed, poor reliability, cost overrun and user dissatisfaction for exhibiting poor performance characteristics, especially failing to meet the requirements [4].

Project management is the application of knowledge, skills, tools and techniques to manage project activities. It embraces four basic disciplines [17]: methodology, or procedures (15%), personnel management (50%), communications (25%), and planning techniques (10%). A project should always pass the SMART test [23] i.e. its objectives should be simple, measurable, achievable, supported by the organisational resources and attainable within the stipulated timetable. The quality, risks, and progress of a well-planned software project can be actively monitored and controlled. Software project management in information systems literature has frequently been referred to management of the system development lifecycle.

The actual costs of software projects often significantly exceed the estimated cost. Other projects are completed within time and cost but do not provide rich user satisfaction. The skilful integration of software technology, economics and human relations in the context of a software project is not easy. Poor strategic management and related human factors are the leading causes of failure [25]. Information overload, a high turnover of skilled staff, and an inability to learn from past failures are some of significant failure points of organisational learning [12]. Software implementations are largely affected by an organisation’s absorptive capacity i.e. its ability to learn from external sources, management of prior knowledge and their application in IS project management.

According to the resource based view, knowledge is the most strategically vital resource. Knowledge can be defined as a belief that represents organisational capability and enhances an organisation’s capability for proper decision making and effective action [1] and determines the organisational identity, its processes and its systems. However, knowledge-based organisational capability relies on the effective application and transfer of knowledge. Most organisations do not have properly defined knowledge management and knowledge absorptive capacities at the organisational level and usually rely on the individuals who possess the knowledge. Organisational units learn and benefit from sharing and transferring their knowledge resources [32]. Effective knowledge transfer within organisations is an antecedent of corporate success. Knowledge transfer in organisations is the process through which one unit (e.g. group, department, or division) is affected by the experience of another [2]. It is about dyadic exchanges of organisational knowledge between a source and a recipient in which the identity of the recipient does matter [30]. Myrna and Martyn [22] observe that knowledge transfer is processed through four steps: 1) acquisition of knowledge by the organisation, 2) communication of knowledge within the organisation, 3) application of knowledge for the creation of business value, and 4) assimilation of the results into business routines.

Knowledge transfer can be facilitated through training, communication, technology transfer and interaction with suppliers and customers [3]. The key issue is that organisations are not in a position to manage knowledge transfer without the participation of the employees who hold the knowledge. The
individual’s knowledge and skills of knowledge transfer does not necessarily constitute organisational knowledge absorptive capacity. Absorption capacity can profoundly influence the software implementation process [10] and, thereby, it leads to the success and failure of the project. Currently, the State Services Commission (SSC) and the Government Chief Information Officer play governance and monitoring roles for large IS projects, but they do not provide the support infrastructure in the way it is needed for IT projects. In the absence of a centralised support infrastructure for absorptive capacity management, complex IT projects in all the ministries and departments are often prone to failure.

3. RESEARCH METHODOLOGY
We have reviewed substantial literature on IT project management, knowledge management, organisational absorptive capacity, and various case studies and reviews of the government sector projects. From this review, we observed a number of normative and empirical models of success and failures of information systems projects and applied them in this Novopay payroll case analysis using the qualitative study approach.

We have collected information from various sources such as New Zealand Government documents [5, 8, 18-21], technical magazines [6], Media [26, 28], and online resources [19, 31]. In addition to providing in-depth information of the project activities, many of these documents have presented critical analysis of various aspects and issues of the Novopay system failure. Though these review documents have analysed from a number of perspectives, they mostly focused on analysis of the project lifecycle and problems in the outcome. We observed that, in addition to normal project management related factors, the crucial issue was the lack of knowledge absorptive capability of both Talent2 and the MoE to deliver such a complex payroll service. Therefore, investigation and discussion of this paper focused on how knowledge management and organisational knowledge absorptive capacity relate to the outcome of Novopay payroll services. This paper does not discuss the impact of the erroneous payroll services.

Based on the analyses, discussions and findings, this research proposes a high level model for the improvement of organisational absorptive capacity improvement that aims to contribute towards improvement of the public sector IT project implementation.

4. PREVIOUS PAYROLL SYSTEMS IN EDUCATION SECTOR
Prior to 1989, the New Zealand Department of Education had 28 separate salary units delivering the schools payroll manually. In the late 1980s, a new centralised computer system was introduced. The ministerial enquiry [18] remarked that the transfer to this software was not problem-free, and many staff were not paid during the transition. The MoE contracted out the operation of the schools payroll to Datacom in August 1995 who introduced Datapay in 1996. The transfer to the new system was again difficult. The project ran late. On the first pay run, none of the employees paid by direct credit were paid and throughout the implementation period dissatisfaction was expressed by school employees about non-payment and incorrect payments. Similar to the Talent2 service, Datacom took considerable time to understand the payroll system, and to develop the transactions and payroll processes within Datapay.

In a paper for Cabinet on the project dated 6 May 2005, the MoE explicitly recognised the impacts of a failure during rollout, and outlined its intended mitigation strategies as including 1) an eight-month staggered implementation, 2) parallel runs of the new and existing systems, 3) ensuring internal capabilities to manage implementation and operation, and 4) extensive communication and change management with the schools. The MoE also assessed that a ‘Big Bang’ model for rolling out the new payroll service to all users at the same time was unacceptably hazardous. However, when Novopay was implemented, the MoE changed its initial position and plan by deciding on a big bang approach [18]. The MoE made the same mistakes in the previous implementation and expected an improved outcome. While people involved in 1989 or 1996 may not be engaged in the Novopay project, the MoE could have easily overcome the previous mistakes and failures if it had a proper knowledge transfer process, and an established knowledge absorptive capacity unit.

5. CASE ANALYSIS AND DISCUSSIONS
Talent2’s failure to provide satisfactory payroll services have extensively reviewed and analysed from various perspectives by the New Zealand Government ministerial enquiry [18, 21], technical review [8], media analysis [26, 28], etc. This analysis concentrates on how the systemic failures occurred due to lack of organisational capability in terms of absorptive capacity and knowledge management. The issues of what happened or what went wrong or what could have been done at what stage at the system or service level are beyond the scope of this discussion and analysis. We first analyse three key reviews conducted by the government, consultant and media in the following three subsections. We then conduct further analysis.

5.1 Ministerial Review
This analysis failed to realize that the agreement was to deliver the payroll service, not the Novopay system as an IS/IT infrastructure.

In its Foreword the ministerial enquiry [18] wrote:

There were many factors that contributed to the Novopay failures. It is our overall view that weaknesses in project governance and leadership allowed the service to go live with a number of significant risks which the Ministry and its vendors were over-confident of managing. When these risks resulted in service issues Post-Go Live, the Ministry and its vendors were overwhelmed by their nature and scale. Over the course of the project, Talent2 had missed agreed milestones or deadlines, which eroded trust and confidence in its ability to deliver. The nature of the service that the Ministry was seeking also diverged from the original proposition. (p.2)

The report also assesses that:

The Ministry of Education has much to learn from this long-running process. … It is critical that public and private sector entities collaborate effectively to bring the required expertise to bear. (p.2)

This assessment clearly demonstrates that both the MoE and Talent2 either underestimated the problems or did not have the requisite knowledge to understand the gravity of the risks. They were, of course, under pressure to go-live due to the impending withdrawal of Datacom. This also demonstrates the lack of leadership and management by the MoE, which was caused from the lack of knowledge management, as the MoE had similar
failures in the past but never retained knowledge from those projects.

In the chronology of events [5], we observe that the MoE decided to replace the Datacom administered system and service in 2003. The Synergy and Talent2 consortium was selected as the supplier of software and hardware for the new schools payroll system in 2005, but the contract was revised in 2008 before it even came to effect. Under the new 2008 agreement, Talent 2 was engaged as the sole payroll service provider. According to the ministerial enquiry [18],

Work commenced on the requirements for the schools payroll project in October 2008. This process was lengthy, and never completed. Even after Go Live, new requirements were being discovered. There was little direct customer (boards of trustees) or user (principals and school administrators) involvement in the definition of the requirements, and Datacom’s involvement was minimal. (p.3)

These are remarkably common mistakes and failure points in most of the enterprise systems implementation i.e. lack of a final sign off on requirements and scope, lack of end user involvement, and lack of involvement from the previous/existing service provider. However, this problem also lies at the core of the client’s absorption capacity and knowledge transfer capability.

The ministerial enquiry [18] continues to express that:

The project had by this stage shifted from implementing a configured package solution towards a heavily customized solution, and was therefore increasingly moving away from the original strategy, business case and basis for procurement. Requirements definition, design, development and testing activity were all occurring in parallel, making it very difficult to maintain a known level of quality. (p.3)

The enquiry clearly brings lack of strategic, as well as tactical, decision making capability at the ministry level. Both the technical review and the ministerial enquiry did not scrutinize the weakness of the methodological aspects of the Novopay system implementation. Some of the IT systems development methodologies such as Agile approach supports parallel processing of requirements definition, design, development and testing. However, was this methodological approach suitable for the project? The MoE should have done more analysis at the outset and could have taken assistance from the Office of the Government Chief Information Officer to conduct this review and analysis. However, it is not certain whether the later office had the expertise and capability or not.

The ministerial enquiry [18] also observes that:

During the service design and development phase, the intended pilot and phased rollout of the service were removed from the project plan. Some important areas of functionality were not fully tested prior to Go Live. Some types of testing were not completed to the original scope, on the basis that testing could be completed after Go Live, or that the risks of not doing the testing had been adequately mitigated. Not all System Integration Testing criteria were met. (p.3)

This was a totally disastrous decision on both the MoE and Talent2’s part. Almost all of the monitoring organisations have failed here. Any sensible IT project management expert cannot take such an insane decision. They might have some hidden reasons which need to be made public or there should be another enquiry for establishing responsibility for such faulty decision making.

Another observation in the enquiry report states:

The Ministry understood that changes to business processes and roles within schools in relation to payroll administration were expected. However, it underestimated the impacts of the changes required of the schools by the introduction of the new payroll service. The execution of the change management plans which the Ministry did have was inadequate, and roles were unclear. The engagement with the payroll service’s customers and users was also insufficient. (p.4)

This observation again indicates the inability of the MoE to provide the leadership required for such a complex IT project, without the support of a specialised IT knowledge organisation.

Other crucial issues observed are a lack of communication, a large degree of turnover in key project leadership positions, and lack of a program director. The MoE also lacked commercial experience to manage such a large vendor. The situation was exacerbated by the unhealthy relationship between the MoE and Talent2, the lack of overall accountability for Independent Quality Assurance, the unduly optimistic reporting, and the failure of monitoring by the State Services Commissioner. The ministerial enquiry [18] highlighted 19 findings on project lifecycle and another 19 findings on project execution and recommended 18 lessons to be learnt from the project. Project lifecycle related issues relate to 10 different areas, namely 1) The business case, 2) procurement, 3) The contract, 4) service requirement definition, 5) service design and development, 6) testing, 7) change management and sector readiness, 8) Decision making: the lead up to Go Live 9) Post-Go Live, and 10) remediation. Project execution related issues are: 1) governance, 2) project management, 3) vendor management, 4) assurance, 5) benefits and costs, 6) leadership, 7) culture, 8) relationship with the sector, 9) ministers, and 10) the central agencies. In order to solve these problems and issues, the New Zealand Government needs to establish an independent centre for absorption capacity as a central knowledge management organisation.

5.2 Technical Review

While the focus of this research is not to analyse technical issues, it does look into some of the technical difficulties that exacerbated the complexity of the overall payroll service management. Deloitte [8] conducted a technical review,

... to assess the core Novopay payroll software platforms with respect to their stability and make recommendations to enable the Ministry to ensure that immediate issues are resolved in short term and that the Ministry has suitable software platforms in place for the eight to ten year delivery of schools payroll. (p.4)

Use of consultants for technical reviews is widely practiced in many countries. However, this is normally done to supplement the client’s internal reviews for identifying the deeper and external issues. In this case, no internal technical review was conducted due to lack of competence, confidence, or organisational capability in undertaking such a review.

According to the technical review [8], Deloitte observes –

…..the core software platforms are not stable for the delivery of schools payroll. This is driven by a backlog of system issues (predominantly related to customized functionality),

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and difficulties with the entry of data and interpretation of reports by schools. (p.6)

While functionality cannot be tested until it is developed, the issues of data entry and report interpretation could be identified much earlier. This highlights lack of knowledge and capability on the client’s part.

In order to provide a stable platform for the delivery of schools payroll for the next eight to ten years, Deloitte [8] states that the MoE needs to extend support to Talent2: “…this would require materially elevated and sustained effort and capability by both the Ministry and Talent2” (p.6). The MoE or another government department can extend this support only when they have the right knowledge and skills to do so.

Deloitte [8] also observes that existing functionality does not support the business processes, and customisation is difficult with the application architecture. Novopay had 500 open defects including 44 ‘very serious’ seven months after Go-Live. There was no formal process in place to assess and manage data quality. Service support processes have struggled to manage the volume of issues. Deloitte also observed insufficient staff and lack of clear leadership accountability to manage end-to-end resolution. All these observations highlight the lack of the client’s organisational capability which cannot be resolved overnight through hiring employees or consultants. Development of organisational absorption capacity and knowledge transfer capability is not an on-off issue; rather they are a continuous process and need to be developed over a sustained period of time.

5.3 Media Analysis

In a media analysis, Seven Sharp [28] presented how Novopay fulfills the eight habits [12] of highly effective IT fascos: 1) ambitious project scope; 2) change of technical specifications during the project; 3) develop long and complex contract and assume this will solve problems that arise (and they will); 4) rely on the advice and skills of salespeople and contract and use lots of consultants rather than develop in-house IT expertise; 5) Ensure project has a long development time-frame so technology becomes outdated and the likelihood of organisational changes increases; 6) believe everything you are told about the progress of the project and assume bugs will be ironed out once project is live; 7) Look for the indication of forthcoming failure, do not terminate project. Instead rely on promised IT fixes, more processes and more monitoring; and 8) Continue throwing money at the project. In this media analysis, item 4 has distinctly touched the issues of knowledge, knowledge management, knowledge transfer and organisational absorptive capacity. Seven Sharp [28] made the comment that: “In August 2007 the Labour Cabinet agreed to outsource the payroll operation because it would require less expertise and resource from Ministry.”

Though this comment may not directly link to implementation of this payroll project, it indicates avoidance of taking an active role in the overall payroll process due to lack of expertise in the MoE. The MoE was kept in the dark during the previous payroll process which was administered by Datacom without full documentation. However, the MoE neither designed a process nor took the initiative to develop a knowledge management capability within the MoE to understand the payroll service process. The MoE continued to make the same mistakes that they made during the previous two decades.

5.4 Other Analysis

So far, the Ministerial enquiry, consultants and media have focused on reviewing and analyzing incorrect functionality, the project lifecycle and aftermath of the Go-Live of the Novopay system rather than the failure of Talent2 and the MoE, especially their organisational capability, to deliver the required services even with extended time and budget. The service procurement was erroneous. Talent2, being an Australian company, lacked the understanding of the complex New Zealand Education payroll services. A joint venture with an experienced New Zealand organisation could have placed them in a better position to deliver the services.

Nickson [23] observes that the bugs in an implementation are not critical in a government funded project as long as the system demonstrated the correct functions so that the training and demonstration staff could prepare their work. However, Novopay even fell below Nickson’s expectation. Nickson [23] also states that scope changes are common in Government IT project, such as 2,500 change requests after the initial specification of this payroll systems project. However, Talent2 could not even finish requirement gathering for Novopay before go-live.

We observe that the payroll project was initiated in 2003 and went-live in 2012. This is a quite long time to change business processes, and laws and regulations. There was no process in place to handle time bound events. The MoE controlled macro level processes, but they lacked understanding of the micro level practices and the Payroll Reference Group (PRG), that was established to support the MoE, was not that useful [18].

According to Nickson [23], a fully staffed project team that has people who have the wrong skill sets, or who require extensive training before they are productive, is a real problem. We also observe some staffing and expertise issues in this project. Most of the school payroll admin and call centre staff had either no, or inadequate, training at Go Live [18]. Failure of communication and management is a common problem in most IT projects. The project team normally tries to hide and solve the issues before they become critical and unsolvable, within their expertise and capacities. Communication issues and missing deadlines from the beginning of the Novopay project were known by the MoE but they did not undertake proper remedial measures for unknown reasons, which could be a further research issue. There was a lot of false hope within the MoE and Talent2 that problems and issues would be fixed once the system went-live.

Strategies such as abandonment, fresh start, or salvage may be used to overcome project disasters [23]. However, none of these options was feasible as the MoE did not have an alternative strategy to manage the schools payroll when the deadline to go-live was imminent.

6. FINDINGS

The ministerial enquiry finds, “The strategic decision to change from purchasing software to an outsourced service was valid, but the rationale was simplistic” [18] (p.11). We argue that this was the key problem point of this project. Contracting a software company to deliver payroll services is the same as hiring a medical equipment manufacturer to undertake surgical operations. Talent2 was hired to configure the Novopay software to deliver the schools’ payroll service requirements. Suddenly, though with valid reasons, the software supply contract was changed to Business Process Outsource (BPO) for payroll
services for which Talent2 lacked expertise. The MoE also lacked experience and knowledge, and exhibited a ‘lack of ownership of the problems’ as it believed, albeit without a valid basis, that Talent2 could finally manage the payroll service. Astonishingly, the State Service Commission, Office of the Government Chief Information Officer, Auditor General, and the cabinet division could not either realize or speak out. Even the current review teams are reluctant to mention this directly. This caused the entire process such as requirements gathering, scope management, design, development, testing (pilot, integration, implementation, deployment, etc) to be flawed. The monitoring and governing bodies tried to minimize the impact of non-achievement (failing milestones) instead of taking timely remedial measures. Quality seemed to be never an issue for any of the stakeholders.

Talent2 was contracted to deliver a complete payroll service which is more than an information system. After dropping the consortium in the 2008 agreement, Talent2 lost a crucial segment of experience and skilled human resources required to deliver such a complex and large payroll service. Hiring of skilled individuals does not make up organisational capability immediately and deliver the required services without hiccups. Datacom who had good experience in both system development and service delivery was kept out of the loop though they were willing to undertake services at a substantially reduced cost. It is apparent that the MoE wanted to avoid Datacom at any cost. Datacom could have been engaged as a consultant and given a transitioning role. Government ICT department was also kept out of support or monitoring process in the contract. Key stakeholders, especially the MoE were paralyzed in identifying contact variations and conducting reviews and failed to provide proper leadership to the project team. The key user groups (schools) were not involved in development and testing, and were neither trained adequately, nor did they buy-into the new payroll processes which required changes to long established practices.

7. CONCLUSION

This research observed that Novopay project was a victim of systematic failures during 2003–2012. The initial scoping of the project was wrong and therefore, the decisions for customisation and implementation processes were changed again and again. No one in the MoE was sure of the success of this project other than relying on a dramatic and magical outcome.

The way forward for the government is to establish a Centre for Absorption Capacity (CAC) as a central learning organisation and to set up of a process for the development of organisational capability. In the current form of organisation strengthening process, the New Zealand ministries and departments normally hire at the start of the project and let them go at the end. Consequently, the experience and knowledge gained, often at a painful cost, disappears after a certain time. It is important to note that while a group of individual experts may be hired to constitute the organisational absorption capacity, this does not increase organisational capability in the long run. The proposed CAC would be tasked to establish a central knowledge management infrastructure that does not rely on individuals and to sustain it even after losing any expertise. The processes of knowledge absorption and capacity are entirely different from organisation to individual. A CAC could be involved in any complex project for supporting the MoE or taking a proactive role in the project.

Further research needs to done in order to define structure and working proposition for the CAC.

8. REFERENCES


The odd one out:
Gender imbalance in tertiary ICT education

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ABSTRACT
The paper explores some of the reasons for the large imbalance between male and female students entering the Bachelor of Information Technology degree from high schools. The literature suggests that only one in six students entering higher education to study computer related degrees are female. It also suggests that occupational stereotyping can be linked to the decline in the number of females entering computing degree courses. This study examines the influences and perceptions of both male and female students leaving high school in 2012 from four schools in the Southland region of New Zealand. A survey was conducted over a four week period in October/November 2012 with four schools within Southland to gather evidence regarding their influences of what Information Communication Technology involved or how they perceived ICT as a job. From the results females found the perception of ICT as interesting, well paid and secure but still do not want to take up roles within the industry. One of the recommendations that came out of this paper would be to look further into the perception of ICT and how that relates to the career choices made by female students.

Categories and Subject Descriptors

General Terms
Measurement, Documentation, Economics, Human Factors

Keywords
Gender, computing, career choice.

1. INTRODUCTION
Within this paper the term ICT, has been used to define any related jobs within the technology field and also for the technology high school qualifications used within New Zealand. It is assumed that computer relates to any device used by the students that can connect to the internet such as tablets, games machines, desktops, phones and laptops

The past two decades have seen an exponential growth of employment opportunities within the ICT industry. Many of these jobs internationally have been filled by graduates coming out of polytechnics and universities with degrees in computing or computer science [4]. Despite the availability of employment opportunities in ICT, there has been a downturn in the number of females entering the industry. This decline has been steady over the past two decades to the point where there is a real risk that females will be almost entirely absent from the ICT industry [32].

The popular stereotype of people working in ICT is that they are ‘geeks’, hiding in darkened rooms, staring at computer screens all day [17, p.128]. This image is promulgated in popular media in TV shows such as NCIS and Criminal minds, which portray a negative stereotype of females within the ICT industry.

Although there are many avenues that females can take into the ICT industry, such as internal promotion, apprenticeships and on job training, New Zealand statistics show that only 1.8 per cent of women identify themselves as employed in ICT, media or telecommunications jobs [19].

This paper focuses on the perceptions of school leavers in 2012. The aim of the research was to identify the influences on these students when deciding whether or not to follow a career in the ICT industry. Data was gathered by way of a questionnaire delivered to two schools in Invercargill and two schools around Southland. Questions were designed to elicit information from students on aspects that influenced their choices.

2. LITERATURE REVIEW
2.1 Global problem
Nearly three decades have come and gone since the publication of the first research papers on the gender-subject split in high schools were published. As early as 1986 Culley wrote about girls being uncomfortable working in computer labs with boys where they felt it to be a male dominated territory. Since then, this trend has continued to be noted in literature.

In more recent times evidence from around the world highlights a general reluctance among females to pursue ICT studies at tertiary level. Females account for 10 to 30 per cent of students studying ICT globally, and across the job sector females make up less than 25 per cent of those employed in ICT based jobs [18]. In 2010, according to a FINS,COM analysis of Labour Department data in the US, women held just 23.9 per cent of high tech jobs [26].

Most of the international research has concentrated on the university and ICT industries, however career paths are chosen much earlier in the student’s educational life. Long before many girls enter higher or tertiary education they have already decided not to follow careers in maths, science and technology [13].

Science and technology subjects in the 1980s in Europe were predominately ‘masculine’ and were mainly taught by male tutors. This gender imbalance in teaching further strengthened the perception that pursing these subjects at a higher level was not for females. Culley as cited by Volman and Van Eck [30] found that teachers in the upper classes of primary schools often considered boys to be more interested in computers, and those male teachers enjoyed teaching boys more than girls. Volman and Van Eck also suggest that this bias was a major factor in the low numbers of females going on to careers in computing. Gras-Velaquez, Joyce and Debry [14] comment on a report compiled by European SchoolsNet and Cisco Systems Inc. which indicated that 46 per cent of female students across Europe who enjoyed studying ICT
at high school still failed to progress to tertiary level or use their skill to get jobs in the ICT industry.

Gras-Velazquez et al. [14] called for closer cooperation between educational agencies and industry as a way to ensure accurate information about ICT is available to teachers, pupils and their parents. They believe that this kind of public-private collaboration can play a role in changing perceptions about industry, by giving access to more realistic information and authentic role models.

2.2 Closer to Home

Currently female students represent less than 19 per cent of all students enrolled in undergraduate ICT programs across Australia [9]. Craig and Lang [10] note that women have many career choices presented to them, which is a luxury not always present in other countries. Women are embracing technology and applications but not ICT careers (p.335). A Tasmanian study in 2003 found that only 5 per cent of Year 9 students intended to continue with their education [33]. Young finds the way that ICT is taught in secondary schools a major disincentive to girls continuing to study these subjects. Female students described ICT as “boring” and did not see the need to learn computing “as it does not relate to the job they are going to do” [33, p.116].

A descriptive study carried out in New Zealand by Abbiss in 2005 sought to explain the gender imbalance in ICT studies within the polytechnic tertiary sector. Lack of interest was the most common response given by female students to questions designed to elicit the perceptions about females in the ICT industry. Another reason for lack of commitment to ICT as a career was identified by Weaver and Tucker [32] who argue that females under-estimated their ICT skills and self-identified themselves as incompetent.

Cater-Steel and McDonald [7] suggest a strategy to build a mentoring and support network among female students to help with their on-going studies from a younger age. With international studies from Gras-Valaquez et al. and New Zealand literature from Young indicate the need to change perceptions earlier on in the schooling of females from Year 5 onwards can help in the foundation of ICT. New Zealand Qualifications Authority are looking at trying to address ICT qualification within New Zealand, they have undertook a study of ICT qualification over the past five years to combine old qualifications and to introduce new concepts to keep up to date with technology [20].

2.3 Family

A desire to follow in the footsteps of one’s parents has long been a very influential factor in the choice of family member’s career. If children view their parents as role models they will be strongly influenced by their choices of career [3]. Adya and Kaiser [3] suggest that those women who enter a male-dominated field such as ICT come from families where both parents are highly educated.

Mothers with degrees are also more likely to influence their daughters’ career choices than mothers without a degree. Women who choose non-traditional careers identify fathers with higher education qualifications as having had a stronger influence on their career choices than mothers without such qualifications. With career advice girls more than boys sought advice from parents when choosing a career. Many girls rejected a career in ICT due to misinformation and misguidance from parents who had limited or no knowledge of the subject or of what jobs were available in the ICT industry [33].

Weaver and Tucker [32] note that there is a great deal of misconception about what a career in computing involves. With so few mentors for women to look up to within the ICT industry, peers and family start to influence their career choices.

The Institute of ICT Professionals New Zealand (IITP) have formed at working group initiative to inform schools about ICT professionals. There are sending ICT professionals to schools to educate students on what is classed as a job in ICT and to try and combat media driven stereotypes [21].

2.4 Media & Stereotyping

Young adults’ perceptions about ICT jobs are biased by media influences and how these depict people in the ICT industry, rather than being influenced by facts and figures about actual people in the industry today [21].

Films, T.V., print and electronic media enhance the stereotypical that ICT is a male occupation. This stereotype ICT professional is a social inept male “geek” in glasses or a teenage boy in a darkened room in front of a computer screen. These images do not represent ICT as an appealing career choice [13, 15].

Girls’ perceptions of ICT jobs mirror the stereotypes that they have been presented with throughout their teen years in television, film and other popular media. Consequently many teenage girls look upon ICT as being “uncool, nerdy or boring” [29, p.110] and [17, 21].

2.5 Role Models

Career choices are often influenced by role models [3]. There are few young female role models in the ICT industry [12]. Media attention focuses on prominent males such as Steve Jobs, the infamous Kim Dot.Com and Mark Zuckerberg. The lack of female role models reinforces the way females and especially young girls view the ICT industry as being male-dominated [13]. Female role models and mentors could be used to increase the percentage of women who take computer courses [32].

One possible solution is to expose middle and high school students to female role models such as female computer science instructors. Even girls with little or no computing experience perform surprisingly well and report positive attitudes when they are in the presence of female instructors [15, 22].

2.6 School

There have been many research papers written on the gender difference in schooling but few of these studies have focused specifically on related ICT influences [13].

Camp and Gruer talk about an earlier paper published by Camp in America he states that despite more girls taking up ICT at high school the number decreases when going on to tertiary education. Camp and Gruer [5] called this the “shrinking pipeline”: where the number of females decreases at each stage in the education process.

The traditional school classroom environment and outdated teaching methods can also cause female students to turn their back on ICT subjects early in their high school lives. Classroom atmospheres have been shown to have an influence on female students, who feel intimidated by the dominant number of male students, or neglected and isolated, and did not receive the right type of support [21].

Abbiss notes that girls lose interest in computing early on due to the fact boys will act without direction and monopolise the tutor’s time, leaving girls to figure out things on their own. She also notes that with the same opportunity to gain computer experience girls are capable of evenly competing with the boys. Boys typically
have access to computers and the use of computers at an earlier age than girls [1], so by the time they reach high school boys are more confident when it comes to using technology than girls [25]. Studies have found that computer enjoyment and interest decreases as age increases. This is the case for both boys and girls but is more extreme among girls [5].

Research in New Zealand shows that girls’ attitude towards ICT tends to become increasingly negative as they progress through schooling. A similar trend is observed in Australia and the United Kingdom [1, citing Alton-Le and Prat, 2000]. Abbiss also notes that girls and boys tend to interact differently with computers and with each other during learning episodes. Girls tend to favour collaborative forms of learning and engage in shared problem solving while boys tend to work more individually.

This attitude is neatly illustrated by a comment from a female high school student in an Australian study in 2011. She wrote: “I am not interested in how it does what it does as long as it does it” [8, p. 53].

Many students were put off studying ICT by their experience of computing in junior school (Years 9 to 10), stating that they had found it boring or that they experienced a lack of assistance in the learning programme or did not get the right help required [28].

Many took discouragement or encouragement from their high school teachers very seriously. According to Margolis and Fisher as cited by Timms et al [28], girls who may be inspired by computers have their interest extinguished during the school experience (p.3). When girls are exposed to technology in a single sex setting with supportive teaching and appropriate tools they show an increased interest and a confidence in technology [28]. Akbulut and Looney [4, p. 70] state that: “As technology continues to rapidly evolve it is important to deliver course content that is fresh, current and aligned with student’s interests”. Carroll, Howard, Vetere, Peck and Murphy [6] looked at the use of technology by female students in schools in the 16 – 22 year old age bracket and recommend that ways should be found to incorporate the use of this technology into the curriculum to entice young adults including girls to take up ICT degrees.

Classroom experience plays a large role in influencing females in the ICT arena. Women report that positive classroom experience led to an increased intention to major in computing and positive attitudes of their tutors and the support they received for the hands on activities really pushed them and made them look at the ICT industry in a different light. The single sex setting also increased confidence with equipment and also they had greater access to help [23].

Lang, Craig, Fisher and Forgasz [16] wrote about the findings from their research project called ‘Digital Divas’ which came from a UK based program Computer Club for Girls (CC4G). The idea was to expose Year 8 students to a variety of computing applications and experiences in a female-only club environment; and to try and make connections between various applications with courses and careers in computing by using university students as classroom mentors and facilitators (pp.38-39).

Lang et al. [16] find within Australian schools by the final year of schooling female students studying computing were in a minority of only 16.5 per cent. One of the conclusions about this low percentage was the ambiguity and inconsistency in the delivering of ICT units in secondary schools may be a factor of putting off females from going on to study further within the discipline. Lang et al also note that many of the teachers teaching computing have not completed a subject specific methodology in their teaching education program (p.39).

A smaller scale version of this type of method of educating females in computing is at Wellington girl’s school. Since 2002 students in Years 12 and 13 look after the computer lab and help mentor students alongside teachers. This has been very successful and the number of students involved has grown from just a few students to over 20. Despite these positive projects, there is no evidence that this is actual getting more females into ICT jobs or related courses.

From the findings, education delivery has not moved forward as quickly as technology in the past three decades and as a consequence the schooling and understanding of ICT trails behind. Until this imbalance can be rectified in the education sector, the gap between male and females will still keep on growing. The need to encourage female role models to stand up and be counted must be fostered within the ICT community and the understanding of parents on ICT within jobs needs also to be addressed.

3. RESEARCH METHODOLOGY
This paper investigates whether schooling, role models, family and media are perceived differently by high school students and whether there are any differences between male and female opinions.

A research project was conducted with students who were in the final year of their schooling within the Southland region. The survey samples were taken from four different schools across the region which included two town schools and two rural schools. The majority of the students were aged between 16 and 18 years of age and were completing the final year of high school. A total of 100 students was asked to complete the survey, 86 questionnaires were completed, resulting in 84 that were useable. Out of the 84 usable questionnaires, 51 were filled in by female students and 33 by male students.

The questionnaire was adapted from Abbiss’s questionnaire from 2005 and validated at one of the town schools, in a pilot study with 20 students. This allowed the researcher to amend/improve the questions from the results of the pilot study.

The anonymous questionnaires were completed during a four week period, from mid-September to mid-October 2012, and given to the students in class and then collected after they had completed the questions. The outcomes of the questions asked were measured by either category choice, a five point Likert scale, or by textual response. The quantitative data was then analysed within survey crafter software to give meaning to the data gathered.

3.1 Results and Analysis
The questionnaire was broken up into three sections’. The first section looked at the previous experience of ICT at school. The questionnaire has been added as appendix A to give clarification of each section and the questions asked.

Students were asked to rank their liking of a range of subjects including ICT from one through to five, one being ‘I hated it’, five being ‘I loved it’. The rankings of these subjects were averaged out of five and this provided a table of results. Overall both male and female students were equally likely to say they liked ICT lessons.
Female
Female
4
7
5
8
6
10
11
12
9
The aim of the next question was to find the perceived difficulty level of ICT at school.

Table 2: level of difficulty students found ICT at school.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Really Easy</th>
<th>Easy</th>
<th>OK</th>
<th>Quite Hard</th>
<th>Really Difficult</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>Per cent</td>
<td>9%</td>
<td>13%</td>
<td>14%</td>
<td>1%</td>
<td>1%</td>
<td>39%</td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>13</td>
<td>19</td>
<td>4</td>
<td>1</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>13%</td>
<td>17%</td>
<td>25%</td>
<td>5%</td>
<td>1%</td>
<td>61%</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>23</td>
<td>30</td>
<td>5</td>
<td>2</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>22%</td>
<td>30%</td>
<td>39%</td>
<td>6%</td>
<td>3%</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Out of the students that filled in this part of the questionnaire only one student from both male and female found the course really difficult. The percentage of females that found the course really easy to easy was 49% compared to the males which was 57%.

Students were then asked why they felt this way about how they found ICT at school. One of the responses that came up many times from the boys was “It’s only unit standards and therefore you can’t strive to achieve and do better”. Response that appeared multiple times from the girls was “Because we had a good teacher”. One of the negative replies that came up on a number of occasions from both male and female was “It’s boring”. The last comment that appeared multiple times was “Because there were parts which were easy to understand and then parts were very hard”. Again both male and female felt the same way.

The question then went on to ask what activities the students did not like about ICT. From the answers the overall comment that came up multiple times from both male and female was: it’s just typing and Microsoft Office. Twelve out of the 51 females did not answer this question but 11 that did, responded with typing and Microsoft office and 7 out of the males responded the same way.

Question 8 went on to ask why they chose ICT as a subject. The main answer to this question from the females was that they thought they needed some sort of computer skill later in life. One male and one female answered by saying they required it to get into University. The main answer from the males was it is easy marks.

Question 9 asked the students if they are studying ICT in their final year. From the data it can be seen that 60% of females questioned are not taking ICT and 54.5% of males are also not taking ICT. The main reason given by both male (7 students) and female (12 students) was “Not interested” from the students that answered this section of the question. Most students felt that it would not improve their chances of getting a job or getting into polytechnic or university.

Table 3: Studying ICT in final year

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>35</td>
<td>42%</td>
<td>15</td>
<td>45%</td>
<td>20</td>
</tr>
<tr>
<td>No</td>
<td>48</td>
<td>58%</td>
<td>18</td>
<td>55%</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>83</td>
<td>100%</td>
<td>33</td>
<td>100%</td>
<td>50</td>
</tr>
</tbody>
</table>

Question 10 looked at the age the students first started using technology.

Figure 1: the age students first used a computer

From the figure it can be seen, just over 20% of the female students started using computers before the age of 6, also from the table 62.5% of female students who answered the question were using technology before they were 9 years of age.

Question 13 asked the students how long they used the computer on a daily basis.

Figure 2: Computer usage on a daily basis

From the questionnaire 39.2% of female students reported they used the computer for about 2 hours a-day and 39.2% of females said they used it for about 4 hours a-day. This figure is slightly higher than the international average for female computer use [24].
Section three of the questionnaire looked at the future of ICT for the student, asking questions about the next step in their education. Questions 15 through 20 looked at the students’ future in ICT and if they were planning on going to polytechnic or university if so why and if not why. Out of 84 questionnaires filled in by the students only 4% of the female students were going on to polytechnic or university to study ICT related courses compared to 26.5% of males. Some of the reasons female students gave were “Good for future skills” and “I find computing interesting”. The ones that were not going on to study ICT at a polytechnic or university, gave responses such as “not interested, other plans, different career path”.

The questionnaire also looked at where the students go for career advice. From the results, career advisors came out on top with 92% of females and 88% of males going to them for advice. 82% of females and males went to their parents also for career advice. Teachers’ advice came in third with 76% of females going to their teachers for advice. From the outcome of the last question it was then asked if the student believed that they were getting the correct advice. 94% of the female students and 91% of male students thought the advice given was helpful to them for making their career choice. Students’ that said no to this question, responded by saying: “it is very general information given by advisors” and “they do not know me or what I want to do”.

Question 18 looked at the student’s attitude towards ICT. The students were given a list of positive attitudes towards ICT and then asked to rank them from strongly disagreeing to strongly agreeing. The attitude of both male and female students on ICT involves repetitive work; both male and female still thought that ICT involved the same thing over and over again. 18 out of 51 or 35% of female students also thought that ICT subjects were not relevant to their future career. Both male and female students said that they were familiar and confident using technology with 35% of females and 44% of males saying so.

One of the final questions that the students were given was to list five characteristics from a table containing 16 words that they perceived to be the main characteristics for a job in the ICT industry.

**Table 4 Overall rankings**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interesting Work</td>
<td>19</td>
<td>9</td>
</tr>
<tr>
<td>Independent</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>High Salary</td>
<td>35.71%</td>
<td>35.71%</td>
</tr>
<tr>
<td>Job Security</td>
<td>49%</td>
<td>57.14%</td>
</tr>
<tr>
<td>Work from Home</td>
<td>25%</td>
<td>40%</td>
</tr>
</tbody>
</table>

From table 4 it can be seen that the overall consensus for the top characteristic for a job in ICT is Interesting work. The second best characteristic chosen was Independent, where more females than males though this was a good characteristic to have in a job. The third characteristic was high salary which was even on the genders. Job security came out in fourth and working from home in fifth.

### 4. DISCUSSION

As a subject ICT was well liked by both male and female students out of all the subjects taken. Females ranked it third behind English and maths and males ranked it fourth, behind math, science and P.E. The reasons that some of the students disliked ICT at school were that it was all about the information and the way it was taught [5].

Both male and female students found the subject really easy to easy, suggesting that the subject matter needed to be looked at for students of today, 30% of females compared to 22% of males found this. A reasons they found it easy was that part of the syllabus used unit standards, which is not conducive to learning and understanding as students just had to follow instructions required [28].

Questions 4 through to 7 give an insight into why students put boring down as an answer when they had also put down easy to question 4. Out of the 23 females that put really easy to easy as an answer to question 4, 11 of the female students also put down boring or not interesting.

One of the major outcomes from the questionnaire was that 96% of the female participants stated that they would not go on to study ICT at a higher level due to the fact of being “not necessary for their career” and “not interested”, as where 77.5% of males said they would not go on to study ICT, giving the same sort of answers. Another fact that came out from the questions asked was the age at which students first started to use computers. 60% of the students started using a computer at eight years of age or before. The level of knowledge most students have by the time they reach high school is now beyond the level of the current curriculum studied [4]. It also can be concluded that females use computers for two major activities, social networking and homework.

A result came out from the question about career advice where 92% of the females went to their career advisor for guidance. The third place that students went was to teachers with 72% of females.
going to them for advice. The trust they gave to guidance advisors and teachers was very overwhelming with 93% of the students trusting the advice they are given is true and correct [3]. There was no definitive gap in the genders about attitudes towards ICT; both male and female students stated that repetitive work was involved in ICT having to do things over and over again which gave a negative light on the subject for the students. 18 out of the 51 or 35% of female students also thought that ICT subjects are not relevant to their future career. From the characteristics given in the table the female students thought that ICT work would be interesting, the second choice they gave was working independent which actually contradicts working in the industry today. Both male and female students looked at ICT as being high paid and secure, especially in the economic climate of today but more females than males still do not want to carry on in an ICT related job.

5. CONCLUSIONS

From the findings of the literature review and the results from the questionnaire, the major stumbling block for females and males comes from the information that is taught in Year 11 and 12 which is not up to the standard of knowledge and quality of the students that are currently taking the course. The course is out of touch with this generation of tech savvy students. Most of the course with its unit standards and typing skills does not embrace understanding and learning but puts off and discourage females from taking ICT as a subject. From the results there is a clear area that both male and female students do not understand, this is the perception of ICT professional job roles, this could be a deterrent for them entering the IT industry. Better education into what is ICT and how it applies to female students would be a good start. Programmes like the Digital Divas and Tech Angels program looks like it has had a positive impact on the upturn of more females who took part in the programs wanting to consider an ICT career path in the future and that their attitudes towards ICT had also changed. The media has a big part to play in addressing the imbalance of females in ICT and need to start showing females in normally male dominated roles.

5.1 Further Research

More research is needed to investigate how career advisor and tutors keep up-to-date with ICT and technology. The reskilling of advisors and teacher to give them a better understanding of what is expected in today’s society for a job in ICT needs to be addressed. The ‘Digital Divas’ program could be an area that could be looked at in New Zealand in a pilot to see if it will work within secondary school curriculum.

Over the last five years the New Zealand Qualification Authority (NZQA) have been looking into the ICT qualifications that are offered within the polytechnics around the country from level 1 through to level 6. Once these have come to fruition it would be a good idea to repeat the survey to see how the new ICT qualifications have changed the status quo.

Another avenue to research would be the ‘Tech Angels’ by looking at the study to see how many of the students that have gone through ‘Tech Angels’ have gone on to either study ICT at a higher level and or gone into an ICT related job (Tech Angles).

6. REFERENCES


25 Snell, S. & Snell-Siddle, C. (2007). Gender and ICT: Toys for the boys or pearls for the girls?


Appendix A: Questionnaire

1 Age: [ ] Male  [ ] Female

2 What type of information communication technology (ICT) course are you taking?

Experience of ICT at school

3 Please tick one box for each of the subjects you do at school to show what you think

<table>
<thead>
<tr>
<th>Subject</th>
<th>1 – I really hate it</th>
<th>2 – I don’t like it</th>
<th>3 – It’s OK</th>
<th>4 – I like it</th>
<th>5 – I love it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P.E.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geography</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Music</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drama</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4 How have you found ICT at school? Please tick only one.
- Very easy
- Easy
- OK
- Quite hard
- Really difficult

5 Why did you find ICT this way; in respect to question 4?

6 List 3 activities you enjoyed in your ICT class

7 List 3 activities you did not enjoy in your ICT class

8 Why did you choose ICT as a subject?

9 Are you studying ICT in your last year of school?
- Yes [ ]
- No [ ]

If not please pick one of the following as a reason
- Not Interested
- Too Hard
- Not Offered
- Too Boring
- Not Convenient
- Looked too easy
- Preferred other subjects

Experience of Computing

10 At what age were you when you first started using a computer?

11 Where do you most prefer to use computers out of school hours? Please tick one

- Home
- Library
- After school club
- Friends
- Other

If other please specify: ____________

12 Who do you most prefer to use computers with outside of school hours? Please tick one

- On your own
- With Parents
- With Brother/Sister
- Other Family members
- With Friends
- Other

If other please specify: ____________

13 How long would you say you spent daily on the computer? Please tick one

- 0 – hours
- 1-2 hours
- 3-4 hours
- 5-6 hours
- 7+ hours

14 What activities do you use a computer for? Tick the boxes that applies to you

- Games / Online games
- Social Networking
- Email
- Graphic Design
- Blogging
- Music
- Website Design
- Homework
- Programming
- Surfing
- Research
- Other

If other please specify: ____________

My Future

15 Are you planning to study ICT at Polytechnic/University?
- Yes [ ]
- No [ ]

If Yes why

If No why

16 Who/What do you go to for career advice? Please tick the boxes that apply to you

- Parents
- Brother/Sister
- Other Family Members
- Friends
- Career Advisors
- Career information leaflets
- Prospectuses
- Teachers
- Media incl. TV, Magazines
- Other:

If other please specify: ____________

17 Do you believe you are receiving the correct career advice?
- Yes [ ]
- No [ ]

If No why
18 What is your attitude towards ICT? Please circle the one most appropriate for you

<table>
<thead>
<tr>
<th>Attitude towards ICT</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am familiar with technology</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am confident using technology</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I have confidence in technology</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am interested in studying ICT in the future</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I think ICT is more for boys than girls</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Studying ICT locks you into the ICT industry</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am attracted to the ICT industry</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Working in ICT involves repetitive work</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Working in ICT means working on your own</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>ICT subjects are not relevant to my future career</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

19 In the table below are “ideal” career characteristics for ideal careers. Please circle the number that you agree with and that you believe best matches your ideal career.

<table>
<thead>
<tr>
<th>Ideal Characteristics</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interesting work</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Working with people</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Interesting challenge</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Creativity</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Responsibility</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>High salary</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Socially useful work</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Travel</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Flexible hours</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Independent</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Job security</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>High status</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Cool image</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Self employed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Working alone</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Working from home</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
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20 Choose five characteristics from the table above that you believe to be the main characteristics of a job in ICT, ranking them from 1 through 5, 1 being the most important and 5 being the least important.

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Thank you for your time.
ABSTRACT
Learning to program is a challenging task for novice learners. This study aimed to investigate students’ concepts as they were being formed. To capture these, we chose to focus on students who made some mistakes in basic concepts. Our study sought to capture students’ misconceptions at a very early stage in their study: five weeks into an introductory programming course. We invited students who did not pass an early mastery test at their first attempt to participate in a diagnostic and remedial session. In this session, the teaching team carried out one-on-one interviews with students to diagnose any misconceptions the students exhibited and devise individual remedial learning. The teaching team documented these interviews and these formed the basis of our phenomenographic analysis. Our main finding was that the lack of success in the test was attributable more to application of process than to conceptual misunderstandings. We also found that the technique of inviting students who do not succeed in a test to participate in a in-depth diagnostic interview and one-on-one remedial instruction was useful, even though no major misconceptions or alternative conceptions were identified.

Categories and Subject Descriptors
K.3.2 [Computer and Information Science Education]: Computer Science Education – programming misconceptions and mistakes.

General Terms
Human Factors.

Keywords
Misconceptions, alternative conceptions, novice programming, programming mistakes.

1. INTRODUCTION
Learning to program is a challenging task for novice learners [5]. Beginning programmers need to master a wide range of concepts [3] and consequently, it is not surprising that many wide scale studies have found that novices are struggling in the early stages of this learning process. Previous research has studied students’ learning of skills [9,10,21] as well as concepts [6,2].

The present research takes its starting point from a phenomenographic study on novice students’ understanding of the concepts object and class [5]. We believe that studying students as concepts are being formed can give us insights into the challenges they face as they struggle to master the necessary concepts. One way of identifying potential students who are in the process of forming concepts is to look at students who make mistakes in an assessment. Thus, we can use their mistakes in a sense as a lens, to capture their ideas as they are forming. Our study sought to capture students’ conceptions at a very early stage in their study: five weeks into an introductory programming course.

We believe this is important because a beginning programmer has to master many concepts and these build on each other progressively as the course unfolds. Unless there is a solid foundation in the early concepts, a student may struggle throughout the course [14].

The rest of this paper is organised as follows. In section two, we review related work. In section three, we describe our method. In section four, we present our findings. In section five, we discuss our findings. Finally, we present our conclusions in section six.

2. RELATED WORK
Students’ misconceptions are frequently reported in studies on students learning to program. Most introductory programming educators will recall when they were completely perplexed by how the novice programming students expressed their understanding of a critical programming concept. Ragonis and Ben-Ari present a large study with high school students learning to program. Their study includes detailed lists of difficulties and misconceptions related to several concepts in object-oriented programming [13]. Holland, Griffiths and Woodman claim that misconceptions of basic object concepts can be hard to shift later and that such misconceptions can act as barriers through which later all teaching on the subject may be inadvertently filtered and distorted [8].

Sanders and Thomas describe a close examination of student programs from an introductory programming course, in which they found evidence of misconceptions. Among other things they found difficulties in distinguishing between classes and objects, and in modelling [15].

Spohrer and Soloway studied novice Pascal students and investigated whether or not most novice programming bugs arise because students have misconceptions about the semantics of particular language constructs [18]. The authors found that for most of the bugs investigated that was not the case. Bayman and Mayer report on a study on beginning BASIC programmers’ misconceptions of statements they had learned [1], and Fung, Brayshaw and du Boulay report on novices’ misconceptions about the interpreter in Prolog [7].

These papers provide several viewpoints on the characteristics and common misconceptions of novice programmers that should be considered when designing approaches for programming.
education. These sources conclude, for example, that novice programmers are typically limited to surface knowledge of programs. They often approach programming line-by-line rather than using meaningful program structures. The knowledge of novices tends to be context specific and they also often fail to apply the knowledge they have obtained adequately. They may know the syntax and semantics of individual statements, but do not know how to combine them into valid programs.

2.1 ALTERNATIVE CONCEPTIONS

We use the term alternative conception to highlight conceptions that do not align with computer science, but are nevertheless rational and typically based on prior ideas that are useful in non-computer science contexts. As Smith and colleagues comment, “We suggest that misconceptions, especially those that are most robust, have their roots in productive and effective knowledge” [16, p.124]. Because such alternative conceptions are useful in many contexts, we would expect them to be difficult to displace. Indeed, it is questionable whether such an attempt should be made. As Smith and colleagues further note:

Instruction designed to confront students’ misconceptions head-on (e.g., Champagne et al., 1985) is not the most promising pedagogy. It denies the validity of students’ conceptions in all contexts; it presumes that replacement is an adequate model of learning; and it seems destined to undercut students’ confidence in their own sense-making abilities. Rather than engaging students in a process of examining and refining their conceptions, confrontation will be more likely to drive them underground. [16, p.153–4]

Moreover, a commitment to allowing the student enough freedom and time to explore an idea is essential. As Duckworth noted,

Teachers are often, and understandably, impatient for their students to develop clear and adequate ideas. But putting ideas in relation to each other is not a simple job. It is confusing; and that confusion does take time. All of us need time for our confusion if we are to build the breadth and depth that give significance to our knowledge. [4, p.82]

From these two perspectives, we should not attempt to expose and confront misconceptions too readily. Nevertheless, we believe that it is helpful to us as educators if we can develop a better sense of the alternative conceptions held by students.

3. METHOD

The context of our study is a compulsory introductory software engineering course, at level 5 in the New Zealand Qualifications Framework [11], which is taught over one semester as part of a three year computing degree. In the first five weeks of the course, the Scratch programming language is used in tutorial sessions to introduce fundamental concepts that underpin programming: variables, sequence, selection, repetition, recursion, and message passing. At the end of this segment, students take a test which assesses their ability to trace and analyse code. The test has six questions; for each question, the student has to predict correctly the output of a short program. Students are expected to carry out hand execution of the code to determine this output. However, a student who can read and understand the program as a whole could bypass the desk-checking process and determine the output directly from their understanding. This test has a mandatory pass requirement. Students who fail the test are allowed one resit, but those who fail the resit cannot pass the course overall.

In this study, we focused on those students who did not pass the test. We were interested in exploring in more detail the reasons for failure. Our interest was motivated from two points of view. First, as part of our normal teaching practice, we were interested in what interventions we could take to enhance the chance of students passing the test on a resit. Second, from a research perspective, we were interested in whether we could derive any general lessons or principles from what we found. In this regard, the tacit theory underlying our teaching is the use of a constructivist learning environment with heavy scaffolding [23]. In the absence of an explicit theory of programming mistakes, we used an exploratory approach based on interpretative phenomenological analysis [17] of a discourse between student and teacher.

We approached students who did not pass the test at their first attempt and invited them to participate in a diagnostic and remedial session. All students chose to participate in this session. Members of the teaching team were assigned to students and worked with them on a one-to-one basis. The assigned teaching team member reviewed the student’s test answers with the student and asked the student to demonstrate how they carried out the desk-checking tasks that gave rise to the answer they had submitted. Each lecturer produced a written report summarising each of these sessions with students and these reports were shared and discussed among the teaching team and used as the source for the analysis in this research.

4. FINDINGS

In this section, we present the lecturer summaries of three of these student interview sessions. We believe these are representative of the overall range of findings.

Student A was a mature female student. She struggled to relate to the course and after failing the resit, withdrew from the course. We present our findings for this student in Section 4.1.

Student B was a mature female student, who also struggled at first to relate to the course. However, she reacted well to the remedial instruction and subsequently succeeded in the test resit and the course overall. The investigation of this student is presented in section 4.2.

Student C had no difficulty understanding the material and related well to programming. However, he felt that using formal desk-checking was too time consuming and looked for shortcuts. Nevertheless, he reacted well to remedial instruction; he subsequently achieved 100% on the test resit and a high grade overall for the course. Section 4.3 presents the investigation of this student.

4.1 Student A

The student was given six different segments of program code to study (under examination conditions) and determine the correct outputs. In the first attempt at answering the questions 5 out of the 6 were answered incorrectly. If one considers success in determining the correct answer is to apply the principles of desk checking, then those principles that were demonstrated and applied during class lectures did not allow the student to achieve this result. The question is why?

The student was asked to study the questions and explain her understanding of what the code was designed to achieve to a staff member. In all cases the student version of the structured desk check taught in class was used. That is to say the methodology taught was not used but a student interpretation of it was. The same general approach and methodology was used with each of the six problems involved.

The procedures used by the student involved an undisciplined method of recording the outcomes of each segment of program
code. In fact the procedures were so undisciplined that the student wrote specific outcomes and results obtained from program code execution in random locations on paper and became totally confused as to where the latest and last result was recorded. That is to say the inability (or unwillingness or failure to identify and replicate, use and apply the structured methodology taught in lectures appeared to hinder the ability to derive the correct solution to the problem.

As an observation, when the student commenced using the standard desk-checking procedures an improvement in the ability to correctly identify code segment outcomes was obtained at a faster and more accurate rate.

4.2 Student B

The academic history of this student demonstrated consistently high academic achievement. However, surprisingly, the student did not pass the test of applying desk-checking with the required minimum mark. To find out the reason why the student failed, the following investigation was implemented.

First, the student was asked to identify which questions the student did not answer correctly in the test. The student did not know. Then, a staff member indicated the incorrect questions and asked the student to re-calculate these ones. The staff member observed how the student applied desk-checking.

It was found that the student did not use the version of desk-checking taught in class. Instead, the student used a different one. The student’s own version of desk-checking clearly involved a less disciplined method of recording the outcomes of each segment of program code. That created an unclear trace of calculation. It confused the student when the student tried to retrieve the temporary values of variables during the calculation. It also prevented the student to implement an effective double check after completing the calculation. Moreover, it was quite difficult for the student to identify which step of the calculation was wrong, even if the student had doubt about calculated values and/or results.

Eventually, the staff member demonstrated how to use the desk-checking taught in class to solve one of the questions which the student did incorrectly in the test. The student was then asked to recalculate all incorrect questions by applying the class version of desk-checking. All questions were solved correctly at a faster and more accurate rate.

Later, the student passed the re-sit test of desk-checking by correctly answering 5 out of 6 questions.

4.3 Student C

This student had a good grasp of programming concepts and subsequently passed the introductory programming paper with a high grade. However, surprisingly, the student did not initially pass the test with the required minimum mark. To find out the reason why the student failed, we carried out the following investigation.

We asked the student to show us his desk-checking method for the questions that he answered incorrectly in the test. Interestingly, he was able to demonstrate a flawless performance when desk-checking each of these questions. When we probed further, he mentioned that he has done desk-checking for the first two questions but, because he found the desk-checking process tedious, he decided to guess the answers to the remaining questions rather than meticulously doing further desk checking. The consequence of this guessing was that he ended up scoring lower marks than he would have achieved if he had applied his desk-checking technique.

In summary, this student had a perfect understanding of desk-checking and a sound grasp of logic. He achieved 100% in his test resit.

5. DISCUSSION

We begin by analysing our intervention from the perspective of attribution theory [22]. Weiner's theory analyses attribution across three dimensions: locus of control (internal and external), stability, and controllability. How a student attributes the reason for lack of success is important because it affects the student’s motivation to remedy the lack of success by engaging in further learning. For example, an attribution to luck which is external and uncontrollable would create little motivation to learn. Similarly, an attribution to internal stable factors such as personality would create little motivation. However, all of the students attributed the reason for their lack of success to an internal locus of control, believed that the outcome could be modified, and believed that this was under their control. This combination suggests that the application of remedial techniques could be effective and supports the approach of offering students who did not succeed on their first attempt the option of attending a diagnostic session with subsequent remedial instruction.

A student is also affected by their motivation for the subject. Subsequent to the experience presented in this paper, the students took different study paths. Student A has a previous degree outside the computing field and was doing the course to develop her understanding of computing rather than to gain accreditation. She has not yet decided on further study. Student B subsequently chose a study path leading to a major in Information Systems. Student C chose a study path leading to a major in Software Engineering. Race [12] uses the terms wanting for intrinsic motivation and needing for extrinsic motivation. At a superficial level, we could say that student C wanted to learn programming and student B needed to pass this compulsory course, but student A neither wanted nor needed nor needed to learn programming. However, this probably underestimates the complexity of human motivation.

We can add two more perspectives. First, desk-checking and tracing is included in the course primarily as scaffolding to support understanding [23]. As a student’s understanding of programming grows, there is less need for such scaffolding and it may be withdrawn. However, the need for scaffolding will vary from student to student and thus the timing of withdrawing scaffolding needs to be considered carefully. Analysis of student C’s performance suggests that the scaffolding may have been withdrawn prematurely in his case.

A second perspective is that of cognitive load theory [20]. Although scaffolding techniques, such as desk-checking or hand execution are introduced as an aid to student understanding, there is a risk that the use of formal techniques might become just another thing for a student to learn and master. Effective instructional design requires careful consideration of the cognitive load imposed by a technique when considering the benefits that arise from its use [19].

Our experience with this exercise has led us to believe that the technique of carrying out in-depth diagnostic interviews with students who do not succeed in a test, and then engaging in one-on-one remedial instruction can be beneficial. In short, such an early intervention works, but it may not work for everyone. A successful intervention is likely to require both that the student
attributes the cause of lack of success to internal, malleable, controllable factors and that they are motivated to succeed in the course, whether this motivation is intrinsic or extrinsic.

We also believe that the nature of feedback given to a student is critical. Such feedback needs to be personalised and given in a form that can be readily acted upon by the student.

6. CONCLUSION

We found that the technique of inviting students who do not succeed in a test to participate in an in-depth diagnostic interview and one-on-one remedial instruction was useful, even though no major misconceptions were identified. Indeed, we found that the lack of success in the test was attributable more to application of process than to conceptual misunderstandings or alternative conceptions. However, our diagnostic interviews focused closely on performance in the test and it is possible that a more broadly focused interview would have discovered alternative conceptions.

Our study was carried out with a single cohort of students in a single course. Accordingly, we do not believe that it is appropriate to generalise from these findings to other contexts. Nevertheless, we believe that the approach to intervention could be tried and evaluated in other contexts.

We plan to continue to explore and refine the use of this technique. In particular, we will use a broader approach in our diagnostic interviews to attempt to elicit alternative conceptions.

7. REFERENCES


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Through the looking glass: Innovative interview experiences for ICT students

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ABSTRACT
This paper provides an overview of previous research undertaken that supports the importance of soft skills for ICT graduates. Specifically this paper reports on the development of a professional practice course including the introduction of an innovative interview technique that was developed as a major component this new course. This interview component was intended to provide ICT graduates with the ability to perform at the highest possible level in interview situations. Data from several iterations of the activity were collected and analysed. This analysis agreed with previous studies and revealed that in an interview environment students were most likely to struggle in the soft skills area. The study also found that the new interview technique allowed students to gain confidence and learn about the interview process from the first person and third person perspectives. Additionally, it allowed students to reflect on their performance through video and lecturer feedback.

Categories and Subject Descriptors
K.3.2 [Computers and Education]: Computer and Information Science Education – Curriculum, Information systems education

General Terms
Performance, Design, Human Factors, Theory

Keywords
ICT education, soft skills, emotional intelligence, professional practice, interview techniques.

1. INTRODUCTION
The nature of work in the ICT industry has evolved over the last decade and ICT graduates are expected to possess not only technical skills but highly developed interpersonal skills and emotional intelligence. ICT professionals now need to develop the ability to seamlessly communicate with colleagues and customers on a technical and non-technical level. This has resulted in an increasing demand for soft skills from employees in the ICT industry. In an article by Salpeter, likability or cultural fit is identified as a determining factor for ICT job candidates [11]. Salpeter also highlights that soft skills or emotional intelligence is the category of skills most likely involved when evaluating likability or cultural fit [11].

The Bachelor of Information & Communications Technology (BICT) at the Universal College of Learning (UCOL) requires a compulsory 45 credit industry-based/capstone project over one semester which is the students’ final semester and culmination of their studies. The Professional Practice course was added to the curriculum as a prerequisite to this industry project to ensure students gained an awareness of the importance of soft skills and emotional intelligence, making them ready for professional integration with industry, the work setting and subsequent recruitment processes.

The aim of the Professional Practice course is to apply communication theories and practice in a professional context. Students also source an industry project and produce appropriate documentation.

The key learning outcomes of the course were:
- Analyse and evaluate applied communication principles
- Demonstrate effective communication skills
- Procure an industry based project
- Create project scope documentation
- Demonstrate ability to work in teams

The content from the course also includes:
- Organisational communication
- Curriculum Vitae preparation
- Interview skills
- Client management
- Conflict resolution
- Assertiveness
- Negotiation skills
- Presentation skills
- Team roles and managing teams
- Industry project overview and project sourcing

The course normally includes the following assessment structure:
- Curriculum Vitae and covering job application letter
- Project proposal presentation
- Project Management Plan documentation and presentation
- Team building workshop
- Interview skills and role play session

The intention of the course structure is for students to complete the interview skills and role play session prior to sourcing their projects and developing their project proposals and management plans. The interview skills and role play session has been developed as an innovative approach for enhancing students ability to perform at a high level in interview situations.

Industry project students often find the interview/initial contact with their project sponsor daunting, as for many students this is
their first encounter with a potential ICT employer. The final choice as to who completes a project is with the sponsor, and if students fail to impress, they can find it difficult to secure a project. Student performance in successfully securing and completing an industry project can be a predictor of future employment success. Consequently those students who are well prepared for their industry projects will also be well equipped for entering graduate employment.

2. BACKGROUND
There appears to be a gap in the literature as to how graduates should actually portray soft skills. Research conducted by Coll, Lay, & Zegwaard [3] reported that students felt their performance at interviews was lacking as they found it difficult to come up with enough examples within the tight timeframe of a job interview. The literature gives little guidance as to how employers assess for soft skills in the pre-employment phase. McCormack [9] and Isaacs [6] believe employers do not use detailed assessment procedures when hiring, relying instead on subjective judgements or instinct when making employment decisions rather than clearly identifying the skills necessary for the job. In a review of the literature Joseph, Ang, Chang, and Slaughter conclude that there has been very little systematic research that has conceptualised or measured these soft skills [7]. Joseph et al. also introduce the idea of practical intelligence which they describe as an overarching concept that could provide a better understanding of the broader set of soft skills required by ICT professionals [7]. They believe that successful ICT professionals not only need technical knowledge and skills but also require practical intelligence which is the managerial, intrapersonal, and interpersonal skills that are used to resolve ICT related work problems [7]. Litecky, Aken, Ahmad, and Nelson support this idea by suggesting that the ICT professional’s role has expanded to include not only technical skills but also increased knowledge of the business, critical thinking, and communication skills [8]. Furthermore, Carter highlights that soft skills are important to students’ future success in industry pointing out that employers are explicitly asking for these skills [1]. Carter also suggests that capstone courses could be altered to afford more opportunity for soft skill education [1]. Interestingly, Joseph et al. also conclude that there is room for research into comparing the efficacy of improving emotional intelligence (or soft skills) through methods such as formal training, mentoring or actual work experience [7].

Soft Skills can be defined as skills, abilities, and traits that pertain to personality, attitude and behaviour rather than formal or technical knowledge [9]. Soft skills include attributes such as team work, communication and interpersonal skills, customer service, leadership, motivation and willingness to learn. Stevenson and Starkweather identify six critical core competencies for successful ICT project managers, these were: leadership, the ability to communicate at multiple levels, verbal and written skills, attitude and the ability to deal with ambiguity and change that were indicative of characteristics important to successful project management [13]. Duncan summarises soft skills attributes as being: self-management, team working, business and customer awareness, problem solving, communication and literacy [4]. Moss and Tilly [10] identified two distinct groups of soft skills - interactive skills and motivation skills. Interactive skills are where an employee needs to interact with other staff and motivation skills are focused on the intrapersonal factors that determine the level of work output of an individual. Aspects from both soft skills groups are required if an employee is to succeed in the current IS workplace. In contrast to these soft skills ‘hard skills’ are the technical skills relevant to a particular industry [5]. In the ICT industry some of these would include systems analysis, database concepts, networking and programming [14].

In previous work softs skills identified as relevant for ICT students were divided into two categories: interactive soft skills and motivation soft skills [10], [12]. The nine interactive soft skills were as follows:

- Listening
- Interpersonal
- Relationship building
- Written communication
- Adaptability
- Team work
- Friendliness
- Attire
- Grooming

The 10 motivation soft skills were:

- Planning
- Initiative
- Problem solving
- Enthusiasm
- Stress tolerance
- Dependability
- Time management
- Innovation
- Willingness to learn
- Self confidence

Based on the work done by Snell, Snell-Siddle, and Whitehouse, [12], the top three interactive soft skills as identified by employers were listening, interpersonal and team work. The top ranking motivation soft skills were willingness to learn, enthusiasm, problem solving and initiative. These findings were also supported by earlier research conducted by Coll, Zegwaard and Hodges [3].

Based on the literature soft skills have been clearly identified as a necessary attribute for ICT graduates looking to begin work in the ICT industry. As these skills are now known as critical for ICT employment it is imperative that educational institutes not only embed soft skills within the curriculum, but also to explicitly provide focused, experiential learning for students to develop and portray these soft skills.

3. METHODOLOGY
In light of the research and the importance of soft skills an innovative interview role play assessment was developed as a major component within the Professional Practice course within the BICT degree. In a related study, Chen, Muthitaacharoen, and Frolick, looked at the effectiveness of role play exercises for soft skills improvement for ICT professionals [2]. They found that role play exercises were an active learning technique that created training situations where the interpersonal interactions and communication flow characteristics of the ICT industry can be simulated. They concluded that role play exercises were a viable training method which can rapidly improve communication skills, allow participants to experiment with different strategies without real consequences, and also enhance to self-confidence of participants (2003).

Building on what is known about soft skills education, an innovative interview role play technique was developed for this
study. It was designed to create an awareness of soft skills and to provide students with a real world experience that highlights the importance of being able to demonstrate an array of the necessary skills, abilities and traits required in an interview situation.

The role play interview exercise comprised of a panel of three ICT industry representatives who took the role of potential employers. The students took on two role during the exercise, first as a third person observer of the interview process, and then secondly and the interviewee. The students took turns in the ‘hot seat’ as the interviewee, meanwhile, the rest of the class would observe the interview process from the perimeter of the room as shown in figures 1 and 2.

Prior to the interview role play the panel members were briefed by the Professional Practice lecturer and were given a structural outline of the interview activity with starter questions and a job outline with scenario (these resources were also made available to the students prior to the activity). Panel members then build from these starter questions and scenario to ask more technically specific questions. Panel members were also asked to give a five to ten minute presentation to the students about how they interview within their respective organisations and key characteristics that they look for when interviewing. These presentations occur directly before the role play exercise and help to set the tone for the coming activity for both the students and the panel members.

![Figure 1. Student in the hot seat with peer observers](image1)

![Figure 2. Interview panel with student participant](image2)

In the weeks leading up to the role play exercise extensive preparatory work is undertaken with the students. Information about the interview process, typical interview formats, common questions, presentation tips, and non-verbal communication skills are covered. Examples range from suitable business attire, personal hygiene, hand shaking, eye contact, ways of answering behavioural descriptive and hypothetical type questions, building rapport, and ways of coping with unexpected questions and interview stress.

Once the interview role play begins each student is randomly called to the interview hot seat by the lecturer. The student will remain in the role of the interviewee for approximately five minutes during which they will answer three to four unique questions. As this is happening the other students are observing the interview process from a third person perspective. This allows each student to learn from not only their own experience, but also from the experiences of other members of the class as they respond to different questions. Furthermore, the entire interview role play activity is filmed enabling each student the ability to review and reflect on their interview experience.

Post interview role play each panel member provides general feedback to the students as a whole regarding the activity. This feedback often includes comments about student responses and interview performance. Positive aspects are highlighted as well as areas that could be improved. This debrief session is often interactive allowing students to seek clarification, ask further questions, and gain specific feedback from the panel members. Finally, to conclude the session an afternoon tea is provide which
also doubles as an opportunity for students to network with the panel members.

The research sample used for this particular study consisted of students enrolled in a level 7 professional practice course. The students were all in their final year of study and were preparing to source industry based capstone projects. The experiences reported on in this study were collected from several iterations of the professional practice course. The data used in this study were collected via general verbal discussions, participant observations, and analysis of the recorded interview footage. The research sample was predominately male with the majority of students being in their mid-twenties.

The interview role play sessions were conducted during the first half of each semester. The activity takes approximately two to three hours and is often dependant on the size of the student group. Furthermore, the interview role play session was also a compulsory assessed component of the professional practice course. Data were collected during these sessions by the lecturer acting as a participant observer, assessor, and session facilitator. Video footage of the interviews was also used as a data source for this study.

4. RESULTS AND DISCUSSION

Although data were collected from several iterations of the interview role play activity, the results will be presented and discussed from the perspectives of the three main roles the participants played during the activity: the student perspective, the panel perspective, and the lecturer perspective.

4.1 The Student Experience

Prior to the session, students reported feelings of anxiety and nervous anticipation, despite the preparatory work undertaken during class time. Although at first thought this sounds like a negative experience, it in fact demonstrates that the activity is a true reflection of a real world interview experience.

During the interview activity, students began to adapt to the environment and were able to draw on lessons learnt in the preparatory sessions. After students had completed their turn in the “hot seat”, they appeared more relaxed, as would be congruent with a real world interview. However students were still able to observe their peers being interviewed. This was a unique environment in which students were able to gain exposure to the varying questions and responses, thus providing a learning experience that otherwise would not be encountered in a real interview situation.

After the “hot seat” component, students actively engaged with the interview panel members. During this dialogue students were observed as being more relaxed, however they still maintained an appropriate level of professionalism towards the panel members.

In the subsequent weeks/months, as students had time to reflect they began to appreciate how beneficial the experience was. This was particularly evident when students were able to draw on the experience when securing their industry based capstone projects and interacting with their potential sponsors. Furthermore, students from the earlier iterations of the exercise who successfully entered the job market have reported the activity as being essential to their success during the interview process.

4.2 The Panel Perspective

Each semester the panel members report that they are impressed with the level of professionalism demonstrated by the students. Some students have also been “head hunted” by members of the panel as a result of their performance during the role play interview. The panel members have always been very supportive of the role play activity and are always willing to participate in future iterations.

4.3 The Lecturer Perspective

From the lecturer’s perspective, the interview role play activity functions extremely well as an assessable component in the Professional Practice course. The lecturer does need to act as a facilitator during the session however this is not a time consuming role. The majority of the time, the lecturer can act as an assessor, observing each student’s individual performance as well being able to review video footage of the interviews to assist with marking and feedback to the students. The activity is also a great way to bring industry into the classroom and connect students with employers.

5. CONCLUSION

There is no doubt that the portrayal of soft skills play a role in most, if not all, hiring decisions. The interview role play technique developed for this study has proven invaluable for students providing them with a real world experience, highlighting the importance of being able to demonstrate an array of the necessary skills, abilities and traits required in an interview situation. The role play activity, while providing the real world interview experience, goes beyond this and gives participants the opportunity to hear a wide range of other “interviewees” responses and their reactions to challenging and “left field” type questions.

The interview role play technique was a valuable learning experience for the participants, providing them with an opportunity to engage with ICT professionals, while at the same time completing part of the assessment requirements for the course.

The researchers envisage that the interview role play activity could well be applied to any discipline which requires students to work within industry as part of their study. Future work could include surveying students, lecturers, and panel members before and after to collect quantitative and qualitative data relating to the suggested benefits and insights of the activity.

6. REFERENCES


Developing a Learning Tool for IT Education

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ABSTRACT
In this paper, the design science methodology is used to develop and evaluate a learning tool for use in a student centered, collaborative learning environment. The particular learning environment used in the study involves first year programming students in a tertiary environment and consideration is given to the special needs they have in learning a technically challenging and constantly evolving topic. A range of issues facing educators and learners is explored and from this the key requirements of a supportive learning tool are identified. This is used as the basis for developing a learning tool which is then evaluated using a combination of quantitative and qualitative methods. The tool used in this investigation was based on an adaptation of the Microsoft OneNote® application. It was found to be generally supportive in the chosen environment but further research would be required to determine if the results were transferable to other learning environments.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education – collaborative learning, computer-assisted instruction (CAI), computer-managed instruction (CMI).

General Terms
Documentation, Performance, Design, Reliability, Human Factors.

Keywords
Learning and Teaching, e-learning, Design Science, Artifact based research, Student centered learning, Interactive learning tools, Microsoft OneNote®

1. INTRODUCTION
Education, like information technology, has seen many changes in my lifetime. The teacher-centric primarily one way flow of information has changed to a student-centric two way flow of information. Currently, education is undergoing a further transformation to a student-centric discovery of information. This change has been prompted not only by the development of our understanding of the process of learning, but also by the recognition of the needs of the workplace for employees who are lifelong learners with “adaptive expertise” [3]. Historically, experts were specialists in their field and any new work built on their body of knowledge. Bransford suggests that technology is changing so fast that experts need to be able to adapt, not just specialise, and that this is a skill we as educators need to impart to our students. No longer can the educator be the font of all knowledge, the student has to learn to discover for themselves their own path to learning. While Bransford’s work focussed on the Engineering environment and its rapidly changing technology, his findings are equally valid in the IT sector which also faces continuous development of technologies.

This new style of learning is a challenge for both educators and students. There is a certain comfort in leaving a lecture with a wad of carefully copied notes. In their work on student centred learning, Lopez and colleagues agree that student centred learning empowers students and enables them to achieve but caution that “Students may be uncomfortable with practice that is not aligned with their expectations and may worry that they will not achieve their learning objectives adequately” [10]. So while research shows that this new style of teaching encourages self-learning and teaches a new skillset which Bransford suggested is needed in a technological environment, this may not have the support of the student (or possibly even the educator).

This research seeks to identify a tool to reduce the challenges facing learners and educators who adopt this style of learning. It will also consider the changes introduced by environmental factors such as increased class sizes, increased teaching load for educators and reduced contact time per subject. It will look at the changes students face as learning moves from textbooks and lecture halls to student supplied resources (BYOD’s) and open space environments.

As a learning tool is to be produced and assessed, a Design Science approach has been selected. This provides a structured iterative process well suited to developing and evaluating an andragogical artefact. Hevner and associates note: “The result of design-science research in IS is, by definition, a purposeful IT artefact created to address an important organizational problem.” [7]. It allows for a pragmatic combination of qualitative and quantitative evaluation of the learning tool with a problem centric approach. Offerman and co-authors explain: “The process combines qualitative and quantitative research and references well-known research methods” [11].

The rest of this paper is structured according to the design science methodology [4] of:

- problem identification and motivation
- definition of objectives of a solution
- design and development of an artefact
- demonstration of the artefact
- evaluation of the artefact
- communication of the results

2. PROBLEM IDENTIFICATION
As discussed in the introduction, both the way we teach and the graduate capability requirements of our students are changing. In addition to this, there is constant pressure to do more with less
particularly as performance (as measured by pass rates) is now a key funding metric. Some institutions are removing lab based computers in favour of student supplied technology (often called Bring Your Own Device or BYOD), are eliminating text books and are altering the dynamics of the classroom to reinforce the shift from teacher-focused to student-focused andragogies.

Students are also driving their own changes, with texting, Twitter and Facebook the communication tools of choice. Students can create, join, leave and re-join collaborations at will. They expect instant (synchronous) communication and instant feedback but show a preference for communication with their lecturers to be separate to their peer networks and to some extent to be asynchronous [2].

The tools we have traditionally used to support learning were developed with a lecturer-focused learning approach and as technologies developed these traditional tools were adapted to the new technologies. For example we have seen the progression from blackboard to overhead projector to PowerPoint display without necessitating a real change in andragogy. Even advanced tools such as Blackboard (the course management tool) are used by many as an organisational and document management tool rather than an instructional tool [16].

The challenge for educators therefore is threefold; to meet the demands of the current teaching environment; to create a supportive and collaborative learning environment; and to meet the students’ expectations of synchronous communication.

3. OBJECTIVES OF A SOLUTION

While the identified problem does not necessarily require a technological solution, it is the intent of this paper to identify, develop and evaluate a technological tool for this purpose. As such, it is important to define the key elements of an ideal solution. This can then be used not only in the selection and development of the learning tool but also in the evaluation process as a measure of the success of the artefact.

3.1 Demands of the current teaching environment

Prior to the commencement of this study, several focus groups of IT lecturers were asked to consider the requirements of an ideal learning tool. These were convenience samples containing specialists in the IT education sector. Although these focus groups cannot be considered a representative sample, they contain the collective expertise of many years in the IT education sector. Thus, the findings they produce provide a strong starting point for defining the objectives of our solution. Their initial findings were summarised into a list of key requirements and this list was then rated under the categories ‘required’, ‘preferred’ and ‘optional’. Table 1 summarises these findings.

Table 1: Focus group results

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Required</th>
<th>Preferred</th>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Independent, supporting tablets and smartphones as well as the more traditional laptops and pc’s.</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessible anywhere/anytime</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fully interactive, integrating seamlessly with Smartboards and other interactive tools</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supports group work</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick and easy to navigate between resources</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supports student centered learning</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support a changing environment</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provides a resource center for students</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptable to student and lecturer needs</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Andragogically flexible</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supports online testing</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Affordable or free</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Empowers students and lecturers</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Low learning curve</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Supports multiple types of files</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Avoids excessive validation (such as multiple login requirements)</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Instantly updates as work developed</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Private and secure</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Highly customisable</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Students are increasingly using BYOD devices. These incorporate the full gamut from smartphone to high end laptops. While some specialist papers would require a minimum standard (including entry level programing papers), these are in the minority. A learning tool will need to be adaptable to all devices. Microsoft’s white paper on BYOD devices in education [5] reflects on the capabilities of each device. It determines that many devices such as tablets and smartphones are best suited to the consumption of information rather than the production and care should be taken to ensure students have a device suitable to their needs. This runs contra to the focus group beliefs listed above where a key requirement for a learning tool is to be fully device independent.

While there may be some standards imposed, clearly any learning tool must be device and operating system independent. In addition to this, simply equipping students with their own devices and digitising existing curriculum is not the right approach. The challenge for any BYOD incorporation is to create “confident, flexible, self-directed, lifelong learners” [5].

3.2 Needs of a supportive collaborative learning environment

One of the main IT streams to be supported is the programing stream. Evidence suggests introductory programing presents
particular learning challenges, but how does this affect our learning tool design? Literature suggests that for entry level students “an average student does not usually make much progress in an introductory programming course” [1]. It also notes that there are typically two types of students, “students who learn without excessive effort and those who do not learn without inordinate personal attention” [1].

Robins has an explanation for this bimodal outcome for programing students. He suggests a new model for student learning (described as the ‘learning edge momentum model’), where learning objectives are interrelated and failure to understand one element impacts negatively on the ability to comprehend another. This results in failure rates of up to 60%, particularly as class sizes increase [13]. One suggested solution to this problem is through collaborative work on projects relevant to the student [3].

It is useful then to describe the key elements of a collaborative style. Based on Scheuermann’s work [14], these are:
1. activities that are learner centred
2. instruction that is personalised
3. learner experiences that are solicited and linked to the learning
4. student needs that are assessed
5. educational climates that are developed where making mistakes and taking risks is normal
6. learning processes where the learners play an integral role
7. opportunities for personal development that are flexible

Clearly, there is an opportunity for technology to support collaborative learning but many of the objectives identified above could be accomplished without any technological support. IT education is perhaps unique in the sense that many of its subjects could not be taught in the absence of computers and there is an expectation that IT students can adapt readily to new technologies. The temptation then is to adapt all teaching to utilise available computing tools, but this is not necessarily desirable. Indeed some argue it is better to use “seamless movement into the use of the computer to complete an activity or lesson only when the technology would truly augment learning” [16, p.12].

3.3 Students Expectations
Existing research suggests that digitally-minded students want information fast but they want it presented visually and interactively [2]. They choose to engage in synchronous interactive activities among their social network. However, this does not necessarily translate to a learning environment where artificial communities are established. To achieve truly collaborative groupings requires cohesion, trust, respect and a sense of belonging. Simply providing an environment where collaboration can occur does not mean it will occur [9].

4. DESIGN AND DEVELOPMENT
The objectives can be grouped into 7 distinct requirements (Table 2).

<table>
<thead>
<tr>
<th>Table 2: Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports multiple simultaneous users for both synchronous and asynchronous use</td>
</tr>
<tr>
<td>Easily accessible and readily available</td>
</tr>
<tr>
<td>Customisable to the needs of the user</td>
</tr>
<tr>
<td>Provides for resource storage and retrieval</td>
</tr>
<tr>
<td>Works with interactive tools such as SmartBoards</td>
</tr>
<tr>
<td>Integrates seamlessly into the lesson</td>
</tr>
<tr>
<td>Quick and easy to both use and to learn to use</td>
</tr>
</tbody>
</table>

4.1 Existing Tools
Currently employed learning tools (such as Blackboard© and Moodle©) meet some but not all of these needs and are constrained in their design. Ray Henderson, president of teaching and learning at Blackboard, agrees that we “are facing a sudden change in the landscape of student use of computing devices” which requires “a bold, imaginative approach” not possible through adaptation of existing products [6]. While Blackboard and others are looking to develop new, more flexible products, at the time of development of the teaching tool these were not available for consideration.

Google Docs, Office 365 and similar online systems can be adapted for use as a learning tool and offer excellent synchronous and asynchronous collaborative opportunities. They meet most of the requirements given, are affordable, customisable and easy to use. As these are a third party online service, server and firewall issues prevented these being considered for this study. While it is acknowledged that these issues can be overcome, it would require an attitudinal shift in some quarters and raised compliance concerns beyond the ability of the researcher to influence.

Social networking tools such as Facebook, blog sites and even YouTube© can also be being adapted for andragogical purposes. These were not selected for this study due to major privacy concerns with this particular media [15].

4.2 An alternative tool – Microsoft OneNote©
One tool which appears to meet most of the requirements is Microsoft’s OneNote©.

First, it supports multiple simultaneous users for both synchronous and asynchronous use. It has a database engine behind it, allowing multiple users to access resources simultaneously. If students have read/write access to a common file store they can work simultaneously on the one document either co-authoring one page or each working on a separate page to produce a combined output.

Second, it is easily accessible and readily available. Students have access to the web version of this product as part of their student email suite and free OneNote apps have become available for I-devices and Android. In addition to this, the Dreamspak STEM subscription allows students to download the full version free for study purposes giving them the ability to use OneNote on multiple devices and any location and files stored on network drives can be accessed without any additional authentication. Native format documents are stored in an ‘open’ state, moving between them is simple and quick with no delays while a document loads.
Third, it is customisable to the needs of the user. Each user can customise their own notebooks and add pages from a common source as needed.

Fourth, it provides for resource storage and retrieval. In addition to its native pages, it can provide either a storage receptacle or a link to any type of file. It does not provide readers for these files, the relevant application software must be loaded.

Fifth, it works with interactive tools such as SmartBoards©. It has a range of built in interactive tools which adapts to multiple input devices such as SmartBoards© or tablets. It does not support the use of an iPad© for this purpose.

Sixth, it may be integrated seamlessly into the lesson. However, this can only be established through a live study.

Finally, it is expected to be quick and easy both to use and to learn to use. However, again, this can only be established through a live study.

4.3 Development of the tool

There is little information available on the use of this product in a learning environment. Therefore it is necessary to develop andragogical methods before assessing the tool from both a learner and a lecturer perspective.

OneNote documents (note books) were created containing all course materials. Daily lecture plans became live documents which were edited during delivery. Students accessed the edited documents during class time to facilitate their independent learning, providing a base for their explorations of the topics. Notifications and links to reference material for assessments were embedded in the documents.

Implementation was hampered by technological issues. Without an SSL internet connection, it was not possible to share database information over the internet. This prevented the students from accessing the OneNote files remotely and restricted use of the range of free OneNote tools for web, iPad© and Android©. OneNote group projects relied upon access to a shared read/write LAN location. Unfortunately this could not be accommodated under the current network server system and required changes could not occur in the time frame of this investigation.

Access to SmartBoard© equipped rooms was limited with only some of the subjects included in this evaluation having access to these rooms. Interactivity with the artefact during lectures was constrained as a result, although it is recognised that the potential for such interactivity exists in the artefact.

5. DEMONSTRATION

A purposive selection was made of all first year programming students at the participating institution. This enabled the researcher to capture the impact of the learning tool on a variety of subjects but with a focus on the key area of introductory programming [8].

The tool was integrated into the daily lesson plan and contained all required background materials with links to external information sources. It also included coding snippets by subject (eg how to write an IF statement). The tool provided various scenarios and objectives for lessons as the basis for collaborative exercises.

Students could look to the relevant note book to find lesson plans, upcoming assessment information, resources to support their current activities and general tips, links and resources to help them with their studies. They could incorporate this information into their own notebook, stored either on their network drive (with remote access) or on a portable storage device.

In keeping with the iterative nature of a design science approach [4], at the end of the semester a self-selected group of students and lecturer reviewed the effectiveness of OneNote as a learning tool with an aim of refining its use. This group identified a student requirement previously missing from the evaluation – video tutorials and teaching tools. While OneNote itself only has limited video recording facilities, video files can be inserted into documents at will.

With the incorporation of these video files and with other minor refinements, a revised version of the tool was introduced the following semester.

6. EVALUATION

Towards the end of the semester, the artefact was evaluated from both a lecturer and a student perspective. The student perspective was captured with a questionnaire. Questions were geared towards the identified requirements including the new requirement of video. Responses were on a standard five point Likert scale. These responses were aggregated to positive, negative and neutral in the final evaluation. All students were invited to participate but participation was optional and anonymous.

The lecturer evaluation is based on personal reflection of the performance against the criteria from an andragogical and technological perspective. As there was only one lecturer involved in the study, it is not possible to remove personal biases from this evaluation and the lecturer concerned is a proponent of the use of OneNote for a variety of purposes.

6.1 Student perspective

Table 3 summarises the results of the student questionnaire.

<table>
<thead>
<tr>
<th>Student Assessment of Learning Tool</th>
<th>(% partially agree or strongly agree, N=76)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides for resource storage and retrieval</td>
<td>97%</td>
</tr>
<tr>
<td>Quick and easy to both use and to learn to use</td>
<td>97%</td>
</tr>
<tr>
<td>Integrates seamlessly into the lesson</td>
<td>93%</td>
</tr>
<tr>
<td>Supports multiple simultaneous users for both synchronous and asynchronous use</td>
<td>92%</td>
</tr>
<tr>
<td>Customisable to the needs of the user</td>
<td>89%</td>
</tr>
<tr>
<td>Easily accessible and readily available</td>
<td>86%</td>
</tr>
<tr>
<td>Provides support for video tutorials</td>
<td>81%</td>
</tr>
<tr>
<td>Works with interactive tools such as SmartBoards©</td>
<td>79%</td>
</tr>
</tbody>
</table>

Note: not all respondents answered every question

6.2 Lecturer perspective

Overall the lecturer noted a high level of engagement and was generally positive about the use of the tool. With regards the requirements, the following summarise the lecturer’s view.

6.2.1 Provides for resource storage and retrieval

The lecturer was able to place all material needed for a lesson in the relevant weekly lesson tab. Material common to several courses could easily be copied between notebooks. Students regularly referred to notes, particularly for programming
assistance and reinforcement of basic principles. Links to online material could be incorporated into the lesson notes and the lecturer noted “material inserted from the web automatically contained a link to the source website, allowing students to explore a topic further”

Students who missed lectures were able to use the OneNote documents to revise missed work. It enabled students to repeat and revise complex concepts at will in a readily accessible format. Programming snippets could be broken down by topic and drawing tools allowed logic paths to be expressed visually.

6.2.2 Quick and easy to use
Very little instruction was given to students; the basic features were intuitive and provided no challenge to the students concerned. The lecturer felt however that less technically literate students would most likely require some tuition.

Some of the more advanced features were not fully explored or used, and some features such as integration with outlook were not available to students.

6.2.3 Integration into the lesson
With the opening of the OneNote application, the relevant notebooks opened automatically. Relevant lesson material was immediately available to the student, and previous lesson material was easily and quickly available.

Students working on programming exercises could easily access coding information such as the basic structure of a ‘for’ loop. This allowed students to focus their attention on design of the program. “This enabled students to spend more time thinking about how to problem solve”.

It was noted students used OneNote to check for upcoming assignments and tests, took copies of crucial pages for use outside of class and added and edited their own versions of the notes.

6.2.4 Synchronous and asynchronous use
The dynamic nature of the tool allowed changes to be made in class, to further illustrate a point or to expand in a student driven direction.

Where students required a copy of some workings, a simple copy and paste from the IDE allowed students immediate access to the code.

The lecturer’s biggest regret with this trial was that OneNote’s use as a synchronous collaborative learning tool was not able to be explored. As there was no student access to a shared read/write LAN location this feature was not available internally. External cloud based options encountered firewall issues, so while the potential is there it could not be utilised or evaluated.

6.2.5 Customisability
The lecturer adapted the tool to the requirements of each class. Students copied supplied pages into their own Notebooks (OneNote’s term for a collection of pages and sections) which they could customise to their own preference.

Not all students took advantage of this feature; quite a few simply used the Notebooks as provided. This was seen as a positive by the lecturer as students who had no interest in customising the work were not forced to do so.

6.2.6 Accessibility and availability
The ability to access information off campus was limited to asynchronous data and required authentication, but on campus it was readily available with no authentication required. The lecturer found the ability to move between pages without having to wait for an application to load a file a significant positive. However the inability of students to access a communal read/write location was seen as a significant negative.

6.2.7 Incorporation of video elements
The use of embedded video explaining key elements was particularly effective. This was simple to incorporate into the OneNote pages as video icons and clips ran directly from the icons. The recording feature built into OneNote would record from a camera, but was not capable of screen capture. Some students used this for recording in class, but for resource purposes, recording had to be made using third party software and then inserted into the pages. This was a time consuming process and only a small number of videos were created.

6.2.8 Use with interactive tools
The drawing tools provided with OneNote generally worked well with the interactive projectors provided, allowing dynamic code exploration and seamless capture of the results.

There were occasions when pen work would appear “blobby” and “dribbles” would appear on the pages. This created enough frustration that there was a general overall dissatisfaction.

The use of tablets was explored as well, but this was found to disengage the students as the focus of the lecturer was on the tablet no ton interactions with the students.

7. COMMUNICATION OF RESULTS
While no tool is capable of meeting every need, in this study OneNote has proven to be a versatile, adaptive and easy to learn addition to the tertiary learning environment. It was readily accepted by student and educator, meeting most of the identified requirements.

Its strengths are its ease of use and its resource management features. It supports interactivity, but not seamlessly and while it supports video files, it is not suitable as a video production tool.

Caution must be shown however as the findings in this report are based on technically literate students and a single lecturer familiar with the OneNote product. It would require further trials with a greater range of students and lecturers to establish if the generally positive results are transferable into other learning sectors.

While it was disappointing not to be able to utilise the synchronised collaborative learning features, this is something which could be explored in the future.

Finally, it is worth noting that OneNote is a bespoke storage, organisation, dissemination and collaboration tool. Its value as a learning tool is very much dependent on the resources provided and the design of each individual delivery structure. It is therefore a requirement to have a thorough understanding of the use of e-learning tools to capitalise on the benefits it offers. Unfortunately, as Reeve and Flowers [12] note in their study of e-learning in the UK, while significant staff development should occur, it rarely does. Without a commitment to knowledge and teaching development, OneNote risks being little more than a highly flexible file storage system.

REFERENCES


Scheuermann, M. Perceptions of nontraditional students and their instructors regarding the collaborative teaching and learning mode and the socialized expectations students bring from the workplace into the undergraduate classroom. Drexel University, 2005.


ABSTRACT
As student engagement becomes more important, alternative techniques and technologies to enhance their participation need to be explored. One consideration is the learning environment and at the start of 2013 the Eastern Institute of Technology (EIT) installed an alternative computer classroom layout where computers were configured into “pods”. The purpose of this paper is to briefly review the literature surrounding learning spaces and using the EIT pod room as a case study, identify whether the physical environment enhanced good pedagogy by asking staff and students to describe their experiences. Based on the feedback a list of recommendations has been developed that others can use when considering alternative configurations when setting up their own computer classrooms.

Categories and Subject Descriptors

General Terms
Human Factors

Keywords
Learning environment, student engagement, learning spaces

1. INTRODUCTION
In the New Zealand tertiary sector it is becoming increasingly important to retain students and this is reflected in the Educational Performance Indicators (EPI) that each institute is measured against and subsequently has an impact on funding [7].

One way to increase retention is to increase student engagement and participation, and in this the learning environment can play an important role. Graetz [3] highlighted its importance and stated “the physical characteristics of learning environments can affect learners emotionally, with important cognitive and behavioral consequence”. Based on experiences in other organisations, at the start of 2013 the Eastern Institute of Technology (EIT) installed an alternative computer classroom layout where computers are configured into “pods” as shown in Figure 1.

Staff and students have been using the new configuration since the beginning of 2013 and there is an opportunity to follow up their experiences to determine whether the initial advantages have and are being realised.

A case study approach was chosen, however unlike earlier studies which concentrated on the physical layout [8, 9] the principal research question of this paper considers whether the room enhanced good pedagogy and student participation.

In order to provide a framework this paper discusses the results based on a well-known study into good practice in undergraduate education by Chickering and Gamson [2], and looks at the following questions:

1. What are the benefits of this configuration to students and educators?
2. What are the issues and disadvantages using this configuration to deliver courses of learning?
3. What lessons can be applied to the process of altering physical learning spaces that could be of use to others in the future?

Since it is becoming more common for students to bring their own devices (BYOD) the ability for the room to cater for this was also considered.

This paper concludes with a set of recommendations that others considering alternative configurations can consider when setting up their own computer classrooms.

2. LITERATURE REVIEW
In their well-cited study into good practice in undergraduate education (over 3,600 citings in Google Scholar), Chickering and Gamson [2] proposed that good practice in undergraduate education:

1. Encourages student-faculty contact.
2. Encourages cooperation among students.

This quality assured paper appeared at the 4th annual conference of Computing and Information Technology Research and Education New Zealand (CITRENZ2013) incorporating the 26th Annual Conference of the National Advisory Committee on Computing Qualifications, Hamilton, New Zealand, October 6-9, 2013. Mike Lopez and Michael Verhaart, (Eds).

Figure 1: POD Room Layout
5. Emphasizes time on task.
6. Communicates high expectations.
7. Respects diverse talents and ways of learning.

They intended these seven principles to act as a guide to educators and administrators as to how to include good practice in undergraduate education, and recognized “that content and pedagogy interact in complex ways” [2, p. 4].

Other studies place the learner at the center, and identify that the effective learner constructs their own knowledge (Chickering and Gamson’s point number 3). Six principles of constructivism are described by leading authors Biggs and Tang [1] as:

1. Learners need guidance and support;
2. Learning is best facilitated when students’ prior knowledge is ‘cued’;
3. Learning occurs through communication and social interaction;
4. Learning is not a spectator sport;
5. Deep understanding occurs when students are able to apply their knowledge to new situations; and
6. Students learn better when they are aware of their own learning processes”.

van de Blink [6] notes that computer laboratories were initially developed to allow students to complete assignments and learn computer programmes, but have evolved, and suggest that the design and configuration of computer labs “transform into flexible, technology-enhanced spaces for maximum effectiveness.”

In 2003 Young and Hubbard [8] found “very few references [in the literature] and no definitive theory or argument on optimum design and layout was obtained.” Many institutes they visited chose layouts either because it was the way they had always been laid out or to fit as many computers as possible in the room. Three common layouts they observed were computers around the walls, computers in rows with all students facing the front, and the computers in double rows with students side-on to the front of the room [8].

In 2004 Young and Mann [9] further noted a lack of theory about the interaction of learning styles and physical spaces; They noted: “When considering the new layouts it is equally important to consider the teaching styles of the academic staff and find out what they required in a computer laboratory”. Both Young and Hubbard [8] and Tansley [4] surveyed academic staff about their requirements and desires for new computer lab layouts. Similarly at Cornell University van de Blink [6] used focus groups and surveys of staff and students to identify different uses and needs for computer labs, combined with observation of actual use.

Tansley [4] noted that “teachers have different methodologies that require particular needs in the layout of the room.” The main requirements she identified from teaching staff were to see the students’ faces to check if they were engaged, for students to be able to see the whiteboard/projector and their own screens without too much disruption, and the ability to engage with the students without screens. She also identified the desire for spaces for group work, and/or books and notes, the ability to have computer desks and non-computer desks in the same room and flexibility to change the layout around as needed.

Young and Hubbard [8] identified four main requirements: the requirement for a theory space in a practical environment, to be able to see the student screens from the front of the room, the opportunity for students to do group work, and a way to manage “the difficulty of inattentive students who did other things (e.g. playing games, surfing the net, reading emails) during the class”.

Young and Mann [9] also noted that “in teaching technical computing (as opposed to end-user computing or computer-aided teaching of other subjects)” there is often a need “to teach theory in a practical setting”. They propose the following needs for specialist computer education:

Students need to be able to see the lecturer and whiteboard without distraction; the lecturer needs to be able to see all the student screens; the lecturer needs to be able to get to sit beside each student to work with them; the students need space, not just for themselves or copy material, but technical material which might mean several books, diagrams and manuals; students need room for group work.

They further noted that when teaching about computers “we might move from explaining some concepts to implementing them using computers - and back again - several times in a single session”.

Van de Blink [6] also found that the location of the computer lab influenced its character: a lab near a library would become a quiet learning space, whereas a computer lab near where students congregate would become a more collaborative learning space. She further notes that “small changes at small cost can be effective and efficient” and recommends continually reviewing lab and space needs for teaching, rather than looking at redesign as a one-time project.

3. RESEARCH DESIGN / METHOD

3.1 Physical room design

EIT has a history of experimenting with learning spaces [Hilton, D, personal communication, June 26, 2013]. The Head of the School (HoS) of Computing and EIT’s Corporate Services, Capital Planner proposed experimenting with new computing lab layouts after they attended a conference on learning spaces, and after seeing alternative lab layouts in Australia (an example is shown in Figure 2) and New Zealand secondary and tertiary institutes ” [S. Corich, personal communication, June 24, 2013].

Figure 2. Example of a future teaching space at Melbourne University

The overriding objectives of the room were to consider the needs of the 21st century leader, and better engage Gen X and Gen Y learners. This lead to the specific objectives of:

- Creating a multifunctional, group collaboration learning space.
Moving away from the more formal tutor controlled/focused environment to an environment that encouraged group interaction and teacher facilitation rather than the ‘sage on the stage’ approach as suggested by Biggs and Tang [1].

A secondary consideration was to attempt to expand the room capacity without compromising either teaching quality outcomes or acceptable circulation space restrictions.

### 3.2 How the design was chosen

Important design considerations were student vision to room activity, and the idea that through the use of appropriate software visual presentations could be imaged on each individual PC rather than a reliance on front of class whiteboard or data projection (again this needed to be experimental and a definite change from traditional front of class teaching methodology (This has proved to be technologically challenging and at this stage has not been implemented).

As mentioned earlier, the HoS and Capital planner visited tertiary and secondary institutes in Australia and New Zealand, attended a learning space conference, and considered literature on collaborative learning spaces [3].

The design chosen was a simplified version of the Melbourne University trial space shown in Figure 2 [5].

The hardware decision was made following suggestions from IT Services, the adoption of integrated (on piece) units was made to reduce the amount of desk space required for computers [3].

### 3.3 Survey design

A questionnaire was developed based on Chickering and Gamson’s [2] seven principles of good practice in undergraduate education. Two slightly different versions were created: one for lecturers and one for students. The questionnaires were then tested for face validity and pre-tested for content validity by a lecturer and a student.

The questionnaires were then administered to lecturers and students who had used the pod room in semester 1 of 2013.

For the students, 19 filled in the survey, of which 58% (11) were female; 53% (10) were under 25 and 21% (4) over 40; 32% (6) had no prior tertiary education with 32% (6) holding a degree or postgraduate qualification; 32% (6) indicated they were confident computer users (able to manage files, use the internet and a variety of applications) and 68% felt they were proficient users (happy to provide assistance to others).

For the staff, 6 filled in the survey, of which 83% (5) were female; all were over 35; 50% (3) holding a degree or postgraduate qualification; all indicated they were proficient users (happy to provide assistance to others).

Results were then analysed.

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### 4. FINDINGS, ANALYSIS AND DISCUSSION

#### 4.1 Survey results

#### 4.1.1 Overall Impressions

The first question asked was for the overall experience with the pod room. As shown in Figure 3.1 74% (14) of the students felt the room had a positive impact on their overall experience, although with issues raised in the comments section (see section 5.1.2 below).

Staff results indicated a neutral overall experience, with no one identifying it as either awful or great, and again with issues raised in the comments (detailed in section 5.1.2 below).

#### 4.1.2 Comparison to standard layouts

The second question asked for a comparison of the room to standard layouts, and at EIT this meant arranged in rows. As can be seen from Figure 4 there was an even split of students...
preferring the different layouts with 42% for worse (1 + 2) and 42% for better (4+5). Student comments tended to cluster around the visibility of the whiteboard, with one commenting: “Pods are great if the whiteboard is not used but as soon as a white is required everyone need to be facing the front of the class”. Comments here suggest that the pedagogy being used needs to be considered, so sessions where demonstrations occur at the front of the class are not well suited to this layout.

From a staff perspective almost all indicated that the layout was not as good as the standard as they needed to demonstrate from the front. One indicated they moved their class and another would ask for a different room. An interesting comment was: “Would work better in a student hub where teaching/learning is not taking place and students are working in isolation, e.g. no group work”.

4.1.2 Benefits and Issues

The third and fourth questions asked for benefits/advantages and problems/disadvantages, and respondents were asked to rank these. For the majority of students group interaction was identified as the main advantage, with the pods actually facilitating groupings. The amount of space in the room, screen privacy, and the ability for groups to congregate around a particular computer were also cited as advantages (these were also mentioned by staff).

For disadvantages, the most significant was the difficulty for those with their backs facing the whiteboard, and it was noted that it was also uncomfortable to look diagonally at the board. The size of the smart board was also highlighted plus problems for “vertically challenged” students who would have difficulty looking over the pod. Several students mentioned the lack of space on desks for course materials, books and folders, or a device such as a laptop or tablet. Amongst other comments students indicated that the layout allowed for privacy, but that student to student interaction was quite disruptive due to the separation distance.

Similar comments were received from the staff. The main perceived advantages for staff included the “informal atmosphere” and the “It is easier to ‘float’ around the room and mingle” plus the increased space around students.

However, comments indicated demonstrating, for example “It was awkward to use for a demonstration show and tell type class room where most of the teaching is done using the PC and datashow”. The placement of the tutor PC attached to the datashow meant that “people are looking elsewhere (the whiteboard) when I am talking” and “cannot see the datashow easily” or “make eye contact”, and the distance of the PC from the smartboard meant “downtime scooting back and forth”. Other issues regarding the smartboard were more apparent than with the older layout: the fine control required by some applications (such as working with Spreadsheets) is difficult on the smartboard and needs easy access to the tutor PC.

Other issues raised by staff were that there is nowhere to set up books, handouts and materials, leading to time wasted finding the materials when needed (“No breakout space for collaborative work”), a lack of privacy when having a discussion with an individual student, difficulty for students to collaborate as “there are computers between them, and they can’t see each other’s screens”, and also “Students don’t have much space to spread out books or put a laptop as a secondary device”.

4.1.3 Pedagogical Questions

To understand the pedagogical effect of the layout, several questions were asked based on Chickering and Gamson’s [2] good practice principles.

Based on the quantitative feedback (Figure 5) it is important to note that the room layout overall has not significantly affected the factors identified by Chickering and Gamson [2]. There are positive indications that the room layout for both staff and students has allowed for diverse learning opportunities (Figure 5. 5b), increased student to lecturer contact (5c), improved feedback (Figure 5. 5f/g) and time on task (Figure 5. 5g/h). Students also indicated a small preference for improved engagement (Figure 5. 5a), student co-operation (Figure 5. 5d), allows for more activities (Figure 5. 5e), and feedback (Figure 5. 5f/g). Students made few comments on their responses. Some included the layout created a “friendly environment, good icebreaker” but there were “more distractions from other students”. Another commented that interaction was “forced” and made the class “uncomfortable” and had a “negative effect on their learning”, and responded to an earlier question that they “regularly skip classes held in this room”.

An interesting student comment was that “Having filled this (survey) in I realise there were quite a few benefits to the set up, in that it made it a more relaxed interactive class with the pods, rather than rows of monitors, with students more isolated in their spots”.

Figure 5. 5a: Learning engagement
Figure 5. 5b: Diverse learning
Figure 5. 5c: Student-lecturer contact
Figure 5. 5d: Student co-operation
Figure 5. 5e: Active learning
Figure 5. 5f: Student centered
Figure 5. 5g: Prompt feedback
Figure 5. 5h: Time on task
Few comments were made by staff although one observed “I think it encourages active learning and student-centered learning because the room is very unsuitable to lecturing, so the lecturer has to plan other sorts of activities.”

The final question asked staff and students to identify what could be done to improve the room. As noted above, student comments mentioned the whiteboard visibility and size, as was computers where student had their backs to the board. One student suggested a mixture of rows and circular tables and increasing the size of the individual desks, thus allowing for more book space to spread out. For the pods it was suggested that the mid-sections could be lowered, and that the screen facing away from the front be removed. The staff comments unanimously indicated the need for a tutor desk with room for materials and a computer facing the room. Students observed the distance tutors were covering between the smart board and the tutor computer. Comments also included that the smart board needed fixing (later identified as a software issue and is currently being tested). One of the staff commented that “workshops work really well in the room at Te Manga Maori where the PC’s line the outer wall of the room and the middle of the room has a large table where discussions and group work take place. The computers are not a barrier to discussion/group work but are rather a place where you can slide your chair off to and work/practice skills when necessary.”

Additionally, comments were sought from the Head of School. His concluding comment was “The pod room has given us an opportunity to try something different. To me it has made me aware of the increasing reliance of teaching staff on technology solutions that work and the benefits that can be gained by making a computer lab a more informal space” [S. Corich, personal communication, June 24, 2013].

5. DISCUSSION
The findings seem to show that the layout was a cautious success, with some issues identified for further consideration. Taking into account the original objectives for the room, some observations are as follows:

- Multi-functionality: Intuitively, the room seems to be flexible for different sorts of learning activities, but responses indicate that this has not necessarily worked in practice. Small tweaks in room layout or facilitation methods may reduce distractions, make group break-outs easier, or enable non-obvious private conversations.
- Responses and comments indicate mixed success at facilitating group collaboration. Some learners also stated a distinct aversion for group work, (as an aside this regularly surfaces in student evaluations) and thought needs to be made as to how the space can be adapted to allow people to “opt out” of collaboration where appropriate.
- Comments indicate that the space does discourage the “sage on the stage” approach, but from feedback in many learning sessions it is appropriate for some amount of teacher-led activity such as class discussions, software demonstrations, and small bites of new information. Several concerns could be addressed if the room catered for this delivery style, and as suggested by Young and Mann [9] “in teaching technical computing”...
- ...there is often a need... “to teach theory in a practical setting”.
- The layout did successfully allow for expanded room capacity, with the number of computers increasing from 24 to 30, while still feeling spacious and providing more space to move around. This has been a big success.
- Student vision across the pods or across the room was obstructed by high screens. Removal of one computer (back facing the smartboard) and reducing the height of the pod could be solutions, but the implications would need to be thought through.
- Software presentations projected from individual screens was not implemented due to technical difficulties. If this were implemented this could have allowed a tutor computer to be in one of the pods as opposed to off the side.

Pedagogically, the findings indicate that the room layout may provide slightly more allowance for diverse ways of learning, improved student lecturer contact, more prompt feedback and more active learning and ‘time on task’, but in all areas responses were mixed. Responses also seem to show a slightly decreased learning engagement and student co-operation, with little effect on student-centeredness. With such a small sample size, these can only be relied on as indications - however, they raise interesting questions, particularly as increasing engagement and allowing for constructivist learning were reasons for choosing the room layout.

The advantages identified were:
- improved group interaction in some cases (although some respondents reported that group interaction was actually more difficult);
- screen privacy, but this was also a disadvantage when students wanted to work together;
- the ability for groups to congregate easily around a particular computer;
- a more informal, ‘friendly’ environment; and
- more space in the room, allowing students and staff to move around the room easily.

The disadvantages to students which were related to this room layout were:
- Group interaction was harder in some cases because students were further away from each other, although others reported more group interaction;
- Students had to move to work together, as they couldn’t easily see each other’s screens;
- Some students disliked being unable to remove themselves from a group setting;
- Students reported more distractions from other students;
- Computers with their backs to the whiteboard and smartboard were unusable when tutor led discussion occurred;
- Students using the rear computers had difficulty seeing the whiteboard or smart board because of computer screens and people; and
• There was little room on the desks for books, folders; paper - or a laptop or tablet. This is a significant limitation particularly if students bring their own devices.

The issues for staff (which become disadvantages to students) were:

• The room is challenging for teacher-led discussions or demonstrations on the smartboard, and it is noted that almost all classes - however student-focused - need to include some of these.
• A lack of privacy when having a discussion with an individual student; and
• The lecturer’s computer and smartboard were separated by a significant distance:
  • It was awkward for the lecturer to move backwards and forwards, breaking the flow; and
  • Students were looking at the smartboard, not the lecturer, so the lecturer could not use body language or expressions to direct attention.

As noted by the Head of School [S. Corich, personal communication, June 24, 2013], lecturers increasingly rely on a smooth technological environment, so it would be useful to consider this issue further.

Other things we learnt:

• It would have been good to have had a quick meeting of those using the room early on, so that teething issue could be identified and in some cases fixed.
• Staff need to be proactive in taking responsibility for logging problems and seeing them fixed (which is a different, ongoing issue). This may have helped sort out the precision issue on the smartboard.
• It would be good to have a reporting system to log suggestions and issues related to the teaching (rather than technical which is separate), such as the size of the smartboard – which could be a campus wide issue not just in the computer labs.

5.1 Internal Recommendations for this room

From the survey responses, the authors would recommend the following:

• Adding a table for the lecturer materials. If it was of sufficient size and included the tutor computer this could also be used for non-computer related group work.
• Assessing smartboard size and whiteboard, smartboard and projector visibility across all computer labs at EIT.
• Adding quick room evaluation questions to the regular course evaluations.
• Position the lecturer’s computer nearer the smartboard, facing towards the students, or allowing for one of the class computers to be used instead.
• Consider how to cater for students with their backs to the whiteboard
• Consider increasing the size of individual desks to allow for books, handouts, paper, and laptops or tablets.

• Consider lowering the heights of screens, allowing students to interact over the screens and also see the whiteboard and smartboard more easily
• Continue evaluating this room; draw up specific objectives for the room in light of the initial evaluation, and evaluate their success.
• Experiment with a range of group collaboration layouts as well as the pods, such as outward-facing curves.

The authors realize that some of the recommendations will be difficult to implement but have them included should further rooms be planned or for other institutes who may wish to use this model.

6. CONCLUSION

It is exciting and motivating to experiment with new ways of teaching and innovation is one way to achieve this. Continuous improvement occurs through critically evaluating existing systems and looking at how these systems can be refined. Regarding the success of the pod room layout, preliminary evaluation of pedagogical aims and student and lecturer opinion showed mixed results, although a slight positive indication, when compared with a traditional computer lab laid out in rows.

There is some concern however with the adaptability particularly for providing an area to place laptops/tablets where students bring their own devices.

Regarding the experimentation with new layouts, useful factors in the experimentation include gathering design considerations from the literature, other institutes and a range of staff and students in a range of programmes and levels; forming clear pedagogical objectives for the room; quick evaluation early in the term to identify any easily-fixed problems; and evaluation of the room against pedagogical principles and its objectives, as well as student and lecturer opinions.

Results of this study line up with those identified by Tansley [4] and Young and Hubbard [8], namely the requirement for teachers to see students faces, for students to see a shared display (smartboard) space, an ability to engage without screens, a space for additional materials, a way for facilitators to monitor what students are doing, and an ability to cope with a variety of teaching techniques (including teaching from the front).

Some advantages highlighted included space for staff to move around the room, space for students to congregate around any PC, screen privacy, and a more informal ‘friendly’ environment.

As noted above, these findings are preliminary, and show results from a small sample size. Both authors have taught in the POD room, which does introduce some natural bias, although care was taken to reduce this wherever possible.

The literature consulted was from Educational Technology sources. It is likely that Workplace Design and Architecture sources could provide useful additional research to inform computer lab design.
6.1 Limitations

One significant limitation of the study is the small sample size, and that the results only span one semester. However, it was felt that as this was “new” there is real benefit in capturing feedback in the early stages to allow improvements to be made if necessary and before some of the issues in implementing a new layout have been either remedied or work-arounds developed.

Both authors have taught in the POD room, which is the motivation for the research, and were keen to provide constructive feedback to the Institute so that improvements (if needed) could be made to the existing room or modifications could be considered if further rooms were to be implemented. However, this does introduce some bias. In order to manage this bias, one of the authors did not complete the survey and in the paper has made explicit reference to any comments added. All survey results were anonymous, however with the small sample size some tutors/lecturers could be identified.

6.2 Ethical considerations

The survey was conducted online and the technology used does not allow individuals to be identified. With such a small sample size care was taken that the questions would not easily identify students.

7. FUTURE WORK

The research will now enter a longitudinal phase and we would like to continue evaluating the effectiveness of this layout as improvements are made and staff and students adapt to the new environment.

8. REFERENCES

Appendix A: Student Survey

1. How would you rate your overall experience with the pod room? Please try not to rate the quality of the course or lecturer. (1-5) + Comment

2. Is it better or worse than a standard computer lab configuration? (1-5) + Comment

3. What do you think were the benefits or advantages of the pod room layout? Please number in order with 1 being the highest benefit.

4. What do you think were the problems or disadvantages? Please number in order with 1 being the biggest problem.

5. Did the pod room layout ...(1-less to 5-more)
   5a. ... Make your learning engaging?
   5b. ... Allow you to learn in different ways?
   5c. ... Encourage contact between you and your lecturer?
   5d. ... Encourage you to work with other students?
   5e. ... Enable you to do learning activities (e.g. discussions, exercises, working on assessments)?
   5f. ... Encourage prompt feedback?
   5g. ... Encourage time to be spent on class activities?
   5h. ... Encourage you to produce better work?
   5j. Any comments:

6. What do you think we could do to improve this classroom? Please number in order with 1 being the highest improvement.

Something about you

- Gender
- Age range ( < 20, 20-24, 25-29, 30-34, 35-39, > 40 )
- Highest prior tertiary education (None, completed undergraduate diploma, completed level 5 or 6 degree, hold a degree, hold a postgraduate qualification )
- Indicate your level of computer confidence (Novice (rarely use), OK (happy working on a computer), Confident (can manage files, use the Internet and a variety of applications) , Proficient (happy to provide assistance to others), Expert(would be considered a power user))
Supplementary papers

(Editorial review)
ABSTRACT
For computing educators in the CITRENZ sector, the 2012 Performance Based Research Assessment took place in a setting that had changed considerably from that which applied for the 2006 round. CITRENZ is a new organization with changed membership, and the impact of progressive funding constrictions imposed upon the ITP sector, have not aided its research mission. The metrics for PBRF itself have also changed which have impacted on the amount of information available, thus a direct comparison of sectoral performance between the two rounds is challenging. Nonetheless, here we compare aspects of the PBRF performance between the two rounds, and draw what conclusions we can from the limited data available.

Categories and Subject Descriptors
K. [Computing Milieux]: K0 General.

General Terms
Your general terms must be any of the following 16 designated terms: Management, Measurement, Human Factors.

Keywords
Keywords are your own designated keywords.

Performance Based Research Funding, CITRENZ, Computing Research.

1. INTRODUCTION
The attached analysis repeats that of 2007 [2] in comparing CITRENZ sector performance in the PBRF 2012 exercise, against 1) other institutions in the Computer Science, Information Technology and Information Science subject area; 2) other subject areas in the ITP sector; 3) the 2003 NACCQ sector participants and their 2006 results. Changes to the reporting of the PBRF 2012 results means that some comparisons are now not able to be made. The membership of CITRENZ has also changed; Unitec are no longer a member and AUT results are now firmly within the University sector, which means there were nine participating CITRENZ members. These changes aside valuable analysis is obtained as to the on-going research activity among the current CITRENZ members.

2. COMPUTER SCIENCE, INFORMATION TECHNOLOGY AND INFORMATION SCIENCE SUBJECT AREA
In the 2012 PBRF round statistics for researchers assigned a category of ‘research inactive’ are no longer available, due to the gerrymandering of eligibility criteria by several Universities and the resulting changes in metrics adopted by TEC., cf. [3, 4]. A threshold of seven rated researchers was also imposed for reporting, to preserve privacy for researchers in smaller institutions and research groups. This makes reporting at subject level, for CITRENZ members challenging.

However figures are available at subject level for the overall numbers who submitted portfolios in this subject grouping, and an average score for the non University and Unitec group (classified as “other”) which is the best match to the CITRENZ membership has been allocated [4, p. A 89-21]. The list of nine participating institutions is given in Table 1.

Table 1. CITRENZ Institutions in 2012 PBRF Round

<table>
<thead>
<tr>
<th>Polytechnics</th>
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<tbody>
<tr>
<td>Christchurch Polytechnic Institute of Technology</td>
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<tr>
<td>Eastern Institute of Technology</td>
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<tr>
<td>Manukau Institute of Technology</td>
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<tr>
<td>Northland Polytechnic</td>
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<tr>
<td>Open Polytechnic of New Zealand</td>
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<tr>
<td>Otago Polytechnic</td>
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<td>Waikato Institute of Technology</td>
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<tr>
<td>Wellington Institute of Technology</td>
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<td>Whitireia New Zealand</td>
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Of the total funded portfolios (271.13) in the computer science, information technology and information science subject area, 13.7 were from this “other” grouping which we impute to represent the CITRENZ membership. Thus, CITRENZ now represents some 5% of New Zealand’s “active” researchers in the field. The average quality score for the CITRENZ grouping - AQS(N) with formula given below - was 2.3, with 1 ‘B’ rated staff member and 12.7 staff rated ‘C’ or ‘C(NE)’.

\[
\Sigma (\text{Count of A Quality Categories} \times \text{FTE-weighting of staff} \times 5) + (\text{Count of B Quality Categories} \times \text{FTE-weighting of staff} \times 3) + (\text{Count of C and C(NE) Quality Categories} \times \text{FTE-weighting of staff} \times 1) \times 2)
\]
By comparison with 2006, AUT and Unitec had moved away from the CITRENZ grouping. Table 2 indicates their comparative rankings for 2012 (upper rows) and 2006 (lower rows). As can be seen from the 2012 increase by Unitec, the quality score AQ5(N) is now inflated by removing the ‘R’ or not ‘quality funded’ researchers from the numerator. It can also be seen that Unitec lost 5 rated researchers and AUT gained 24.54, over the period. So the impact of PBRF at both the University and non University levels is beginning to be seen.

Table 2. AUT & Unitec 2012 & 2006 PBRF Rounds

<table>
<thead>
<tr>
<th>Institution</th>
<th>Subject Area</th>
<th>Quality Score (FTE)</th>
<th>Staff rated</th>
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<tbody>
<tr>
<td></td>
<td>Results</td>
<td>A</td>
<td>A (FTE)</td>
</tr>
<tr>
<td>CS, IT, IS</td>
<td></td>
<td>3.8</td>
<td>6.7</td>
</tr>
<tr>
<td>AUT</td>
<td></td>
<td>3.5</td>
<td>0</td>
</tr>
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</table>

Thus, Unitec and AUT as former CITRENZ members comprise some 20% of New Zealand’s researchers in the field. Therefore adding those ITPs who chose not to participate in PBRF, the former NACCQ sector members still have a major presence in the field. The advent of the new metrics means that the total number of CITRENZ sector researchers including those not ‘quality funded’ is now unavailable for reporting. Thus, assuming a total of CITRENZ researchers fairly close to that in 2007 (and removing Unitec from the calculation), rather than being merely deemed ‘research inactive’ some 80-100 New Zealand computing educators have now been rendered invisible at a stroke of a pen.

3. ITP Sector Comparisons

Considering the ITP sector and medium sized institutions, the PBRF 2012 report notes “concentrations of staff whose EPs were assigned a funded Quality Category in a number of subject areas including: computer science (19.96); design (8.68); education (30.60); engineering (12.00); Māori knowledge and development (15.00); music (10.75); and visual arts and crafts (46.21)” [4, p. 52]. This medium sized grouping includes a College of Arts (9.39 in visual arts) and a Wananga (unknown no. of researchers) so these totals are not restricted to the ITP sector.

For the group of small institutions (which includes several PTEs) the report notes “The subject areas of religious studies (13.90), education (8.50), and visual arts and crafts (7.56) account for the bulk of the 41.16 funded EPs within the group of small TEOs” [4, p. 53].

So computing shows a presence among the disciplines at the medium institution level, but not below. Comparing the discipline performance by sector through applying the AQ5(N) across disciplines is rather hit and miss, with unknown participants in the comparison groups and small numbers of rated EPs with an occasional B rating having the ability to skew results in comparison with larger groups with more C and (CNE) portfolios. Therefore demonstrating a level of critical mass in a discipline (as shown by the computing totals in the medium sized grouping above), is a more realistic indicator of sectoral research strength.

4. Funding Comparisons

As can be seen from Table 2, [4] the ITP sector (including Unitec) received 2.34% of the total PBRF funding from the round in 2012. This was up from 1.12% and 2.10% in 2004 and 2007 respectively. The three top universities by funding, Auckland, Otago and Massey, continued to hold the top three positions in the ranking over the three PBRF rounds and combined received between 64% – 66% of the funding pool.

The ITP sector had remained ninth in the three rounds while Auckland University of Technology increased their ranking by one place replacing Lincoln University which is now in 8th place. The Colleges of Education have been slowly integrated with universities and in the latest round have not received a separate funding allocation.

The Wananga Sector gained one place in the rankings in 2007 from the 2003 round however has slipped one place in the 2012 round, with Te Wananga o Aotearoa apparently not submitting in this round. The PTE sector is now stronger having overtaken the Wananga sector in rankings in 2012. It is interesting to note that in 2003 the whole PTE sector received just $22,643 in funding whereas in 2012 they now receive $493,915. The percentage increase however is only .04% of the total funds available for allocation.

The ITP sector includes Unitec who are one of the few ITP’s who have postgraduate research degree completion funding. The data indicates that the other ITP’s have received some $0.5 m in research degree completion funding[4, p. 85], however for these CITRENZ sector members this is the funding for all postgraduate degrees with little if any expected to be based on computing completions yet. As more postgraduate degrees come on stream this picture may change, although the taught postgraduate models may predominate over the research thesis option.

The biggest gain of all institutions from 2003 to 2012 is Auckland University of Technology who only 13 years ago were part of the ITP sector. The variance of 2.23 is the largest of all the institutions which took part in the 2012 round. Both Auckland University of Technology and Victoria University of Wellington gained one place in the overall rankings Victoria University of Wellington’s variance was 1.32. The highest negative variance was Massey University whose decrease was _1.81.

5. Momentum Stalled

One of the assumptions from the data, for the ITP sector and in particular the CITRENZ participants, is that the momentum of the research activity has stalled. It does not seem to be that CITRENZ member institutions’ researchers are publishing internationally, as all research outputs are counted. CITRENZ offers two main vehicles for publication of quality assured outputs, the Journal of Applied Computing and Information Technology and the annual conference which includes quality assured published proceedings. The submissions to both these publications have diminished over the past few years. The editors of these publications assumed it was that the researchers in the sector were publishing elsewhere, international journals and quality assured conference proceedings, however the data received from the PBRF reports [2] suggest that this is not happening either.

The majority of the CITRENZ members and eight of the nine institutions in Table 1 offer or are about to offer a degree programme. One of the main criteria of offering a degree programme is that it is taught “mainly by people engaged in
research” [3, p.21]. If the CITRENZ sector institutions wish to retain their degree accreditations then they need to resolve this stalling and encourage their staff to increase their activity well in advance of the next PBRF round.

CITRENZ have been actively supporting the sector researchers now for over 15 years. There is a vast wealth of expertise and a willingness to help; it just needs to be actioned.

6. CONCLUSIONS
With the changes in the CITRENZ sector since the previous PBRF round, and the more limited information now available on sector PBRF participation and performance, it appears that research momentum in the sector has stalled. Nonetheless, there is still a moderately sized group of active researchers in the sector underpinning degree provision.

At a guestimate some 20% of the computing educators in the sector “meet the standards required for the award of a quality funded category” [5, p. 21]. Whether this puts these institutions in breach of section 254 of the education act, namely that their degrees were not being taught “mainly by people engaged in research” [3, p.21], is an open question. However, as noted in the analysis by Clear and Clear [2], some of the Universities are probably on equally shaky ground if only 40% of their academic staff are deemed eligible for the PBRF census.

Table 2: PBRF Indicative TEO Funding 2013

<table>
<thead>
<tr>
<th>TEO</th>
<th>Quality Evaluation</th>
<th>Research Degree Completions</th>
<th>External Research Income</th>
<th>Total PBRF funding</th>
<th>% Total PBRF funding</th>
<th>variance from 2003</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Auckland</td>
<td>$44,437,837</td>
<td>$21,773,223</td>
<td>$14,154,079</td>
<td>$80,365,139</td>
<td>30.62</td>
<td>0.34</td>
<td>1</td>
</tr>
<tr>
<td>University of Otago</td>
<td>$33,547,732</td>
<td>$11,115,785</td>
<td>$8,716,494</td>
<td>$53,380,012</td>
<td>20.34</td>
<td>-0.68</td>
<td>2</td>
</tr>
<tr>
<td>Massey University</td>
<td>$22,254,987</td>
<td>$7,070,970</td>
<td>$5,265,164</td>
<td>$34,591,120</td>
<td>13.18</td>
<td>-1.81</td>
<td>3</td>
</tr>
<tr>
<td>Victoria University of Wellington</td>
<td>$16,167,631</td>
<td>$7,611,273</td>
<td>$3,213,973</td>
<td>$26,992,876</td>
<td>10.28</td>
<td>1.32</td>
<td>4</td>
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<tr>
<td>University of Canterbury</td>
<td>$15,294,553</td>
<td>$6,571,582</td>
<td>$2,723,468</td>
<td>$24,588,901</td>
<td>9.37</td>
<td>-0.78</td>
<td>5</td>
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<tr>
<td>University of Waikato</td>
<td>$8,564,155</td>
<td>$4,345,671</td>
<td>$1,920,815</td>
<td>$14,920,640</td>
<td>5.68</td>
<td>-0.74</td>
<td>6</td>
</tr>
<tr>
<td>Auckland University of Technology</td>
<td>$7,745,924</td>
<td>$3,499,414</td>
<td>$762,001</td>
<td>$12,007,339</td>
<td>4.57</td>
<td>2.26</td>
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<tr>
<td>Lincoln University</td>
<td>$4,271,640</td>
<td>$2,128,136</td>
<td>$2,298,582</td>
<td>$8,698,358</td>
<td>3.31</td>
<td>0.01</td>
<td>8</td>
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<tr>
<td>ITP Sector</td>
<td>$4,720,507</td>
<td>$1,200,036</td>
<td>$1,200,036</td>
<td>$7,120,543</td>
<td>2.34</td>
<td>0.24</td>
<td>9</td>
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<tr>
<td>Colleges of Education</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>0.00</td>
<td>-0.14</td>
<td>12</td>
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<tr>
<td>Wananga</td>
<td>$135,725</td>
<td>$95,914</td>
<td>$83,772</td>
<td>$315,411</td>
<td>0.12</td>
<td>-0.05</td>
<td>11</td>
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<tr>
<td>PTE sector</td>
<td>$359,309</td>
<td>$122,998</td>
<td>$11,608</td>
<td>$493,915</td>
<td>0.19</td>
<td>0.04</td>
<td>10</td>
</tr>
</tbody>
</table>

$157,500,000 $65,625,002 $39,374,522 $262,498,820 100.00 -0.01

7. REFERENCES
Crowdsourcing a Student Business Competition

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ABSTRACT
Audacious Skullsource is our innovative crowdsourcing platform for showcasing StartUps in the Audacious community, generating feedback to make the businesses stronger, and contribution to the judging.

Keywords
Student, business, startup, crowdsource, entrepreneurship

1. INTRODUCTION
The capstone course is an integral part of most IT degrees internationally. While the majority of these are research based exercises, in New Zealand it is more common for the courses to involve a relationship with a real client to solve a real business problem. A trend in recent years is to offer an “entrepreneurial option”, where students establish a real business as the basis for their capstone. This requires careful thinking about how such entrepreneurial capstones are supported. This paper describes the design and application of a crowdsourcing platform in a student business competition (Audacious).

1.1 Entrepreneurship in capstone
A particular driver for the introduction of an entrepreneurial capstone route is the changing nature of employment where entrepreneurship and enterprise are increasingly important components of graduate employment [4, 6]. Bridge et al. [3] distinguish employability (being able to get jobs that exist); enterprise for life (being able to get on, even when right job doesn’t already exist); and entrepreneurship (new venture creation). Gilbert [5] describes the challenges as to “design and develop applied, industry-engaged learning environments that embrace ambiguity and uncertainty in overcoming pedagogical inertia in educating young entrepreneurs and innovators”.

Mann, Smith and Regan [8] described a model that considered aspects of the education process in terms of elements of enterprising activity. Aspects include revenue generation, value proposition, integration into learning, and meeting community expectations. This model was used to consider the status of an Information Technology School within a New Zealand ITP.

There is an entrepreneurial route through the projects, and has been enhanced with a close relationship with a student business entrepreneurship programme (www.audacious.co.nz). There have been some successes. One student project, Trunk.ly, for example, placed in the Audacious top five in 2011 and was subsequently sold to AVOS. In 2012 Mann described how of 20 capstone projects underway, eight were explicitly entrepreneurial. It was argued that it should be a priority to support these and future groups to make the transition to successful business. The approach should involve a reinforcement of entrepreneurial aspects of the capstone (such as a requirement for delivering real sales by the end of the project) and to develop a relationship with the city’s business incubator UpStart (www.UpStart.co.nz).

1.2 Student business competition
Audacious is a collaboration between the University of Otago, Otago Polytechnic and the Dunedin City Council. It is aimed at encouraging students to start up businesses. It is both a competition and a community of founders. Audacious (then called KickStart) started in 2004 with the vision of Dunedin becoming a magnet for young entrepreneurs. It has run a student business idea and business plan competition every year since then.

Previous winners of the Audacious competition include Medikidz, which has created more than a million comic books that help explain medical conditions to children, and Language Perfect which sells its language learning software to the world from its base in Dunedin.

The Audacious competition is now embedded in a number of courses at the University and Polytechnic, as the lecturers have seen the benefits the programme offers. It is open to all tertiary students and around half of those who enter are not business school students.

Audacious provides a structure for students who want to start businesses. It aims to provide inspiration, community, advice and funding. Round one, in the first semester, involves idea development. The winners receive $500 to get the ball rolling on their start-ups. In second semester students further develop your initial concept and pitch it to the judges. Finally, up to $25,000 is awarded at the end of year prize-giving.

Audacious is run by a team of recent graduates who have intertwined roles of roles of event manager, design and competition coordinator. They are supported by a steering committee, with oversight from a governance committee. There are also currently two “Entrepreneurs in Residence” who are successful entrepreneurs who are working on their own businesses while committing to supporting student founder groups.

The goal in the first semester is to maximize awareness – both of enterprise as an opportunity, and the competition itself. To engage as many students as possible, considerable effort is put into high profile events and marketing, class lecture visits, halls of residence visits, etc.

In the second semester the Top 40 from round one have the opportunity to develop their idea, consult with experts in business, entrepreneurship, finance and marketing, write a fantastic business plan, pitch their idea to the judges in 60 seconds, and survive the Dragons’ Den. A full business plan is developed before final judging and a ceremonial awards night. Judges come from a range of backgrounds with range of experience and expertise from the areas of banking and tax, to IT, marketing and social entrepreneurship.

The competition is really a vehicle to create and support a community of start-up founders. Hence there is a focus on events that serve the purpose of gaining skills, finding inspiration and motivation and the building of support networks. Events in the first semester include speakers on local business
success, business planning, social entrepreneurship and workshops on lateral thinking.

1.3 Crowdsource

There are a number of areas in which the student experience of Audacious could be improved. These include a deeper experience for those who are involved, and a widening of the engagement beyond the entrants. To address these areas the authors looked to the opportunity of crowdsourcing.

A model is proposed whereby the entrants are required to enter their business onto a web-based platform. More than a repository of the fledgling businesses, this platform is intended to facilitate the benefits of collective intelligence [7] to collaborate on business development and encourage the building of support networks for the businesses.

In The Wisdom of Crowds, Surowiecki [11] examines several cases of crowd wisdom at work, where the very success of a solution is dependent on its emergence from a large body of solvers. The trick of this ‘wisdom of crowds’ is to aggregate solutions, not average them.

In his 2013 book, Crowdsourcing, Brabham [2] puts forth a problem-based typology of crowdsourcing approaches. These types are:

- Knowledge Discovery & Management - for information management problems where an organization mobilizes a crowd to find and assemble information. Ideal for creating collective resources.
- Distributed Human Intelligence Tasking - for information management problems where an organization has a set of information in hand and mobilizes a crowd to process or analyse the information. Ideal for processing large data sets that computers cannot easily do.
- Broadcast Search - for ideation problems where an organization mobilizes a crowd to come up with a solution to a problem that has an objective, provable right answer. Ideal for scientific problem solving.
- Peer-Vetted Creative Production - for ideation problems where an organization mobilizes a crowd to come up with a solution to a problem which has an answer that is subjective or dependent on public support. Ideal for design, aesthetic, or policy problems.

1.4 Objectives

The following objectives are proposed for a crowdsourcing system to support a student business competition system to

- To provide a vehicle for student engagement beyond the entrants;
- To provide a vehicle for including the competition in teaching programmes;
- To provide entrants the experience of managing marketing and narratives surrounding their business;
- To generate technical and commercial validation and feedback for the businesses;
- To provide a base for integrating social media into the business competition;
- To make greater use of 60 second pitches
- To provide exposure for sponsors (commercial, academic and government);
- To provide a mechanism for encouraging participation by formalising both late entries and keen but underperforming entries with a repechage system; and,
- To provide a mechanism to simplify logistics.

2. DESIGN

A system has been created that attempts to meet these objectives: Audacious Skulksource (Skulksource.com

Skulksource is essentially a content management system to hold student start-up information. To this, social media elements are added and, crucially, elements of gamification. The Audacious Business Competition is already in a sense a “game” but has not previously had a distributed game mechanic [9]. Previously the entrants completed a series of tasks that were assessed by a panel of judges. In Skulksource, the goal is to spread this judging.

A scoring system has been created whereby participants can vote for entries using a proportional preference system. In effect they are spending a virtual currency “FoxBucks”.

The scoring system is based on set allocations within bands, and different weightings. This means that judges, lecturers (and their classes), entrants, sponsors and public can all participate equally (on the surface at least).

A risk with this approach to introducing public gameplay is that the system gets subverted – or, ironically, “gamed”. Much thought has gone into making the game game-proof. Verified
emails are required. The scoring will be hidden until after the final awards to avoid a couple of front-runners getting all the attention.

The design, of the front page and the analysis screen reflects this sequence:

- **Favourite**: Browse and thumbs up the businesses that look interesting on first glance. Random order (default) or sort by category.
- **Analysis**: Go through your favourites list and score according to simplified judging criteria (stars).
- **Vote**: Spend your 100 FoxBucks
- **Promote**: Send the ones you like to Facebook and twitter. People who receive such messages can come back and vote once (for a “People’s choice”) or register and spend FoxBucks.
- **Feedback**: We hope to strengthen the start-ups by building community and advice around each one. This may be in the offer of technical advice, offer to be a first customer, or one-off suggestions.

3. **ELEMENTS**

3.1 **Browse and favourite**

Users can browse through the entries, using the filters to make browsing easier (Figure 2). Clicking on a thumbnail brings up the thumbnail for an entry.

![Figure 2: Browse, filter and favourite](image)

Use the heart to “favourite” businesses that look interesting (you can the easy find these ones again by using the filter). Use the arrows to scroll through the businesses.

3.2 **Profile page**

![Figure 3: Profile page for StartUp Entry](image)

Click on “vote for” to go to the detail page for that entry (Figure 3). This is the heart of the crowdsourcing of Audacious Skullsource. This is where we can make use of the strength of the crowd to help develop awesome start-ups.

Entrants are encouraged to create social media presence for their fledgling company – icons link through to the businesses page on major social media platforms or individual websites. A longer description of the business is required. There is also facility to link to longer documents such as business plans.

Up to six pictures can be loaded which cycle through in a slide show – both here and on the browse page. Videos of the 60 second pitch are also embedded on this page (Figure 4).

![Figure 4: Business detail page with video of 60 second pitch](image)
3.3 Analyse
A scoring system was developed to facilitate analysis of the potential of the start-ups (Figure 5). These five star factors were developed from an informal survey of successful New Zealand entrepreneurs in what they look for in businesses.

- Problem Identification
- Product Service
- Market Validation
- Resources/Funding
- Gut Feeling

These scores do not contribute to the formal judging but are intended to help both the businesses and other participants understand the value of the business. It is intended that Skulksource be useful for introducing entrepreneurship and enterprising concepts to students beyond those actively involved in the programme.

3.4 Voting
Every user on Audacious Skulksource has 100 “FoxBucks” to allocate as if they were investing in the businesses (Figure 6). This FoxBucks Vote will be used in two ways:

- In the repechage stage this voting will be used to identify start-ups for the second round of Audacious. This gives entrants who were not placed in the Top 40 in Round 1 a chance to demonstrate a commitment to the process of starting up in their business and in participating in Audacious.
- In round 2, this voting will be used to generate a “people’s choice award” and to contribute to the overall voting.

Feedback is designed to make the Audacious businesses stronger by widening the network supporting each business. Users are asked to give feedback and indicate areas where they are able to support each start-up. This is emailed to the start-up entrepreneurs.

The user can view a summary of their scoring and voting (Figure 7).

3.5 Sharing
Users are encouraged to send entries they like to Facebook and Twitter. Entrants supply a tweet-style summary of their business that can be sent to the major social media platforms or emailed (Figure 8).
4. Backstage

Audacious Skulksource is intended to be self-managing for the entrants. The entrants use Skulksource to create their own entry, update the information and choose when to make it live.

When the entrants are logged in, they can switch to edit mode on all fields (Figure 9).

An administration panel gives access to all activity on Skulksource.

5. Results

Audacious Skulksource was used in the second round of Audacious 2103.

In all, 42 start-ups completed their business profiles on Skulksource; 36 presented their Sixty Second Pitches; and 33 submitted their final business plans and appeared before the final Dragons’ Den panel. This is a slight increase on previous years.

The success of Audacious Skulksource can be considered against the objectives described in section 1.4.

- To provide a vehicle for student engagement beyond the entrants; Yes. There were 775 registered users. Although we did not request institutional affiliation, approximately a third of the email addresses are institutional.

- To provide a vehicle for including the competition in teaching programmes; No. This was not achieved but it is believed that this was a timing rather than structural issue.

- To provide entrants the experience of managing marketing and narratives surrounding their business; Yes. All but five of the entries on Skulksource were complete (had both tweet and description). Skulksource also provided a conduit to websites and other messaging (see Figures in Appendix).

- To generate technical and commercial validation and feedback for the businesses; Partial. Of the 52 detailed comments left, about half are of the “fantastic job” encouragement variety. The rest could be considered as specific advice for that business.

- To provide a base for integrating social media into the business competition; Yes. 61% of entrants had either Facebook, Twitter or LinkedIn accounts specific to their Skulksource profile. 41% had a website linked. Skulksource collected the number of shares via Twitter (this was not possible for other social media). In all, 602 tweets were sent from the site to promote individual start-ups. The most for an individual start-up was 63, the least 5 (median 13, stdev 12.37).
• To make greater use of 60 second pitches. Yes. The profile pages were uploaded with the videos. These were watched a total of 466 times (median 14.12, stdev 12.1)

• To provide exposure for sponsors (commercial, academic and government); Yes

• To provide a mechanism for encouraging participation by formalising both late entries and keen but underperforming entries with a repechage system; Yes, six businesses entered the competition through this route.

• To provide a mechanism to simplify logistics. Yes.

It is not the intention here to consider the relative strengths of the participating businesses. There is no obvious relationship between completeness of their Skulksource profile page and submission of a final Business Plan.

Skulksource is considered a success in the first instance. It met all but one of the performance criteria. In future years it is hoped that the use of the system for the whole competition will result in a use of the system in the many, not the few. With scrutiny on the spending of public money on entrepreneurship development programmes such as Audacious, it is important that research be undertaken to validate this approach.

Brahams (2008) made the point that true crowdsourcing needs to be “more than a new format for holding contests and awarding prizes”. He points to use of collective intelligence for developments whereby a company posts a problem online, a vast number of individuals offer solutions to the problem, the winning ideas are awarded some form of a bounty, and the company mass produces the idea for its own gain”. While Brahams refers to businesses such as Threadless (T-shirts) and iStockphoto (photographs), the potential is for a system such as Skulksource to be used to crowdsource the business development itself. While Skulksource went some way to achieve that, with feedback for business development teaching programmes.

The question arises, is Skulksource a distraction from the real job of running a business? Indeed, what is the role of a business competition such as this? Further research will be undertaken to investigate the assertion that Skulksource is good for students as they practice mobilising others to support their startup and provide feedback, a critical skill in entrepreneurship.

It is also argued that Skulksource is good for potential investors because the start-ups are strengthened through the knowledge of how to carry out a business. This is a significant area for potential research.

6. ACKNOWLEDGMENTS

Our thanks go to the rest of the Audacious 2013 team: Jessie McKay, David Wilson, Louis Brown, Carl Crawford, Fabienne Lecomte and Henk Roodt. We are also grateful for the patience and good humour of Perrin McKenzie.

7. REFERENCES


8. Appendix

Examples of Websites linked from Skulksource

Step.org.nz Youth dream jobs to reality. Real mentor testimonials. Follow their Footsteps.

http://resourcelocus.co.nz/

http://flowbot.co.nz/


Enterprise Engine

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ABSTRACT

This paper describes a model for the development of an “enterprise engine” within a tertiary institution. This approach has the potential to transform IT education. A model is derived to provide a platform for student-led innovation and enterprise.

Keywords
Education, Innovation, Entrepreneurship

1. INTRODUCTION

This paper describes a model for the development of an “enterprise engine” within a tertiary institution. This approach has the potential to transform IT education.

Most, if not all, computing graduates will work in an enterprise of some sort. This may be an established business, a start-up, a not-for-profit or even a government agency – all of these are run according to the principles of the enterprise. The premise of this paper is that education can improve the preparation for such a career by a focus on enterprise and entrepreneurship. This paper presents a model of an innovation engine that can drive the convergence of several imperatives in vocational education. This includes work-based learning, the evolution of the capstone, the changing nature of innovation and employment, resource diversification demands Bridge et al. [1] distinguish employability (being able to get jobs that exist); enterprise for life (being able to get on, even when right job doesn’t already exist); and entrepreneurship (new venture creation).

In a Northern Ireland context, Bridge and colleagues [1] argue:

In a Northern Ireland context, Bridge and colleagues [1] argue:

Individuals, organisations and countries must become more flexible, responsive, knowledgeable, mobile and proactive, and people who possess enterprising attributes such as boldness, innovation, and confidence will not only profit themselves, but will lead society in its drive to make necessary changes. The future, or at least a significant part of it, is likely to be made by, and belong to, the enterprising.

Bridge et al. [1] describe the attributes of an enterprising graduate: “Unique, innovative and creative contribution in the world of work, whether in employment or self-employment” and “Develops the capacity to respond positively to change”.


The mindset and process to create and develop economic activity by blending risk-taking, creativity and/or innovation with sound management, within a new or an existing organisation.

We argue that all of these skills and attributes would be useful in the portfolio of Information Technology graduates (indeed all graduates – Bridge [1] gives the example of enterprising nurses). The question becomes: how to achieve that? This is not a simple task, and we can’t hope to produce such attributes by accident. Gilbert [3] describes the challenges to “design and develop applied, industry-engaged learning environments that embrace ambiguity and uncertainty in overcoming pedagogical inertia in educating young entrepreneurs and innovators”.

In this paper a model is derived to provide a platform for student-led innovation and enterprise. The current state is considered, first in a general sense, and then with a focus on entrepreneurship. The model is proposed and used to develop priorities for ongoing research and institutional development.

2. Enterprise in Education

Previously, Mann et al. [8] described an Enterprise in Education model (Figure 1). We used this model to consider the positioning of a School of Information Technology. This assessment was used to derive a set of priorities for development of the School (Figure 2).

Figure 1 arranges institutional activities according to a hierarchy of increasing scope and scale. For the purposes of this model scope and scale are treated as an integrated measure. At the top of the model are major projects such as multi-year externally funded research projects. Next are on-going research programmes, primarily reflecting staff research interests and usually not explicitly funded. Beneath this are major student projects such as capstone projects or year-long internships. Smaller than these are small-scale research or development projects, labelled here as “Jobshop”, although funding could be internal or external. Project-based learning within courses (other than the capstone) is labelled “micro-projects”. At the bottom of the model are student ideas – although potentially large scale we have put them at the bottom on the basis that most of them don’t get beyond an idea at the lunch table before it is back to the grind of assignment work.
Seven priority areas were identified. Of particular interest here are:

- Priority 1: Jobshop
- Priority 2: links between capstone projects and major projects
- Priority 5: Increased use of problem based learning at all levels
- Priority 6: Develop stronger entrepreneurial aspects in projects
- Priority 7: Develop an “ideas factory”. The notion is that an “ideas factory” captures and supports students at all levels to explore their ideas. This implies the creation of a creative space to support initiatives of any scale and from any source.

All of these areas would benefit from a consideration of the role of entrepreneurship in encouraging both an enterprising and entrepreneurial mind-set. This is the focus of the remainder of the paper.

Figure 1: Institutional activities arranged according to hierarchy of scope and scale

Figure 2: EinE model used to develop a development strategy for the School.
3. Entrepreneurship in Education

Figure 3 presents a simplified model of the current state of support for entrepreneurship in education. Although the model could be applied to any institution, to give it context we describe it in terms of Otago Polytechnic’s experience.

The model shows that within existing undergraduate programmes there is some development of business. Most usually, this is as part of a capstone project. There is also a student business StartUp competition – Audacious (www.audacious.co.nz). This competition is aimed at the awareness of entrepreneurship, a supportive network and a community of founders [9]. While there is some overlap between the capstone (or other credit-bearing activity) there is not much. Some students undertake business development independent of both formal learning and the support systems such as Audacious.

Within the School of Information Technology there is an entrepreneurial route through the projects, which has been enhanced with this close relationship with Audacious. There have been some successes. One student project (Trunk.ly), for example, placed in the Audacious top five in 2011. This capstone project was subsequently sold to a large USA based software company. Also in the top five in 2011, Fish Basket aims to provide IT solutions to the fishing industry. This development is on-going and the system has been installed on several boats from a major New Zealand fishing company.

Out of the 20 capstone projects underway in 2013, 13 are explicitly entrepreneurial. A further three are working with recent start-ups, and four are working with social enterprises. It should be a priority to support these and future groups to make the transition to successful business. The approach should involve a reinforcement of entrepreneurial aspects of the capstone (such as a requirement for delivering real sales by the end of the project) and to develop a relationship with the city’s business incubator UpStart (www.UpStart.co.nz).

Funded in part by government but with contributions from the city council and tertiary organisations, UpStart supports start-up businesses. Unfortunately, with some exceptions there have been remarkably few start-ups make the transition from student business to UpStart supported business (indeed resolving this discontinuity was the original premise of Audacious).

Lastly on the current model are the various institutional service departments – marketing, research, contracts, finance and the like. While we might hope that these departments would be useful to fledgling companies, in practice there is little engagement.

Figure 4 shows the proposed Polytechnic Innovation Engine. The model can be seen as a funnel from left to right.

The model has the following aspects. The paper describes each of these, and progress towards developing them.

Within all undergraduate programmes, we intend to recognize enterprise as core graduate outcome (1). This was the approach successfully adopted for the development of sustainability as a focus area within the institution [7].

We intend to extend the overlap between Audacious and undergraduate programmes (2). This means more capstone projects (and the equivalent) making use of the Audacious programme. This is also an opportunity to build connections between disciplines within the institution.

The institution intends investing in Micro-Enterprises (3). These Micro-Enterprises are to be:

- Student led and driven
- Small scale funding and services (a smart money approach)
- Added-value focussed
- Preferably aligned with OP values and strategy
- Funded through a validation fund via Enterprise Vouchers.
Figure 4: Polytechnic Innovation Engine

Polytechnic Innovation Engine

1. Enterprise as core graduate outcome
2. More overlap between Audacious and programmes
3. Investment in Micro-Businesses
4. Enterprise vouchers
5. OP Graduate Enterprise
6. Culture and inspiration
7. Governance
8. Measure and results driven
9. Align with strategies (Open education, sustainability)
10. Integration across the innovation system (links between all aspects, not shown)
11. Specialist WBL degree
12. Graduate Enterprise School

OP Enterprise Vouchers are allocated to Micro Enterprises and Graduate Enterprises. They are worth (say) $5000 for completion of work by an OP Enterprise service agency (or another OP Enterprise service agency) or another Micro Enterprise.

- Innovation Workspace
- CORES
- New Spin
- Marketing
- MMFAC
- Research & Enterprise office
- Quality
- Finance

UpStart

OP Graduate Enterprise

OP Micro-Enterprise - Student led and driven - Small scale funding and services - Added value in aligning with OP vision and strategy - Validation fund

Audacious

Undergrad Academic Programmes

Bachelor of Enterprise

Graduate Enterprise School

OP Enterprise Services

Governance

Enables (Dragons x Mentors) UpStart and Audacious

Student
The Enterprise Vouchers (4) are designed to close the gap between the start-ups and the service departments of the institution. On the expected basis that start-ups require some cash but mostly advice and services, the plan is to incentivise the service departments to undertake this work. The vouchers will be redeemable at face value within the institution, or for a lesser amount externally.

It is hoped that this approach will provide motivation for institutional departments to see themselves in a more entrepreneurial manner.

For a small number of the Micro-Enterprises, we intend supporting the progression to a real start-up as Graduate Enterprises (5). These will similarly be supported through a mixture of money and services. We expect to support these businesses in the area of a year’s salary. These businesses will be high growth and must align with Polytechnic values and strategy. The relationship will be structured to suit the nature of the business. This may range from an equity stake to a first customer relationship. The support agency for these businesses is yet to be determined. While it would have traditionally been the role of UpStart, it may be more appropriate to develop a new structure that is focussed on continuing development of the business founder (rather than the investment focus of the existing incubator). It would be expected that graduates in this space enrol in a post-graduate programme – either the work-based-learning approach of the Masters of Professional Practice, or the Masters of Design Enterprise. In either case, this would be aimed at recognising the significant learning in establishing a business and the benefits of reflecting upon that learning and articulating it at an appropriate level.

All this must happen in a context where enterprise and entrepreneurship are valued. In addition to the hoped for effect of the voucher scheme, we aim to continue to develop a culture of innovation (6). Amongst other things such as the potential for an Entrepreneur in Residence, we hope to build closer links with other activities such as the high school level Young Enterprise scheme.

We hope to create a system that will have the benefits of serious clout through a governance structure (7) of respected entrepreneurs. It is hoped that they will provide both the oversight of the system but also potentially open doors for the Start-ups through access to their networks. This will also align with the city’s Economic Development Strategy of which the Polytechnic is a partner. It is intended that the system be measure and results driven (8).

This scheme is intended to align with other strategies of the institution (9) such as Open Education, Sustainability and The Maori Strategic Framework. For example we might choose to preferentially support a start-up business developing mobile applications for experiential learning.

Another version of this model (not shown) looks like an exploded plate of spaghetti, with links between every aspect. That version attempts to portray integration across the innovation system (10). The system is intended to support integration whereby, say, we invest in a business that stems a graduate from one discipline who makes use of the Polytechnic services (including further education), and who works with undergraduates from several disciplines (say Business, IT, Design).

Also fitting into this overall strategy is the possibility of an entirely work-based learning degree, a Bachelor of Enterprise (11). Students would be assisted to establish businesses and learn on a just-in-time basis as the degree progresses. This same model could work at post-graduate as a Graduate Enterprise School (12).

4. Discussion

Bridge et al. [1] distinguish employability (being able to get jobs that exist); enterprise for life (being able to get on, even when right job doesn’t already exist); and entrepreneurship (new venture creation). In this development we have deliberately included both Entrepreneurship and Enterprise as the basis for the model. We are not intending that everyone be entrepreneurs, but believe that there is a considerable overlap both in substance and in the experiential benefits of running a business as part of the overall pathway of study.

Also, so that people are not always working at the limit of their competence, we believe that it is appropriate to teach the level of skills at least a level higher than needed in employment. Thus we argue that it is appropriate for all students to experience entrepreneurship.

5. Conclusion

The paper has proposed an Enterprise Engine for developing enterprise and entrepreneurship as a basis for tertiary education. The model was usefully applied to the exploration and articulation of a development strategy for New Zealand ITP with particular emphasis on Information Technology.

ACKNOWLEDGMENTS

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REFERENCES

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Enhancing Student Engagement by Student Presentations in Discussion Tutorials

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ABSTRACT
The need for business graduates to have good information technology skills and presentation skills has been well established. This paper presents the outcomes of the introduction of a student presentation assessment into the discussion tutorials of a large first year information systems course, with the students also being allocated marks for giving feedback on the presentations of their fellow students. The results of this study highlight increased rates of attendance at the discussion tutorials; increased confidence of female students and students with no prior experience at delivering presentations; the realisation that attendance and participation at the discussion tutorials served to increase learning; and students with English as an additional language benefitting from giving feedback on other students’ presentations. These findings along with the high levels of agreement that what took place with the presentations and the discussion tutorials helped the students’ learning in the course.

Categories and Subject Descriptors
K.3.2 [Computer and Information Science Education]

General Terms
Measurement

Keywords
Student Engagement, Presentation Skills, IT Skills, Graduates

INTRODUCTION AND METHODOLOGY
Attendance rates at the discussion tutorials were particularly low (15%-20%) in INFO123 (Information Systems and Technology) at the University of Canterbury. It was felt by the staff involved that those students who did attend the discussion tutorials appeared to gain in their understanding of key concepts. INFO123 is a compulsory first year information systems course for students completing the Bachelor of Commerce (BCom), and many of the students were only enrolling in the course because of its compulsory nature.

In 2012 it was decided to introduce a student presentation as one of the assessments in the course and to allocate marks to students for giving feedback on other student presentations. The main aim of doing this was to formally assess oral communications skills in the first year of the BCom as this is part of the graduate profile for the degree. The topics for the presentations were based on the content of the course and real life examples that related to the content.

The aim of this paper is to analyse the effectiveness of the use of the presentations in increasing student engagement in discussion tutorials.

A brief literature review is presented covering the importance of IT skills and communication skills for business graduates; the importance of student engagement; and the importance of students having multiple opportunities to grasp key concepts.

The reasons for introducing the presentations and how they were organised within the course are described to provide additional background information for the paper.

The results of the survey are presented along with a summary of the attendance rates at the discussion tutorials and how the attendance rate changed with the introduction of incentives to attend the discussion tutorials. These results are analysed and discussed, with conclusions being drawn regarding the effectiveness of the introduction of the presentations.

This paper has relevance to higher education institutions who are offering large classes in computing, information systems or information technology that are part of business qualifications, and where there is a desire to increase student engagement with the content of the course and to enhance communication skills.

2. LITERATURE REVIEW
2.1 Introduction to Literature Review
The following brief literature review covers the importance of information technology (IT) skills and communication skills for business graduates; the importance of student engagement and the importance of revisiting content a number of times.

2.2 Importance of IT Skills and Communication Skills for Business Graduates
The need for business and commerce graduates to have well developed information technology (IT) skills and communication skills has been well documented [1, 2, 10]. The need to increase student engagement has also been well documented, particularly when it comes to cognitive engagement [8]. The need for giving students multiple opportunities to engage with content has also been identified [3].

2.3 Importance of Student Engagement
The concept of engagement in learning has been the subject of much research in an attempt to address student motivation in learning situations [8]. Three types of engagement have been identified as being behavioural engagement, emotional engagement and cognitive engagement [8].

Behavioural engagement relates to positive conduct and following rules and norms [5, 6, 7]. Emotional engagement refers to students' affective reactions in the classroom, including interest, boredom, happiness, sadness, and anxiety [4, 11]. Cognitive engagement refers to psychological investment in learning, a
desire to go beyond the requirements, and a preference for challenge [4, 9, 12]. Cognitive engagement includes flexibility in problem solving, preference for hard work, and positive coping in the face of failure [4].

The nature of engagement referred to in this study is predominantly that of cognitive engagement in particular the “student’s psychological investment in an effort directed toward learning, understanding, mastering the knowledge, skills or crafts that the academic work is intended to pro-mote” [9].

2.4 Revisiting Content
Learning developed through discussion, especially if it leads to substantial changes in understanding, likely will be forgotten or subsequently distorted unless the new understandings are revisited on several occasions. The most efficient way to accomplish this is to maximize the connections across subsequent activities and revisit main ideas frequently [3].

3. INTRODUCTION OF THE PRESENTATIONS
The course is offered in semester one and semester two of the academic year with enrolment numbers in each semester ranging from 200-400 with students being allocated to weekly discussion tutorials with 30-40 students in each one. It was decided to have the students complete their presentations during the weekly discussion tutorials that are held across the semester with 3-6 students completing their presentations in each discussion tutorial each week. The topics for each presentation needed to be related to content that had been covered in the two previous weeks of lectures and could include real-life examples or additional research relating to the content.

Some observations made by the academic staff involved in the presentations included:

- Students were gaining in their understanding of the lecture content by presenting about the lecture content.
- The need to give feedback on other students’ presentations increased the attendance rate and had some affect on the students understanding of the topics that they were giving feedback on.
- There was a much higher attendance rate at the discussion tutorials.

4. THE SURVEY
4.1 The Population Surveyed and Introductory Questions
The survey was made available via the Moodle (the Learning Management System used at the University of Canterbury) for the students at the end of each semester across semester one and two of 2012 and semester one of 2013.

The students were asked to indicate the following in the demographic section of the survey:

- Gender
- Age at the start of the semester
- Whether English was their first language
- The degree they were studying towards
- Their planned subject major
- How long they had been in tertiary study
- Their experience in doing classroom presentations

4.2 Confidence Regarding the Presentations
The students were asked to indicate which of the following applied to their confidence about doing presentations as a result of completing the presentation in INFO123:

- I feel more confident about doing presentations in the future
- I feel less confident about doing presentations in the future
- I have the same level of confidence about doing presentations in the future
- I didn't do the presentation

4.3 Perception of Presentations
The students were asked to rate each of the statements shown in Table 1 on the following 5 point Likert scale.

- Strongly Agree
- Agree
- Neither Agree nor Disagree
- Disagree
- Strongly Disagree

Table 1 – Statements the Students Were Asked to Rate

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doing the presentation helped me understand the topic for my presentation better</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Providing feedback on other presentations helped me understand those topics better</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I did my presentation before the term test and it helped my preparation for the term test in that topic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apart from being able to gain marks by attending the tutorials to present and give feedback, attending the tutorials helped my learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. RESULTS
This section presents the results of the survey and in the final subsection data relating to the attendance rates at the discussion tutorials is presented.

5.1 Enrolments and Response Rates
The number of students enrolled in each semester and the response rates to the survey is shown in Table 2 and indicate an overall response rate of 24% and a total sample size of 225.

Table 2 – Responses to Survey

<table>
<thead>
<tr>
<th>Year</th>
<th>Semester</th>
<th>Enrolments</th>
<th>Respondents</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>One</td>
<td>324</td>
<td>62</td>
<td>19%</td>
</tr>
<tr>
<td>2012</td>
<td>Two</td>
<td>391</td>
<td>76</td>
<td>19%</td>
</tr>
<tr>
<td>2013</td>
<td>One</td>
<td>221</td>
<td>87</td>
<td>39%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>936</td>
<td>225</td>
<td>24%</td>
</tr>
</tbody>
</table>

5.2 Responses to Demographic Questions
Table 3 shows the breakdown of responses by gender and indicates a relatively even spread across the genders amongst the 225 respondents.
Table 3 – Respondents by Gender

<table>
<thead>
<tr>
<th>Age</th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>32</td>
<td>33</td>
<td>42</td>
<td>107</td>
<td>48%</td>
</tr>
<tr>
<td>Male</td>
<td>30</td>
<td>43</td>
<td>45</td>
<td>118</td>
<td>52%</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>76</td>
<td>87</td>
<td>225</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 4 shows the breakdown of responses by age at the start of the semester and indicate that the majority of the students who responded were from 18-21 years of age at the start of the semester when they were enrolled for the course (169 out of the 225 = 75.1%).

Table 4 – Respondents by Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>18</td>
<td>13</td>
<td>35</td>
<td>26</td>
<td>74</td>
</tr>
<tr>
<td>19</td>
<td>16</td>
<td>12</td>
<td>16</td>
<td>44</td>
</tr>
<tr>
<td>20</td>
<td>8</td>
<td>8</td>
<td>13</td>
<td>29</td>
</tr>
<tr>
<td>21</td>
<td>9</td>
<td>3</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>22</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>23</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>24</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>25-29</td>
<td>8</td>
<td>3</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>30-34</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>35-39</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>40+</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>76</td>
<td>87</td>
<td>225</td>
</tr>
</tbody>
</table>

Table 5 shows the breakdown of responses by whether English is their first language or not.

Table 5 – Respondents by English as First Language

<table>
<thead>
<tr>
<th>English as First Language</th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>English as First Language</td>
<td>49</td>
<td>62</td>
<td>71</td>
<td>182</td>
</tr>
<tr>
<td>English as Additional Language</td>
<td>13</td>
<td>14</td>
<td>16</td>
<td>43</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>76</td>
<td>87</td>
<td>225</td>
</tr>
</tbody>
</table>

Table 6 shows the breakdown of responses by the degree the students had enrolled for.

Table 6 – Respondents by Degree Enrolled for

<table>
<thead>
<tr>
<th>Degree</th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor of Commerce</td>
<td>58</td>
<td>65</td>
<td>82</td>
<td>205</td>
</tr>
<tr>
<td>Bachelor of Science</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Bachelor of Arts</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Bachelor of Engineering</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>76</td>
<td>87</td>
<td>225</td>
</tr>
</tbody>
</table>

Table 7 shows the planned majors of the respondents. Where students were planning a double major they were asked to choose their preferred major.

Table 7 – Respondents by Intended Major

<table>
<thead>
<tr>
<th>Intended Major</th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting</td>
<td>19</td>
<td>29</td>
<td>22</td>
<td>70</td>
</tr>
<tr>
<td>Finance</td>
<td>4</td>
<td>8</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Economics</td>
<td>4</td>
<td>7</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>International Business</td>
<td>7</td>
<td>4</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>Information Systems</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>HRM</td>
<td>5</td>
<td>3</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>Management</td>
<td>11</td>
<td>6</td>
<td>15</td>
<td>32</td>
</tr>
<tr>
<td>Taxation</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Management Science</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other or Undecided</td>
<td>8</td>
<td>18</td>
<td>13</td>
<td>39</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>76</td>
<td>87</td>
<td>225</td>
</tr>
</tbody>
</table>

Table 8 shows how long the respondents have been in tertiary/university study.

Table 8 – Respondents by Intended Major

<table>
<thead>
<tr>
<th>Time in Tertiary Study</th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year, First Semester</td>
<td>23</td>
<td>7</td>
<td>41</td>
<td>71</td>
</tr>
<tr>
<td>First Year Second Semester</td>
<td>8</td>
<td>50</td>
<td>6</td>
<td>64</td>
</tr>
<tr>
<td>Second Year</td>
<td>21</td>
<td>12</td>
<td>24</td>
<td>57</td>
</tr>
<tr>
<td>Third Year or Later</td>
<td>10</td>
<td>7</td>
<td>16</td>
<td>33</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>76</td>
<td>87</td>
<td>225</td>
</tr>
</tbody>
</table>

Table 9 shows the level of experience that the students had in completing classroom presentations before enrolling in INFO123.
Table 9 – Respondents by Presentation Experience

<table>
<thead>
<tr>
<th></th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>11</td>
<td>14</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>1 to 3</td>
<td>22</td>
<td>22</td>
<td>26</td>
<td>70</td>
</tr>
<tr>
<td>4 or more</td>
<td>29</td>
<td>40</td>
<td>46</td>
<td>115</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>62</strong></td>
<td><strong>76</strong></td>
<td><strong>87</strong></td>
<td><strong>225</strong></td>
</tr>
</tbody>
</table>

5.3 Confidence Regarding the Presentations
Table 10 shows the students’ level of confidence about giving presentations after their INFO123 presentation.

Table 10 – Confidence Regarding Future Presentations

<table>
<thead>
<tr>
<th></th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feel more confident</td>
<td>17</td>
<td>24</td>
<td>23</td>
<td>64</td>
</tr>
<tr>
<td>Feel less confident</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Same level of confidence</td>
<td>42</td>
<td>42</td>
<td>58</td>
<td>142</td>
</tr>
<tr>
<td>Didn’t give presentation</td>
<td>3</td>
<td>8</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>62</strong></td>
<td><strong>76</strong></td>
<td><strong>87</strong></td>
<td><strong>225</strong></td>
</tr>
</tbody>
</table>

5.4 Perception of Presentations
Table 11 shows the student responses to the statement “Doing the presentation helped me understand the topic for my presentation better”.

Table 11 – Doing the presentation helped with topic understanding

<table>
<thead>
<tr>
<th></th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>17</td>
<td>17</td>
<td>25</td>
<td>59</td>
</tr>
<tr>
<td>Agree</td>
<td>33</td>
<td>41</td>
<td>40</td>
<td>114</td>
</tr>
<tr>
<td>Neutral</td>
<td>8</td>
<td>9</td>
<td>17</td>
<td>34</td>
</tr>
<tr>
<td>Disagree</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>62</strong></td>
<td><strong>76</strong></td>
<td><strong>87</strong></td>
<td><strong>225</strong></td>
</tr>
</tbody>
</table>

Table 12 shows the student responses to the statement “Providing feedback on other presentations helped me understand those topics better”.

Table 12 – Providing feedback helped with topic understanding

<table>
<thead>
<tr>
<th></th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>6</td>
<td>4</td>
<td>12</td>
<td>22</td>
</tr>
<tr>
<td>Agree</td>
<td>28</td>
<td>24</td>
<td>34</td>
<td>86</td>
</tr>
<tr>
<td>Neutral</td>
<td>12</td>
<td>26</td>
<td>21</td>
<td>59</td>
</tr>
<tr>
<td>Disagree</td>
<td>15</td>
<td>18</td>
<td>19</td>
<td>52</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>62</strong></td>
<td><strong>76</strong></td>
<td><strong>87</strong></td>
<td><strong>225</strong></td>
</tr>
</tbody>
</table>

Table 13 shows the student responses to the statement “I did my presentation before the term test and it helped my preparation for the term test in that topic”. Note that only 96 of the 225 respondents had completed their presentation before the term test.

Table 13 – Doing the presentation helped with preparation for term test

<table>
<thead>
<tr>
<th></th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Agree</td>
<td>16</td>
<td>14</td>
<td>18</td>
<td>48</td>
</tr>
<tr>
<td>Neutral</td>
<td>7</td>
<td>5</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Disagree</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>32</strong></td>
<td><strong>27</strong></td>
<td><strong>37</strong></td>
<td><strong>96</strong></td>
</tr>
</tbody>
</table>

Table 14 shows the student responses to the statement “Apart from being able to gain marks by attending the discussion tutorials to present and give feedback, attending the discussion tutorials helped my learning”. Note that of the 225 respondents, 3 indicated that they did not attend any discussion tutorials, leaving 222 responses to this question.

Table 14 – Providing feedback helped with topic understanding

<table>
<thead>
<tr>
<th></th>
<th>Sem One 2012</th>
<th>Sem Two 2012</th>
<th>Sem One 2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>23</td>
<td>23</td>
<td>32</td>
<td>78</td>
</tr>
<tr>
<td>Agree</td>
<td>32</td>
<td>43</td>
<td>46</td>
<td>121</td>
</tr>
<tr>
<td>Neutral</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Disagree</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>61</strong></td>
<td><strong>75</strong></td>
<td><strong>86</strong></td>
<td><strong>222</strong></td>
</tr>
</tbody>
</table>
5.5 Discussion Tutorial Participation Rates
While attendance was not taken at the discussion tutorial rates, the weeks in which students submitted feedback on other presentations was recorded with this being displayed in Table 15. This table also shows the average number of students participating (providing feedback or giving presentations) in each week; the participation rate and the percentage of students providing more weeks’ worth of feedback than the number required for maximum marks (more than 5).

Table 15 – Frequency of Students Submitting Feedback

<table>
<thead>
<tr>
<th>Number of Weeks with Feedback Submitted in Discussion Tutorials</th>
<th>2012 Semester One</th>
<th>2012 Semester Two</th>
<th>2013 Semester One</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>91</td>
<td>68</td>
<td>26</td>
</tr>
<tr>
<td>1</td>
<td>12</td>
<td>21</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>24</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>28</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>31</td>
<td>30</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>84</td>
<td>84</td>
<td>33</td>
</tr>
<tr>
<td>6</td>
<td>51</td>
<td>78</td>
<td>39</td>
</tr>
<tr>
<td>7</td>
<td>17</td>
<td>39</td>
<td>35</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

Weeks of discussion tutorials | 8 | 9 | 10
Total enrolled | 324 | 391 | 221
Average number participating in each week | 159.6 | 201.3 | 122.9
Participation rate | 49.3% | 51.5% | 55.6%
Percentage of students providing more than 5 weeks of feedback | 21.9% | 34.8% | 49.3%

6. ANALYSIS AND DISCUSSION
The results of regarding the students confidence about the presentations and their perceptions of the presentations were analysed to determine if there were any trends relating to the gender of the respondents; whether English was their first language; their length of time in tertiary study; and how many class presentations they had made in the past. The following sections of the paper present those areas where there appears to have been some difference based on a visual inspection of the results.

6.1 Confidence by Gender
An analysis of the affect that making the presentation had on confidence about making future presentation is shown in Table 16. This shows that of the respondents a higher percentage of male students felt more confident about doing future presentations in the future. This data also shows that a higher proportion of male students than female students didn’t make the presentation. This however does not measure the degree of confidence prior to making the presentation, and is something that could be considered in later iterations of this study.

Table 16 – Confidence Regarding Future Presentations by Gender

<table>
<thead>
<tr>
<th></th>
<th>More Confidence</th>
<th>Same</th>
<th>Less Confidence</th>
<th>Didn’t present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>31.78%</td>
<td>62.62%</td>
<td>0.93%</td>
<td>4.67%</td>
</tr>
<tr>
<td>Male</td>
<td>25.42%</td>
<td>63.56%</td>
<td>0.85%</td>
<td>10.17%</td>
</tr>
</tbody>
</table>

This however does not measure the degree of confidence prior to making the presentation, and is something that could be considered in later iterations of this study.

6.2 Confidence by Time in Tertiary Study
The impact of the presentations on the confidence of making future presentations was analysed based on the time that the students had spent in tertiary study, with this analysis being shown in Table 17. This shows that the biggest impact of confidence for the future was with students in their first year of tertiary study, with this being at its highest point with students in the second semester of their first year of study.

Table 17 – Confidence Regarding Future Presentations by Time in Tertiary Study

<table>
<thead>
<tr>
<th></th>
<th>More Confidence</th>
<th>Same</th>
<th>Less Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester 1, Year 1</td>
<td>32%</td>
<td>66%</td>
<td>2%</td>
</tr>
<tr>
<td>Semester 2, Year 1</td>
<td>41%</td>
<td>59%</td>
<td>0%</td>
</tr>
<tr>
<td>Year 2</td>
<td>24%</td>
<td>74%</td>
<td>2%</td>
</tr>
<tr>
<td>Year 3 or Later</td>
<td>20%</td>
<td>80%</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>31%</td>
<td>68%</td>
<td>1%</td>
</tr>
</tbody>
</table>

That the second and third students had less increase in their confidence levels is likely to be due to their confidence levels having grown through their first one or two years of tertiary study. As indicated previously the confidence level prior to making the presentations in this course had not been measured and is something that could be measured in a later iteration of this study.

6.3 Confidence by Presentation Experience
The degree of confidence for future presentations was analysed based on the amount of presentation experience the students had prior to the presentation with this being shown in Table 18. There is a big difference in the percentage of students with increased confidence who had no previous experience in delivering presentations compared with those who had some prior experience.

Table 18 – Confidence Regarding Future Presentations by Presentation Experience

<table>
<thead>
<tr>
<th>No. of previous presentations</th>
<th>More Confidence</th>
<th>Same</th>
<th>Less Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>61%</td>
<td>39%</td>
<td>0%</td>
</tr>
<tr>
<td>1-3</td>
<td>29%</td>
<td>68%</td>
<td>3%</td>
</tr>
<tr>
<td>4 or more</td>
<td>23%</td>
<td>77%</td>
<td>0%</td>
</tr>
</tbody>
</table>
As indicated previously the confidence level prior to making the presentations in this course had not been measured and is something that could be measured in a later iteration of this study.

6.4 Presentation Helped Understanding of Topic by Gender

The analysis of the responses about whether doing the presentation helped students’ understanding of the topic based on their gender is shown in Table 19. This shows that a higher percentage of female students (85%) agreed or strongly agreed compared with male students (69%).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Agree or Strongly Agree</th>
<th>Neutral</th>
<th>Disagree or Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>85%</td>
<td>12%</td>
<td>3%</td>
</tr>
<tr>
<td>Male</td>
<td>69%</td>
<td>18%</td>
<td>13%</td>
</tr>
</tbody>
</table>

The level of disagreement with this is significantly higher with the male respondents (13%) as compared with the female respondents (3%). In future iterations of the study, it would be of interest to explore why this is the case.

6.5 Presentation Helped Understanding of Topic by Time in Tertiary Study

The analysis of the responses about whether doing the presentation helped students’ understanding of the topic based on their time in tertiary study is shown in Table 20. This shows that a higher percentage of students in at least their second year (82%) agreed or strongly agreed compared with students in their first year (73%).

<table>
<thead>
<tr>
<th>Time in Tertiary Study</th>
<th>Agree or Strongly Agree</th>
<th>Neutral</th>
<th>Disagree or Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year</td>
<td>73%</td>
<td>18%</td>
<td>9%</td>
</tr>
<tr>
<td>Second Year or Later</td>
<td>82%</td>
<td>11%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Given that the levels of disagreement are very similar, this is an area where more formal tests as to the significance of the difference would be of use in further iterations of the study.

6.6 Presentation Helped Understanding of Topic by Presentation Experience

The analysis of the responses about whether doing the presentation helped students’ understanding of the topic based on their prior experience at delivering presentations is shown in Table 21. This shows a very low proportion of students who had done no prior presentations have a strong level of agreement that the presentations helped their understanding of the topic.

<table>
<thead>
<tr>
<th>Prior Presentations</th>
<th>0</th>
<th>1-3</th>
<th>4+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>5%</td>
<td>36%</td>
<td>28%</td>
</tr>
<tr>
<td>Agree</td>
<td>70%</td>
<td>41%</td>
<td>49%</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>20%</td>
<td>16%</td>
<td>13%</td>
</tr>
<tr>
<td>Disagree</td>
<td>3%</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>

However when those that agree and that strongly agree are grouped together there appears to be little difference based on prior presentation experience as shown in Table 22.

6.7 Discussion Tutorials Helping Learning by Time in Tertiary Study

The analysis of the responses about whether the discussion tutorials helped learning based on the time spent in tertiary study and slightly lower for students in their third year.

<table>
<thead>
<tr>
<th>Time in Tertiary Study</th>
<th>Sem 1 Year 1</th>
<th>Sem 2 Year 1</th>
<th>Year 2</th>
<th>Year 3+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>28%</td>
<td>41%</td>
<td>47%</td>
<td>18%</td>
</tr>
<tr>
<td>Agree</td>
<td>59%</td>
<td>51%</td>
<td>47%</td>
<td>64%</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>7%</td>
<td>5%</td>
<td>6%</td>
<td>12%</td>
</tr>
<tr>
<td>Disagree</td>
<td>3%</td>
<td>3%</td>
<td>0%</td>
<td>6%</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

This difference may be explained by students in their first semester having not experienced end of semester exams and results at the time they completed the survey, and with third year students having become more independent learners based on their experience as students. When the strongly agree and agree responses are combined together as in Table 24 this shows the proportions of students agreeing or strongly agreeing is reasonably consistent across students in their first two years of study and slightly lower for students in their third year.
6.8 Discussion Tutorials Helping Learning by Presentation Experience

The analysis of the responses about whether the discussion tutorials helped learning based on their level of presentation experience were analysed and are presented in Table 25. This analysis shows the highest level of strong agreement being with those who had prior experience of delivering presentations.

Table 25 – Discussion Tutorials Helped Learning by Presentation Experience

<table>
<thead>
<tr>
<th>Prior Presentations:</th>
<th>Agree or Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1-3</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>28%</td>
</tr>
<tr>
<td>Agree</td>
<td>59%</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>7%</td>
</tr>
<tr>
<td>Disagree</td>
<td>3%</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>3%</td>
</tr>
</tbody>
</table>

When the strongly agree and agree responses are aggregated as shown in Table 26 the difference does not appear as significant.

Table 26 – Discussion Tutorials Helped Learning by Presentation Experience Version 2

<table>
<thead>
<tr>
<th>Prior Presentations</th>
<th>Agree or Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>87%</td>
</tr>
<tr>
<td>1-3</td>
<td>92%</td>
</tr>
<tr>
<td>4+</td>
<td>94%</td>
</tr>
</tbody>
</table>

6.9 Providing Feedback Helped Understanding of Topic by Language

The analysis of the responses as to whether providing feedback on other presentations helped with learning based on whether English was the first language is shown in Table 27. For this analysis the strongly agree and agree responses were grouped together and the strongly disagree and disagree responses were grouped together.

Table 27 – Providing Feedback Helped Understanding by Language

<table>
<thead>
<tr>
<th></th>
<th>English as First Language</th>
<th>English as Additional Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree or Strongly Agree</td>
<td>45%</td>
<td>63%</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td>Disagree or Strongly Disagree</td>
<td>29%</td>
<td>11%</td>
</tr>
</tbody>
</table>

This suggests that students who do not have English as their first language were more likely to benefit from providing feedback on the presentations that those who do have English as their first language. The proportions that were neutral were similar resulting in there being a marked difference in the proportions that disagreed that providing feedback helped.

6.10 Providing Feedback Helped Understanding of Topic by Time in Tertiary Study

The analysis of the responses as to whether providing feedback on other presentations helped with learning based on their time in tertiary study is shown in Table 28. This is showing the students in their second year appear to have a higher overall level of agreement with this than students in their first or second year.

Table 28 – Providing Feedback Helped Learning by Time in Tertiary Study

<table>
<thead>
<tr>
<th>Time in Tertiary Study</th>
<th>Sem 1 Year 1</th>
<th>Sem 2 Year 1</th>
<th>Year 2</th>
<th>Year 3+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>11%</td>
<td>8%</td>
<td>14%</td>
<td>3%</td>
</tr>
<tr>
<td>Agree</td>
<td>33%</td>
<td>39%</td>
<td>51%</td>
<td>24%</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>27%</td>
<td>30%</td>
<td>21%</td>
<td>27%</td>
</tr>
<tr>
<td>Disagree</td>
<td>27%</td>
<td>19%</td>
<td>11%</td>
<td>46%</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1%</td>
<td>4%</td>
<td>3%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Combining the strongly agree and agree responses and combining the strongly disagree and disagree responses shows this a bit more clearly and is presented in Table 29. This also shows the level of agreement is higher with the first year students that with the third year students, with the third year students having quite a high level of disagreement.

Table 29 – Providing Feedback Helped Learning by Time in Tertiary Study Version 2

<table>
<thead>
<tr>
<th>Time in Tertiary Study</th>
<th>Sem 1 Year 1</th>
<th>Sem 2 Year 1</th>
<th>Year 2</th>
<th>Year 3+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree or Strongly Agree</td>
<td>45%</td>
<td>47%</td>
<td>65%</td>
<td>27%</td>
</tr>
<tr>
<td>Neither Agree nor Disagree</td>
<td>27%</td>
<td>30%</td>
<td>21%</td>
<td>27%</td>
</tr>
<tr>
<td>Disagree or Strongly Disagree</td>
<td>28%</td>
<td>23%</td>
<td>14%</td>
<td>46%</td>
</tr>
</tbody>
</table>

This is similar to the data presented in Table 23 and Table 24 that depicted whether the discussion tutorials in general helped with learning based on the time spent in tertiary study.

In a similar way this difference may be explained by students in their first semester having not experienced end of semester exams and results at the time they completed the survey, and with third year students having become more independent learners based on their experience as students.

6.11 Discussion Tutorial Participation Rates

The data presented in Table 15 regarding the attendance rate at the discussion tutorials shows that there has been a significant increase in the attendance at discussion tutorials due to the encouragement by way of marks to attend. Whereas the
attendance rate had been 15-20% previously it had moved from 49.3% to 55.6% across the first three semesters where the presentations had taken place.

An increasing proportion of students are now attending more sessions than are needed to gain the maximum marks that are available with this having increased from 21.9% to 49.3% across the three semesters. This is consistent with the earlier analysis that suggests there is a high level of agreement in discussion tutorial attendance helping with learning.

6.12 Summary
When it came to the students’ level of confidence regarding the presentations very few students felt they had less confidence with one third of students reporting that they had a higher level of confidence as a result. Female students reported a higher level of confidence increase as did students in their first year of tertiary study and students who had no prior presentation experience. As mentioned earlier the level of confidence prior to the presentations had not been measured.

High levels of students reported that doing the presentation helped with their understanding of the topic with this being most noticeable in female students and students in their second or third year of tertiary study.

Providing feedback on other presentations was reported by reasonably high levels of students as helping their understanding of the topic but not at the same level as for the topics that they presented on. This was reported as being more helpful by students for whom English is not their first language. Students in the second year of study reported this as being more useful than students in their first year who reported this as being more useful than students in their third year.

Attendance at the discussion tutorials was reported as being helpful for student learning was reported by high proportions of students with this being at its highest level of agreement amongst students in their second year followed by students in their first year followed by students in their third year. Students who had not made presentations before were not in as high level of agreement with students who had made presentations but their overall level of agreement was similar.

The introduction of the presentations and making marks available for providing feedback has significantly increased attendance rates at the discussion tutorials and with the number attending once they had gained the maximum possible marks, this indicates that more value was being placed on attending than previously.

7. CONCLUSIONS
The introduction of the presentations and making marks available for providing feedback has been successful overall. This is highlighted by:

- The confidence levels regarding doing presentations increasing with many of the student, with this being more noticeable with female students, those with little experience in conducting presentations.
- An increased understanding of topics when presenting on them with this being more noticeable for female students and students in their second and third year.
- An increased understanding of topics due to giving feedback with this being more noticeable for students for whom English is not their first language
- Students in their second year appeared to gain more than first year students from the giving of feedback and the overall attendance at discussion tutorials than first and third year students with this being related to first year students having experienced less end of semester exams to know what is helpful and third year students having become more independent learners by then.

- The incentive to attend discussion tutorials by awarding marks for giving feedback on presentations appears to be at the right level with significant numbers of students continuing to participate after they had received the maximum possible number of marks.

This research will continue into the future with some thought being given to measuring the confidence levels of students prior to doing the presentations.

8. REFERENCES
ABSTRACT

This paper describes the results of a workshop that examined different models of community engagement for schools of Information Technology within New Zealand Institutes of Technology. A model is developed that is based on articulating the nature of the relationships between different stakeholders.

Keywords

1. INTRODUCTION

This paper describes the development of a relationship model of community engagement. The model is derived from case studies presented to the CITRENZ Computing South Island Educators Forum (CSIE).

Participants in the CSIE workshop each presented a short description of an activity that they were involved in (using the template in the Appendix). The theme for all these case studies was tertiary community/industry engagement.

2. RELATIONSHIP MODEL

Participants explored a number of potential models for describing community engagement. From these models, a set of principles were derived.

Models include:

- Participation (Arnstein’s ladder [1])
- Knowledge transfer [8,11]
- Corporate Social Responsibility [2]
- Stakeholder mapping [5]
- Communities of Practice [3, 6]
- Stakeholder models [7]
- Business models (especially win-win)
- Outreach
- Leadership
- Action research [13]
- Capability maturity models [12]
- Innovation diffusion models [4, 10]
- Organisational learning [9]

The workshop participants mapped all the case studies to a table that summarised the engagement models (Figure 1). It was realised that all of them had relationships as the common thread. To understand the community engagement we had to understand the extent and nature of the relationships between the different parties. This model is represented in Figure 2. Note that the classification is somewhat arbitrary in some cases, particularly the distinction between Lecturer and Institution – the separation is intended to represent the difference between a relationship that is primarily with the lecturer, from one that is formalised with the institutional body. The model does not purport to represent the entirety of the relationship, for example the student and institution clearly have a relationship, but it is only on the model if this relationship is clearly enhanced by the particular activity.
3. CASE STUDIES

3.1 Secondary school programming competition (SIT)

Ken Sutton teaching high school advanced programming techniques in preparation for international competition is an ongoing activity of Southern Institute of Technology (SIT). SIT has been running after school sessions for high school students to encourage participation in national and international programming challenges. Particular successes include three students travelling to India to represent NZ at SEARCC, one who participated in IOI 2005, and for the last two years two have attended the national NIOO training camp in Auckland. Although only anecdotal information is available, the project is encouraging talented students to take their IT studies to a tertiary level.

3.2 Enterprise Engine (Otago Polytechnic)

Otago Polytechnic is developing an Enterprise Engine to invest in student start-ups. This will operate through micro-funding business vouchers and curriculum alignment. An evaluation of Polytechnic activity in the entrepreneurial arena showed that the space was fragmented and not actually addressing barriers faced by student led start-ups. The Enterprise Engine is aimed at providing a whole pathway of support for enterprising activity. Some activities have been trialed, others are planned for development. In addition to significant business opportunities the intention is to recognise enterprise and graduate outcomes across the institution. This case study is focused on the institution forming relationships with businesses both new and existing. It is also successful in making connections between students, especially across disciplines.

3.3 Insourcing the helpdesk for SIT using students (SIT)

SIT have an existing relationship with a national company (Gen-I) which manages their IT infrastructure, including their helpdesk. Gen-I ran the SIT helpdesk from an Auckland location. SIT wanted to change this structure so that the helpdesk was based in Invercargill and therefore some of SIT students could be employed to be on the helpdesk as tier-1 support. This formed a three way relationship between Gen-I, the student, and SIT. SIT received an improved service due to the organisational knowledge of the students. Gen-I were able to offer an improved service, as well as have an improved recruiting process through SITs prior knowledge of the students. The students received an employment opportunity while still receiving transitional support from SIT. The helpdesk provides us an example of building connections between the institution, business and students.

3.4 Using Programming to Assist Primary Mathematics (Otago Polytechnic)

The students in Otago Polytechnic’s BIT second year Java Programming class are developing an applet that is based on the mathematic goals of a lower decile primary school. The applet will be given to the teachers for use in their classrooms. The BIT students do not form a relationship with the school children (Figure 3). Otago Polytechnic forms a relationship with the school. In this example the relationships are indirect, future work will aim to create direct relationships – for example between the students and the school.
3.5 Community computing (Otago Polytechnic)
Otago Polytechnic is supporting IT in the households of our wider polytechnic community. Following discussion with a Programme Manager in the Foundation School, an exploration was undertaken into the possibilities of providing computers to their students. Issues surrounding licensing, but also internet access, technical support, educational support need to be explored. The intention is that IT students will engage with this programme both in terms of technical work on computer maintenance and in engaging with individual’s households and communities. Initial findings support the programme but stress the importance of looking wider than the students but to their households and communities and to the importance of engaging people with an overall digital experience not just a computer. Not just for the Otago Polytechnic students but for their households. This community IT infrastructure project is based around building relationships – this network effect can be seen in a dense relationships model (Figure 7).

3.6 HCI for children with disabilities (SIT)
Staff and students of SIT are using rapid physical prototyping (phidgets) to provide interactive experiences for children with disabilities. SIT has built a relationship with a special education school that works with disabled children. This came about from a request from the primary school teacher to help to develop devices to attempt to enhance communication for a group of children with severe disabilities. Although not formally assessed, the children and school enthusiastically welcomed the communication system. The project has now been extended with a new group of SIT students. It is worthwhile noting that this HCI development is research with an uncertain outcome. It was important that this uncertainty be communicated as part of the relationship building. This case study of applied HCI has relationships between the lecturer and institution and the social group (special education school). It directly exposed the students to a group of computer users with specific needs, very different from traditional development focus (Figure 8).

3.7 Raspberry Pi in secondary schools (NMIT)
NMIT liaisons with local secondary schools in the use of RP to explore its potential in the delivery of the digital curriculum. Historically NMIT has not had as high a profile as desired with secondary schools in the Nelson region. The RP is a simple computer and as it is designed for education, NMIT approached local secondary schools to explore how RPs could be used in the digital curriculum. One of the schools had already invested in RPs and enrolled all the students in the National codeworx challenge run by Orion Health. NMIT are now supporting five schools from across the region in the codeworx challenge. NMIT is also sponsoring some extra RPs and some peripherals. The next stage is to run a workshop for teachers to practice and brainstorm. NMIT students will then work with schools in the initial setup and school teams will visit the NMIT Campus for monthly sharing, problem solving and brainstorming sessions. This case study is explicitly aimed at fostering better relationships with feeder schools and building connections with high school teachers and students (Figure 9). NMIT aims to be seen as a viable alternative that is innovative yet approachable. An important part of the approach is an intentional win-win outcome: something in it for NMIT (direct contact with teachers and students) and something in it for the schools (help with the subject they are not experts in, and support for students in becoming NZs next generation of IT professionals).

3.8 Stories and hands-on hardware (CPIT)
CPIT is working in engaging students. In one example they are taking what could be considered dry computer architecture
concepts and reworking this material with the goal of as much hands-on as possible. In a separate work stream CPIT is aiming to develop a greater of storytelling practice is an integral part of teaching practice. These case studies highlight perhaps the most important relationship in the IT education community, that of the academic and student (Figure 10). We still have lots to learn in how we engage people in this.

Figure 10: Stories and hands-on hardware

3.9 Job Shop (Otago Polytechnic)
OP has been developing a job shop that allows students to complete commercial work for clients. The work is organised by OP staff and assigned to students. The continual success of the job shop is based upon the quality of the work and the reputation of the institution. Relationships between the staff who run the job shop and potential clients need to be established and maintained in order for the job shop to be successful. Relationships may be established between students and clients as individual jobs require. This venture has the potential to influence the position/relationship of the institution within the local communities (Figure 11).

Figure 11: Jobshop

Although not presented as a case study at the workshop, we present two further case studies to investigate the applicability of the model.

3.10 Capstone
Most institutions have a capstone project where final year students undertake a significant piece of development work, often in a partnership with an external client (Figure 12). The capstone has a strong relationship between the student and the community or industry (or both). It is also an opportunity for the supervising academic to develop their own relationship with the community and industry. In some projects there is the potential for IT students to collaborate with students from other disciplines, particularly design and business. We have not drawn relationship lines between community/industry and the institution (P) as the capstone projects tend to go “under the radar” in terms of institutional relationships.

Figure 12: Capstone

3.11 Sustainable Community Enterprise (Otago Polytechnic)
To push the model to the limit, we describe here a project that was intentionally established to build relationships (Figure 13). Sustainable Community Enterprise is an initiative of Otago Polytechnic. It was intended to demonstrate a win:win:win approach for community engagement by tertiary institutions. Three subprojects are Port Chalmers Community Wifi, Polytechnic eWaste, and Alternative Energy Generation. All three involved direct partnerships between the community, institution, industry, academics and students. The premise is that every activity the institution engages in must have recognised benefits for the community (read sustainability), the institution (read positive impact on finances), and learning. What this means in practice, for example, is that we added to external contracts a requirement for students to be involved in the delivery of the service.

Figure 13: Sustainable community enterprise

4. DISCUSSION
It may seem almost trite to conclude that we need to focus on the relationships in community engagement, but this process has been useful in articulating the relationship benefits of different approaches to community engagement.

The model is clearly simple. It does not take into account the nature of the relationship nor any of the wide range of different theoretical approaches to considering engagement. Nevertheless, it is a useful first step in considering different approaches to community engagement. The value in this model is the exploration of relationships in a visual manner. We could have used alternative nodes – a separation of IT student and IT student group might have been interesting. It might be
interesting to attempt to quantify the relationships (and represent these visually such as with differently weighted lines).

Different approaches to community engagement serve different purposes. It would be a mistake to use this model as a scoring system (more relationship lines better). It is not expected that each activity completes every relationship pairing. But would be a worthwhile exercise to examine an institution’s portfolio of community engagement activities and to use this visual representation to explore opportunities for development.

REFERENCES
Computing South Island Educators’ Forum – Case Study

Title:

Tweet: Abstract with a 140 Character Limit (!).

Why? Driver. Why did you need this? How did this situation arise?

What? Intervention (What did you do?).

Wishes? Hoped for (measureable?) improvement. Why did you think this would work?

Outcome? Did it work? Would you do it again? How would you do it differently?

Thoughts? Any traps for young players? Any other thoughts?

General Comments

Institution:

People Involved:

Qualification Level:

Subject Area:

When:
A Pacific Collaboration Model: Whitireia New Zealand and Tupou Tertiary Institute

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ABSTRACT
In this paper, we explore the history from a Tupou Tertiary Institute (TTI) and Whitireia New Zealand (Whitireia) perspective, Values, a partnership model, education and relationship partnerships and the on-going collaboration between Whitireia and TTI, Tonga. We will explore how the institutes have managed the process and also the long term effects of such a relationship and the possible benefits to both institutes. The results of the partnership for Tongan success within Information Technology (IT) courses at TTI are evident.

Categories and Subject Descriptors
Computers and Education: Computer Uses in Education

General Terms
Collaboration, Management, Measurement, Cultural Theory,

Keywords
Pacific collaboration, New Zealand, Tonga, Information Technology, Education Model, Partnership Model, Kaupapa Maori Theory, Talanoa Theory

1. INTRODUCTION
This paper highlights a working collaborative education model across the Pacific between two tertiary institutes Whitireia New Zealand (Whitireia) and Tupou Tertiary Institute (TTI), Tonga. This paper describes a model of education collaboration across the Pacific between two Pacific nations that has been on-going for a period of time that has shown success over that time. It shows how this model has incorporated the different cultural aspects from both institutes but still retains cultural identity and moves into the new realm of Information Technology education.

2. HISTORY
2.1 An Idea from New Zealand
This collaborative model started as an idea from a Tongan woman Valeti Finau who was employed by Parumoana Community College (now Whitireia) as a Pacific Island Liaison Tutor. The position was to coordinate and support any Pacific Island student who started at Parumoana. This position included housing, educational support and other duties in ensuring better outcomes for all Pacific Island students.

As a former student of Tupou College, Valeti saw there was a need for an applied tertiary institute in Tonga and proceeded to have talks with Deidre Dale the CEO of Parumoana and Linda Baylis, business tutor about starting an applied business course in Tonga in association with Tupou High school and also an agreement with Victoria University for Business Students completing courses in Tonga having an agreement to attend Victoria second year Business degree (personal communication, Brimblecombe, 2013). After several visits to Tonga an agreement was signed and this was the birth of the model which is currently in use. This model is one of collaboration, quality education and one that is full cost recovery for Whitireia with provided services to TTI.

2.2 History from a TTI Perspective
Tupou Tertiary Institute (TTI) is at the current apex of the Free Wesleyan Church (FWC) Education System’s development in higher education. The ceremony to mark the laying of the foundation of the Centre was officiated by Her Majesty Queen Halaevalu Mata’aho on 29 June 1998 and construction work began in October of the same year. The grand opening of the Centre by His Majesty Taufa‘ahau Tupou IV on 4 May 1999 was celebrated together with the official launching of a Joint Venture Agreement for a working relationship between Tupou High School and the Whitireia Community Polytechnic of Porirua, Wellington, New Zealand.

This Joint Venture Agreement made possible the extension of the Whitereia’s NZQA accreditation to cover for the delivery of New Zealand accredited programs at Tupou High School. The first of these programs was the New Zealand Diploma in Business which began in February 14, 1999 with a cohort of 20 students. More programs were added in the later years and it did not take long for the project to gather momentum and make favourable impacts on higher education in Tonga. Students are now able to access New Zealand qualifications locally at a much reduced cost of about 10% of what they would pay to study overseas. All the above developments were brought about under the auspices of the Tupou High School’s management and commonly referred to as the Tupou High School Diploma Program. It was not to be for too long though - the ever increasing interest expressed by the public and students in the growing number of courses that were now available at this new development was a clear indication of the need for a post-secondary institution. This led to the inauguration of the name Tupou Tertiary Institute (TTI) conferred in 2004 by the late King Taufa‘ahau Tupou IV.

By 2008, TTI had grown in stature and nature thus requiring more space for its development. Hence, the separation of the high school programs from the newly introduced tertiary programs. It was like Tupou High School handing over the torch of higher education to be Tupou Tertiary Institute’s mandate. Such is the current situation with TTI, it has slowly but successfully located itself at the old Tupou High School Campus at Koloto‘ou.

It has now expanded to include four main areas of NZ accredited study programs, namely, Business and Management, Information and Communication Technology, Architectural and Construction Technology and Teacher Education. The first two programs are
delivered in collaboration with the Whitireia Community Polytechnic; the latter two are delivered in conjunction with the Wellington Institute of Technology and Bethlehem Tertiary Institute respectively. In addition to this, the University of the South Pacific (USP) pre-degree studies courses, formerly known as USP Foundation / Tupou High School Form 7 are also being taught at TTI. Partnerships in developments and expressions of interests are familiar news at TTI. ITU and Cisco Academy have established their training centre on campus.

The United States (US) Embassy has set up an American Corner in the Institute’s Learning Centre. Education USA have also found space in the same niche. It has been said that TTI mandates higher education and enhancing employment capacity. To mark its 10th anniversary, statistics reveals that close to 500 students have graduated with diplomas and 45 have graduated with bachelor degrees, and a further 3 with masters degrees.

The graduates who are serving in the workforce in Tonga and abroad are abundant in numbers and fortunes. The chapter 1 of TTI’s story is only unfolding and the adventure in the vast world of higher education promises more blessings amidst challenges. It is envisaged that the pages yet to be written “will bring joy to the Free Wesleyan Church and Tonga and above all – glory and honour to the Almighty God, who is the source of all Wisdom and Understanding.” [4].

2.3 Values

One of the highlights of this relationship is the respect towards the reality of working together and the deeper respect of aspirations of Tongan students and the values and aspirations set by TTI and Whitireia as set out below.

Tupou Tertiary Institute is a Christian Higher Educational Institution. Considering this background and identity, we strive to fulfil our mission through decisions and actions based on our core values

TTI values, from their web site, are:

**The Teaching of Jesus Christ:** Jesus taught us to love God, and to love one another. We show compassion, forgiveness, patience, concern and care for others because we first have been loved by Christ.

**Faith:** Our faith in God inspires us to trust that He knows what’s best for all of us, and that all will happen according to His plan.

**Mutual Respect:** Individuals treat others with respect and are accepting of differences. Interactions are based on good manners and consideration of the ideas and feelings of others. Disagreements are dealt with peacefully with the intent to understand.

**Obedience:** We all strive to follow the rules and policies of our Institution and the Church.

**Teamwork:** Effective teamwork encourages creativity, innovation, and self-initiative in our respective roles and partnerships. It is essentially in getting the task done and in developing the skills needed to meet future challenges.

**Integrity:** Integrity includes adoption of a Biblically centred morality, congruence in thought and actions, wholesomeness, justice, grace, and being responsible and accountable. Persons of integrity uphold honesty and forthrightness at all times. We shall respect the confidentiality of the individual and confidences extended to us.

**Services and Sacrifice:** Offering our time and skills for the good of our fellow citizens leads to the prosperity of the community and to the character development of the individual.

**Equity/Equality:** We will provide equal opportunities for learning and training to all, irrespective of gender, age, creed, culture, or social standing.

**Humility/Reverence:** We will act as humble servants of God, acknowledging that all we achieve is by the grace of God, and not by our own powers alone. Without God, nothing can be accomplished.

**Accountability:** Any and all dealings and actions which could affect the Institution will be open to public scrutiny

**Success:** We encourage all students and staff by words, deeds, and, example, so that they can achieve their maximum potential. [5]

Whitireia New Zealand values are as follows:

**He Whakatauākī**

*Ko te manu e kai ana i te miro, nōna tengahere.* Engari, *ko te manu e kai ana i temātuaranga,* nōna te ao.

The one who partakes of the flora and fauna, that will be their domain. The one who engages in education, opportunities are boundless.

**OUR VISION** - Whitireia will lead and illuminate its communities through tertiary education.

**OUR VALUES** - Council and staff are committed to the following values:

**Manaaki** - Encouraging cooperation in learning and resource sharing to promote individual confidence and group harmony through a positive and supportive learning environment.

**Identity** - Creating a learning environment where all people feel they belong because their uniqueness is valued and promoted.

**Equity** - Achieving more equal outcomes by providing significant learning and education success for those who have previously lacked such opportunities.

**Responsiveness** - Being flexible, creative and open to change, to better meet individual, industry, and community learning needs.

**Success** - Being an effective organisation with a clear sense of purpose, striving for excellence and creating an environment where all have the right to succeed.

**Integrity** - Maintaining the highest ethical standards and permitting public scrutiny to ensure the maintenance of those standards.

**Accountability** - Monitoring and reporting on the maintenance of educational quality standards and on the responsible use of public resources. [7]

These values are an integral part of each institute but also need to be acknowledged as an important understanding of the cultures as described with the Talanoa and Kaupapa Maori theories which both acknowledge cultural values as a core component.

**3. A PARTNERSHIP MODEL**

After looking at different partnership models, the one model chosen has the main aspects considered in which most of the other
models investigated. As described below these are the basic parts of this model:

- **Have the Same Mission and Goals**: Long-term planning is vital
- **Trust is Earned over Time**: Be open and honest
- **Both Partners Must Contribute to the Relationship**: Be committed to your mission and vision
- **Clear and Constant Communication Leads to Understanding**: Keep an open atmosphere and meet regularly
- **Both Partners are in Relationship for Long Haul**: Set long-term goals for sustainability
- **Create Culture of Sharing and Collaboration**: Always be open to share
- **Mutual Respect is Key**: Maintain mutual respect even in disagreements

### The Partnership Model

![Figure 1: Partnership Model](image)

The model in Figure 1 has a standard look at educational partnerships [2], but does not take into the consideration the unique Pacific relationship between New Zealand and Tonga. However, the basic components of the model are integral in the collaborative model used between Whitireia and Tupou Tertiary Institute and are used on a regular basis.

### 4. EDUCATION PARTNERSHIP

The questions that came to mind for the authors was: “What makes this relationship?” and “What does it bring to both parties?” From the institutes’ perspective there are several advantages:

- A relationship that has been ongoing since 1998 that adds value to building capacity and capability of Information technology teaching staff for TTI.
- Tutors generally that have received their IT qualifications from Whitireia New Zealand and then return to Tonga as teachers at TTI. These tutors generally spend three years and some move on to other employment but a few still stay and teach.
- The students in Tonga have the opportunity to do a six month Certificate in IT, The first two years of the Bachelor of Information Technology with the successful students completing the third year of the degree at Whitireia New Zealand at either Porirua or Auckland Campus.
- There are regular visits from staff from both institutes to carry out many tasks related to moderation of all assessments, management, attendance at conferences, to talk about curriculum and course changes, course content training and the latest change in Tonga is the Pacific cable being introduced, Whitireia IT staff will help to build a network infrastructure (backbone) capable of connecting to this cable.
- Since 2009 there has been one Whitireia point of contact for the Information Technology Courses and this person deals with all communications between his counterpart in Tonga and then passes communications to the appropriate other IT staff members.
- This will give TTI a greater capability and will also give greater communication between both institutes and also the capability to run similar software and programmes simultaneously as opposed to the current system of running programmes with a six month delay.

### 5. COMMUNICATION RELATIONSHIP

Having a single point of contact at both ends for this relationship has also been a bonus with greater continuity building taking place. Most communication except for official emails requesting work is done using online tools like Skype and Facebook chat at night in a relaxed manner. This has worked more effectively than the official telling off scenario which has forced other groups within Whitireia not maintaining the relationship with TTI to the same level.

If we consider the style of Pacific oral knowledge as stated by Vaioleti: “Superficially, Talanoa can be referred to as a conversation, a talk, an exchange of ideas or thinking, whether formal or informal. It is almost always carried out face- to- face. Tala means to inform, tell, relate and command, as well as to ask or apply. Noa means of any kind, ordinary, nothing in particular, purely imaginary or void.” [1].

This model of Talanoa is not dissimilar to the Kaupapa Maori Theory as stated by Pihama: “Kaupapa Māori theory is simultaneously local and international. Local, in that it is necessarily defined by Māori for Māori, drawing on fundamental Māori values, experiences and worldviews. International, in that there are many connections that can be made through a process of sharing Indigenous Peoples theories.” [3] and this has been evident in the communications relationship with both institutes.

Taking into account the closeness of the countries within the Pacific, the approaches towards the communication within the two parties of the relationship and the similarities of Talanoa and Kaupapa Maori theories are key aspects within the cultural communication aspect. This is because the authors’ ethnicities are Maori and Tongan respectively and these values of cultural awareness of this relationship have a significant role.

Management and Administration relationships are sometimes separate and also integral within the institutes and are handled accordingly with the appropriate management levels still driving the appropriate management directions for the overall partnership.

Having a single point of contact at each institute for the day to day business makes sure any enquiries at both ends goes through this person and they have a handle on all queries regarding the course and their experience and their relationship with other tutors is vital in the relationship as well.

### 6. CONCLUSION

TTI and Whitireia have entered into a partnership model that is respectful of both cultures, values and a partnership model which is mutually beneficial to both parties since 1998. Valeti’s dream led to a viable model which has stemmed from a common partnership model but is unique to a solely Pacific island nations
through the Christian values of the Wesleyan Church in Tonga, using the Talanoa and Kaupapa Maori theories. This model is a user pays model which allows the input to come from a Tongan perspective a major advantage for both parties and for Whitireia that this is not a subordinate relationship but a mutually beneficial model which allows equality in decision making.

The Information Technology courses that are offered in Tonga are the pathway that opens the building of capacity within this discipline with students finishing their degree in New Zealand. This model also allows the unique cultural input by Tongan staff to increase their capacity as tutors and pass this knowledge to the students.

The communication skills used are not always the formal ways of communication but fall into typical Pacific communications which are generally oral and also done in a relaxed mode of using other forms of communication i.e. online using tools like Skype and Facebook chat. This is further enhanced with a single point of contact for moderation and academic quality for the IT Courses.

This collaborative educational partnership model has lasted over time and the culture and values of each partner are at the forefront of the model and mutual sharing of communication. One of the main aspects is having a single point of contact at each institute for the day to day business makes sure who the contact person handles any enquiries at both ends and they have a handle on all queries regarding the course.

7. REFERENCES
Invited presentations
Pre-degree Intervention Strategies to Support Student Learning and Success

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ABSTRACT
The Certificate in Science and Technology (CertScT) was approved by the New Zealand Committee on University Academic Programmes (CUAP) in 2008. The main objective of the certificate was to provide a pathway for “second chance learners” to progress into STEM (Science, Technology, Engineering and Mathematics) undergraduate degrees. A secondary but no less important goal was to increase the participation of Māori, Pasifika and female students who are currently underrepresented in these subjects [3, pp.10-14].

The New Zealand Government signalled through the Tertiary Education Strategy 2010-2015 that it would link funding to educational performance through the use of Educational Performance Indicators (EPIs) [1, pp.1-25]. The Educational Performance Indicators [2, pp. 1-3] reveal that for the University sector the overall course completion rate at Level 3-4 was 75%. Auckland University of Technology’s overall course completion rate at Level 3-4 was 73%, but programme data indicated that the CertScT course completion rate for 2011 was only 60%. This was of significant concern given that STEM education was an area that the Government had targeted for increased funding. In addition, the TEC expectation was that the target course completion rate should be in the region of 85% not the current programme rate of 60%.

This paper examines the pre-degree intervention and support strategies incorporated in the CertScT at the end of 2012 to support student learning and success in a University setting.

REFERENCES
Novopay: Dilemmas in a Nearshore Outsourcing Project Failure

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ABSTRACT
This presentation revisits a recent critical review of the Novopay project presented at the International Conference on Global Software Engineering in July 2013. That study which adopted a ‘critical evaluative’ stance, applied dilemma analysis to review the implementation of a nationwide payroll system responsible for the payment of some 110,000 teachers and education sector staff [1]. The project stands as a notable example of a large New Zealand Government Business Process Outsourcing project involving a nearshore provider. It is now well known that the project had become so troubled that a Government Minister has been assigned responsibility for troubleshooting it, a portfolio which he still holds. The Australian company who won the contract for customizing and implementing the Novopay system, took over from Datacom an existing New Zealand service provider. While commonalities in business practice and cultural awareness might be expected in projects spanning a relatively small temporal and geographical distance, in this project that did not appear to be the case.

Obvious parallels between the latest cutover and the previous two cutovers in 1989 [2] and 1996 [3] are drawn, as are comparisons with the recent Queensland Government health payroll debacle [4]. The latter project had its roots of failure in a different political context and origins, but presented a similar case of a transition from an old yet functioning but very complex payroll system, and resulted in a commission of enquiry. It is notable that after the experiences of 1996 the then Chairman of Datacom had opined, “Lessons learned about the rate of change possible in large systems will never be forgotten by those involved”, and “This big bang approach is a recipe for failure” [3]. But evidently memories in such major, costly and high risk endeavours are short, and the ability to transfer such knowledge to other (even nearshore) contexts seems limited! Practitioners do not seem to read the academic literature either, where many of the pitfalls in not addressing concerns from a multi-stakeholder perspective have been outlined, together with strategies for addressing them [2, 3, 5, 6, 7].

It is clear that large complex software transitions of this sort are challenging for all parties involved, and beset with dilemmas. So how might we better learn from them? In the study reviewed here the potential for dilemma analysis [8] to highlight risks and stakeholder impacts is illustrated. To our knowledge this is the first such use of dilemma analysis (which has its origins as a methodology for educational research) in a global software engineering study. Empirical analysis, in this case, of publicly available data, has adopted an evaluative-critical approach. We argue that this methodological approach to such projects can usefully highlight tensions and barriers to satisfactory project outcomes. The study starkly illustrates the extent to which large software projects are beset with dilemmas, which must be navigated by the parties involved. This work is the subject of an on-going doctoral study by Bilal Raza at Auckland University of Technology.

REFERENCES

This invited presentation was given at the 4th annual conference of Computing and Information Technology Research and Education New Zealand (CITRENZ2013) incorporating the 26th Annual Conference of the National Advisory Committee on Computing Qualifications, Hamilton, New Zealand, October 6-9, 2013. Mike Lopez and Michael Verhaart, (Eds).
Poster papers
ABSTRACT

This poster paper presents the results of an internship carried out to fulfill the requirements of the Universal College of Learning (UCOL) I302 Industry Project paper, during the first semester of 2013. The internship was sponsored by the Training Manager of Information Technology Services (ITS) at Massey University. The objectives of the internship were achieved, with positive feedback being received about the intern’s training delivery style and the training documentation developed. The internship provided valuable learning opportunities for the intern and the knowledge and skills gained will be a solid foundation for future success.

Categories and Subject Descriptors

General Terms
Management, Documentation, Design, Human Factors.

Keywords
User Support, Internship, Training, Resources, Design, Delivery, Presentation.

1. INTRODUCTION

Massey is one of New Zealand’s largest universities employing over 5,000 staff. It has a strategic commitment to raise IT literacy across the University. Information Technology Services (ITS) provides staff with resources, online tutorials and face-to-face training for a range of software. ITS created a new training team whose purpose it is to deliver a high quality training experience to staff and students, building ICT related skills and competencies across the campuses in Auckland, Palmerston North and Wellington. During Semester 1, 2013, the ITS Training Manager, based at the Massey Turitea Campus in Palmerston North, (Figure 1), sponsored an internship for a UCOL student taking the Industry Project paper (I302) as part of the Bachelor of Information and Communications (BICT) degree. The objectives of the internship were achieved, with a positive academic outcome. Furthermore, the intern is now established in permanent employment, in the role of Trainer – ITS.

2. OBJECTIVES

The internship comprised the first three months of a new role of Trainer - ITS. The objectives of the internship were to develop and present a portfolio of training initiatives; design and develop training material including online resources; contribute to the marketing of training activities and encourage a training culture across the university; assist with the administration of course scheduling, room and resource preparation, and training participation; and participate in the reporting and analysis of training needs, participation and feedback.

3. METHODS

3.1 Research and Learning

The intern gained an understanding of the Information Mapping methodology for instructional design using ‘maps’ and ‘blocks’ to present training information through online research and self-directed learning.
3.2 Analysis and Development
Consideration of the existing training portfolio; analysis of training needs; and the planning and development of new course material to meet identified training needs, were carried out.

3.3 Testing
The accuracy and relevance of course content was tested by nominated ITS staff critiquing practice examples, and the delivery of preliminary ‘test-run’ courses.

3.4 Reporting and Communication
Regular face-to-face and email communication with the Training Manager was conducted, to report on progress, discuss challenges, agree solutions, and plan work.

4. RESULTS
The internship provided a range of activities which provided invaluable experience for the intern. She participated in and reported on the induction process, which included setting up office workspace and laptops for new roles; learnt the Information Mapping methodology and application of FS Pro 2013 within Microsoft Word; redesigned training courses and resources for Microsoft Outlook 2010 and ShadoCMS; delivered training courses for ShadoCMS and Microsoft Excel; assisted the development and application of an interim solution to record training bookings and participation using Marval and Microsoft Excel; implemented new systems and processes to support the day-to-day operations of the training team, including a shared Microsoft Outlook mailbox and calendar, and template documents for training material; and participated in professional development activities. The range of resources utilized, is shown in Figure 2.

Figure 2. Resource logos.

5. CONCLUSIONS
The objectives of the internship were achieved and the intern is now established in the role of Trainer – ITS. Positive feedback has been received about the intern’s training delivery style and the training documentation developed. The internship provided valuable learning opportunities for the intern and the knowledge and skills gained will be a solid foundation for success in the role.

6. ACKNOWLEDGMENTS
Our thanks go to the Internship Sponsor: Linda Nevin, Training Manager, ITS, Massey University, Palmerston North, and to ITS, for approving the Internship.
Minecraft or Mindcraft? The Value of Online Games in Education

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ABSTRACT
In this poster, we explore four examples of the value of PC gaming to education in the context of a design science research project. This project hope to develop a suitable set of game experiences to teach some fundamental networking concepts to tertiary students enrolled in a Level 4 Certificate. The research suggests that this endeavour is likely to be successful in terms of promoting learning.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education

Keywords
Games, education

1. INTRODUCTION
Education through gaming, what does it mean and what are its implications? There are many thoughts that cross our mind both positive and negative when the words ‘gaming’ and ‘education’ are used together. While there appears to be a widely held belief that playing computer games is time-wasting, anti-social behaviour, research is suggesting that used appropriately, gaming can provide learning opportunities and enhance learning particularly for those students who are less successful in the academic classroom. Indeed, it could be considered that gaming exercises the mind as physical activity exercises the body.

It can be argued that playing games help to develop interpersonal skills, persistence, communication ability and other non-cognitive skills which are just as essentially necessary as cognitive skills in how we learn and if we are to be successful. Even the process of failing (or dying) in a game can provide the motivation to learn from the mistakes and develop new strategies.

This poster explores four studies on learning through gaming. From the knowledge gained through this review, the intention is to implement an initiative to provide similar ‘learning through gaming’ experiences for students enrolled in a Level 4 Certificate in IT programme.

2. BACKGROUND AND METHOD
The research is an on-going Design Science Research seeking to create an effective ‘gaming through learning’ teaching resource for the students identified above. The project is divided into four stages: a) identify the problem, b) design a solution, c) implement the solution and d) evaluate the solution. The work reported here is a consideration of four examples that are informing the work of the first two stages.

3. RESULT
The first study [1] concludes that playing a hard version of a strategy game over a period of time increased cognitive abilities. In their study a group of non-gamers were put in three separate groups in which they either played the Sims, Starcraft on easy difficulty or Starcraft on hard difficulty. Each student played the allocated game for roughly an hour a day for six to eight weeks.

Their results indicated that in subsequent psychological tests, volunteers who played the most complex version of StarCraft were the quickest and most accurate in their responses and had increased cognitive abilities, primarily in the decision making and speed of reaction areas. From these results they concluded that playing the advanced game promoted cognitive flexibility, particularly under conditions in which players had to rapidly switch between contexts while maintaining memory for both contexts and that it was valuable for enhancing ‘grace under pressure’ thinking which involved making quick educated decisions.

The second example comes from the use of the game Skyrim to teach aspects of Norse culture [2]. In this case the game was addressing a specific body of content knowledge rather than generic skills. The course description, from Rice University, Department of English stated “This course has two goals. First, it introduces students to fantasy as both psychological concept and driving force in gaming culture; and second, using these paradigms, it considers how and why medieval Scandinavia serves as a locus of modern Anglo-American fantasy.” In addition, “Students are involved in ‘quests’ within the Skyrim game in which they read Old Norse and Old Icelandic sagas (in translation), discuss the ideals of empire vs. rebellion political stances in the world, and identify where the saga world and the Skyrim world entwine.” This is an example of an existing game being used to provide a rich insight into a specific example of an historical culture and its lore. It also allows for an in depth study of perspectives within rebellious or empire controlled areas and an analysis of where lore and the game overlap.

The third example is the use of Minecraft [3]. Minecraft is a free, easy to use, modifiable game which allows for a customisable world. Teachers have used its capabilities to do a number of complex and sophisticated things: from re-creating simple circuit

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boards using the games ‘redstone wire’ system to showcasing old architectural. Many YouTube videos exist demonstrating how to build a fully functional calculator or exploit the characteristics of water to farm resources. Minecraft has both an easy, intuitive interface and the ability to ‘turn off’ the monsters to enable uninterrupted complex building in ‘creative’ mode. It enables learners to engage at a simple level with the inner workings of complex ideas that might otherwise be inaccessible.

The final study [4] examines a number of games and highlights some of the learning that can be derived from them. Their study categorises the learning as follows:

- **Cognitively Stimulating:** Use of these games stimulate the cognitive processes of the brain and seem to affect those even while sleeping.
- **Motivating:** Whether it be victory over the game’s battles, solving a puzzle or the prospect of a better looking character to control, the player is constantly motivated with goal orientation via a “carefully calibrated balance of rewards, challenges, and chance”
- **Constantly Providing Feedback:** Commercial off the shelf games are all about “delayed gratification” which is granted only when the player’s skill and consistency has been assessed and deemed sufficient to proceed to the next, inevitably harder stage of assessment.
- **Ensuring Failure is used as a Learning Device:** Probably the most common source of failure for students is failing to engage with a task in the first place. Video games bypass this personal barrier by adhering to the principle of “low cost of failure and high reward for success”
- **Encouraging Systems Thinking:** Games such as Wright’s “SimCity” might not teach players what single-handedly running a bustling metropolis is like in real life but what it does teach is how different variables within a system interact in emergent and complex ways. As a result, the player learns to instinctively view the situation in front of them, be it real or virtual, as a whole and as such can micromanage accordingly. They see each immediate task as part of a much larger system with numerous different, interacting variables at play, developing their own mental model in order to introduce order to something that is otherwise chaotic.”

4. **DISCUSSION**
The focus of this poster is around the feasibility of education in a tertiary environment by verifying that games aren’t just for entertainment but can actually revitalize, train and even enhance brain functionality through problem solving. Why might games be good for our mind? Is it the improvement of hand and eye coordination through shooting simulated guns and other weapons with your friends? Not all the games on the best sellers list contain violence. Indeed, the most popular PC game of all time is The Sims, which involves very little hand and eye coordination but a significant amount of challenging strategic thinking. The player manages an entire household or town of characters, each endowed with individual personality traits, each cycling through an endless series of short-term needs. These needs such as food and friendship are in a network of relationships with other characters who have their very own individual personality traits. When playing this game, the player is required to multitask and balance the needs of a virtual reality, from kids going to school, going to work or tidying up the house.

Games entice us and teach us patience, the value of learning from failure, advanced problem solving and so much more. It approaches problems and teaches in a way that is often intriguing and attention-getting, stepping away from the traditional ‘sage on a stage’ approach and even going as far as helping tune the brain for specific problems and tasks.

5. **CONCLUSION**
Games can certainly be entertaining but we need to move away from the misconception that they are only for amusement or that success in them is a sign of misspent time. Just because there is enjoyment and a virtual environment doesn’t mean that we are not learning. In fact research suggests that the opposite is true. The question we need to ask ourselves is: why can’t learning be fun and something to look forward to? When applied correctly the benefits and opportunities are huge. We believe that our investigation of recent research into the value of gaming provides evidence that it could be worthwhile developing our own ideas for utilizing a game for teaching various concepts to our students.

6. **REFERENCES**
Add-Fun: PowerShell, a Soldering Iron, Some LEDs, a Synthesizer

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ABSTRACT
This paper explores a potential non systems administration centric approach to teaching scripting using PowerShell.

Categories and Subject Descriptors
K.3.2 [Computer and Information Science Education]: Computer science education

General Terms
Languages.

Keywords
Scripting, programming, PowerShell, hardware, interfacing, libraries, objects, Arduino, microcontroller and embedded computing.

1. INTRODUCTION
PowerShell is Microsoft’s systems administration and task automation scripting language [1] which has been available for both server and desktop operating systems since 2006. CPIT introduced their DICT540 “Introduction to Scripting” course in 2012 as a consequence of Microsoft placing greater emphasis on task automation using PowerShell. The Microsoft courses that expected PowerShell skills available at the time illustrated how tasks that traditionally would have been repetitively done using GUI tools could be automated through the use of command line scripts but fell short of explaining the commands used or their syntax. In a departure from the traditional Management console, Microsoft GUI tools such as Exchange 2010’s Exchange Management Console [2] became a PowerShell script generator invoking the script rather than calling the underlying API calls directly. After examining Microsoft’s PowerShell course [3] in 2011, CPIT staff recognized that an in house course needed to be developed as the Microsoft course prerequisites required the student to have systems administration experience. The current DICT540 course does not assume prior systems administration knowledge but through the use of practical examples uses common systems administration tasks as a vehicle for delivering scripting concepts.

When the DICT540 content was created at the start of 2012, the author viewed underpinning knowledge of the environment an important factor as the Microsoft centric courses that followed expected the student to be competent in the use of unfamiliar commands. The content of DICT540 subsequently directed the students towards learning how to write code in a scripting language whose list of commands (technically cmdlets) can be extended by hundreds at a time through use of modules (libraries). Initial emphasis was placed on concepts (objects, properties and methods), syntax, parsing and parameter passing before moving onto the more typical concepts usually found in teaching programming languages such as iteration, conditional statements, functions, exception handling and debugging. The variation in approach was that the author used practical examples of managing infrastructure services throughout the course and due to the prerequisite course being DICT440 which is delivered using Scratch, it was necessary to “set the scene” and subsequently give high level overviews explaining the concepts of directory services, network name resolution, file systems, registry and the management of both client and server based operating systems. The scene setting approach was adopted in order to satisfy the practical requirements of the Microsoft centric courses that followed.

As the author wanted to focus on content delivery, this position led the author to consider changing the requirements in the course descriptor and/or a change in delivery approach. In an ideal scenario courses that laid the foundations for the systems administration focus of PowerShell would be available but to date, none are. While course feedback from the students was positive, the author thought more could be done to focus on teaching PowerShell and lessen the emphasis on systems administration topics. This led the author to consider an alternative approach.

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2. AN ALTERNATIVE APPROACH
As some students will not major in topics to which task automation is applicable i.e., networking, systems administration, infrastructure management, or the provision of services within cloud computing, the author decided to test the water by pitching a scenario where they believed encompassed common programming concepts and added a command-line-based FunFactor parameter. The concept was presented to the students and described as a model that would embody the objectives of the course and gave examples of an alternative method of delivery that would retain the systems administration aspect but with an added fun component. The example of reading the unique serial number from an RFID-enabled student ID card and using that as a key to look up student’s Facebook ID (a specially created one, not their personal account) in Microsoft’s Active Directory, then retrieving the details of their favorite track from Facebook and finally finding said track in a filing system and playing it through a MIDI-enabled synthesizer, all using the command-line version of PowerShell, was well received. Other examples such as interfacing with 20x4 LCD displays LED and sending SMS (txt) messages via GSM boards were equally enthusiastically received by the students. Using a prototype, the author demonstrated how a musical note could be played on a keyboard from PowerShell.

The author explained that the interface devices would be treated as black boxes subsequently would be pre-programmed and via a module cmdlets would be made available that facilitated interaction using PowerShell.

Raspberry Pi was examined as the bridging interface but Arduino Uno was chosen as it is popular in the Academic environment, affordable to students, and cheaper to interface to real-world devices. The interface to the Arduino is via a USB-hosted virtual serial port which PowerShell can connect to through .Net. As a result of the author showing the Arduino boards to the students, most students expressed an interest in the boards themselves. Subsequently, the author would like to explore the possibility of an advanced hardware course being adapted to present the teaching of computer systems incorporating programming and networking through the use of microcontrollers.

As PowerShell was primarily designed for systems administration tasks, the author is not aware of any environments teaching it through the use of microcontrollers and MIDI devices.

3. THE NEXT STAGE
A request for hardware has been placed and the author hopes it will be available in 2014. Using Microsoft Visual Studio, a module containing custom cmdlets will be written [4, 5].

4. CONCLUSION
While an alternative approach may well help maintain the motivation for keeping the students actively interested in a subject, the issue of the suitability of the prerequisite course is still present and should be addressed. PowerShell provides a rich programming environment while aimed at systems administration is versatile enough to facilitate scripts to interact with the physical world. Students seemed genuinely enthusiastic about being able to have their PowerShell scripts interact with physical objects. The new direction will be cheap to implement, and the hardware can be used by other courses. All existing course objectives would be met and no modifications to the course descriptor are envisaged. A bonus was that some students are interested in learning more about embedded computing, a topic which the author has a long personal interest in.

5. REFERENCES
ABSTRACT
This poster illustrates both an embedded internship and a project undertaken by Linda Brown, a third year Bachelor of Computing Systems (BCS) student at the Eastern Institute of Technology (EIT) in 2013. Linda worked in the IT department of Heretaunga Intermediate School (HIS) in Hastings, and also carried out a project of website design and creation for them during this internship semester. This poster outlines both of these roles and the tasks associated with them which were carried out as part of the Final Project paper of the EIT BCS degree. This paper helps prepare students for entry into IT industry roles and gives them a taste of the working environment of the IT organisation.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education

General Terms
Human Factors

Keywords
Web Development

1. INTRODUCTION
Computers at Heretaunga Intermediate School (HIS) [1] are used daily by staff and students to run the school; systems are required to deliver the programs needed to achieve the school’s goals. IT assists with the setup, running and maintenance of these computers. The work includes the machine hardware, software applications and the network to run them. IT also assists the users of these computers. Their goal is to limit downtime, initiate and run enabling technology and increase efficiency.

Linda was able to be involved in all of these activities while interning at HIS. In addition she was able to work on a major project for HIS, the design and creation of a new website. This flexibility of being able to do both an internship and project for the final paper of the BCS is very beneficial to the student’s work experience.

An evolutionary prototyping methodology was used for the website development at HIS where the heart of the website was created first then extended as time allowed.

The Bachelor of Computing Systems degree at Eastern Institute of Technology (EIT) includes a compulsory 45 credit internship or project to be carried out in the final semester of study. This poster visually highlights the student’s experience; it shows some of the internal workings (operations, tasks and projects) carried out for the organisation while still a student at EIT.

Linda was approved by the school’s principal to carry out the website project as well as being an intern on the basis of another business website she had created that was online and operational. This shows some of the filtering process that sponsor companies may follow to help them select suitable students.

2. STUDENT WORK-INTEGRATED LEARNING & PROJECT LEARNING
This internship and project poster describes and shows project processes and results, along with some technical details of the internship work, while still enrolled with the Eastern Institute of Technology and preparing for entry into the IT work environment. The student worked on a major project of designing and creating a new website, and other mini projects of setting up iPads for teacher and student use, along with installing backup software on teacher’s laptops. This was in addition to intern work which included network support, providing IT support to teachers and students and general Help Desk tasks.

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3. RESULTS
The school has a new website with which they are very pleased. The school’s IT department has improved their provision of IT support and have shortened their list of mini projects that needed to be done.

The student has another website to add to her portfolio and also up-to-date IT work references and experience to add to her EIT qualification.

The results of the internship and project show that the EIT papers previously studied had prepared the student to accomplish the organisation’s requirements.

4. CONCLUSION
This final project paper was a successful experience for the student. The option of doing both an internship and a project proved to be valuable in comparison to doing a class-based theoretical project paper. Immediate proof of project work-readiness, based on her extension on her previous studies i.e. a successful commercial website, was a deciding factor in this student securing this internship and project.

5. REFERENCES
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Evolving Project Management Teaching and Practice at Whitireia New Zealand

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ABSTRACT
This paper reviews the evolution of the teaching and application of project management techniques for Bachelor of Information Technology students in their third year of study at Whitireia New Zealand. In that year of study the students complete a paper on Project Management in their first semester and then participate in a capstone project in their second semester course. Both the paper and the project have been modified due to experience over the years, and further changes are planned.

Categories and Subject Descriptors
K.6.1 [Project and People Management]

General Terms
Management.

Keywords
Project Management, PMBOK, PRINCE2, Capstone Project.

1. INTRODUCTION
Whitireia New Zealand offers two undergraduate courses in information technology, a Bachelor of Information Technology and a Graduate Diploma in Information Technology. Both qualifications include a compulsory 20 credit paper in project management in the first semester of the final year and a compulsory 40 credit capstone project in the second semester. The project management paper was designed around the Project Management Body of Knowledge (PMBOK) approach developed by the Project Management Institute (PMI) and students were expected to use this method to manage their capstone project. Most capstone projects are carried out by groups of two or three students but the nature of the projects vary widely.

2. CHANGE DRIVERS
2.1 Student Managers
The first stage of every project is the development of a project proposal including a project plan but, although a few students, mainly the mature ones, referred to their project plans during the execution of their projects, without pressure from supervisors very few would do so, or record their progress. Also project groups would state in their proposal that they would use a particular approach, yet, when the projects were reviewed, it was apparent that they had not really applied it correctly, or at all.

2.2 Work Experiences
Recently two students who were already in employment carried out their capstone projects in their workplace under staff supervision. Both these students were required by their management to control their projects using the PRINCE2 approach. PRINCE2 is now listed, along with the PMBOK, in the New Zealand State Services Commission Better Practice Guidelines. As students could be working on PRINCE2 projects when they graduate it was considered that PRINCE2 should be included in the program.

3. PAPER CHANGES
The project management lecturer undertook a study of PRINCE2 and realized that it made use of all the knowledge from the PMBOK but added a framework around the process that could be tailored to any size project. It added clearly defined roles, responsibilities, and processes that potentially could help students plan and manage their projects, without a major change in the paper or the capstone project. PRINCE2 was introduced into the project management paper in stages as its value has become more apparent, firstly as a mention, then as an extra, and now as an integrated part of the course.

4. CAPSTONE CHANGES
In order to improve the project management practice in the capstone project and to incorporate PRINCE2 as a management option, a number of changes have been implemented.
4.1 Supervisor management
Until recently the academic supervisors have been given an advisory role, but this is being modified to the more controlling role that PRINCE2 calls “executive”. Staff are expected to put greater emphasis on ensuring the project is managed correctly. It is also expected that the supervisory role will allow quicker response to changes and greater protection for students against scope creep.
Supervisory staff also need to be trained in the appropriate management techniques and this is under way.

4.2 Marking emphasis changes
The marking scheme for the capstone project has been adjusted to include a specific mark for how the project was managed and, associated with this, regular progress-against-plan reports are required.

4.3 Tailored Framework
For those planning to a PRINCE2 approach a paper has been written giving guidance in tailoring PRINCE2 to projects of the general size of the capstone projects.

5. THE FUTURE
The PRINCE2/PMI approach is not always suitable for the capstone projects and it is acknowledged that other approaches should be used in many cases. Efforts by students to use agile methods have not proved particularly successful from a management point of view. Managing agile projects needs to be added to the material presented in the project management paper to better prepare students for its use in the capstone project. The PMI has recently produced its agile equivalent to the PMBOK and this will be the basis for this. The challenge is that the paper is being converted from 20 credits to 15.

6. SUMMARY
The wide range of activities available for capstone projects means that no one project management process can answer all needs, and the capstone processes and marking need to be flexible enough to cope.
Project management papers also need to reflect a range of current practice as students need to be provided with the skills to use these methods, both for the capstone projects and for their eventual progression into the workplace.
ABSTRACT
People working on a ship’s bridge can come from a number of countries, cultures or social situations. Having people from three or four different nationalities is not unusual. Issues arise when bridge personnel cannot communicate in emergency situations, leading to grounding or other disasters. Work is being started on developing a 3D Virtual World where Ship’s Bridge Teamwork can be practiced as part of research into how to use Multi User Virtual Environments (MUVEs) in vocational education contexts. An educational design based research methodology that uses theory to seed development work.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education

General Terms
Design, Experimentation.

Keywords
3D Virtual World, Ship’s bridge simulation, teamwork, design based methodology.

1. INTRODUCTION
People working on a ship’s bridge can come from a number of countries, cultures or social situations. Having people from three or four different nationalities is not unusual. Issues arise when bridge personnel cannot communicate in emergency situations, leading to grounding or other disasters. For example, on a ship where the captain was from a different culture from the other officers, staff were not able to tell the captain he had the wrong heading in a direct enough manner because the culture of both the captain and the staff would not allow direct contradiction by subordinates of the captain. In the captain’s culture subordinates would be listened to but he would insist on making the call. Other ship’s personnel were not able to contradict the captain because in their culture making an error causes a person to lose face hence they did not communicate in a clear direct manner to the captain. In a second example the captain was not able to accept warnings from the subordinate because she was female. The consequence being that the boat capsized and sank.

A theory seeded methodology [2] is being used to develop a 3D Virtual World, also known as a MUVE, to help ship’s bridge personnel develop bridge communication and teamwork.

2. BACKGROUND
The International Maritime Organization (IMO) is the United Nations agency responsible for the safety and security of shipping and the prevention of marine pollution by ships [1]. The IMO provides training material to assist in the implementation of the International Conversion on Standards of Training, Certification and Watchkeeping for Seafarers. We note all teamwork aspects in a relevant model course from the IMO “Model Course 1.22 Ships and Bridge Teamwork” does not involve using a simulation system.

3. CURRENT SITUATION
The methodology is being applied. At this point the researcher is taking a developer role. Having tested a prototype of the 3D Virtual World in a Maritime Studies simulation laboratory. Voice communication is being developed to meet the ship’s bridge training requirements.

4. NEXT
Marine Studies tutors will test the system and work with the researcher to develop a classroom intervention based on the IMO Module Course 1.22.
5. REFERENCES


Dancing in the Cloud: Design for Dance Technology Collectives

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ABSTRACT
Cloud systems provide infrastructure, platforms and software applications as service. Taking a design based approach that develops how these services can become central for developing dance technology collectives, a one day technical workshop on how to deploy a 3D Virtual World on the OpenStack Cloud system was created and presented. The workshop ran successfully on personal computers. However, performance of the deployed cloud services was inadequate. Thus connecting disparate members of a collective by adding their personal computers as nodes of the Cloud system was rejected. An alternative approach that deploys fit for purpose computers on fast network is being considered for the next design cycle.

Categories and Subject Descriptors
K.4.3 [Organizational Impacts] Computer-supported collaborative work.

General Terms
Design, Experimentation.

Keywords
Design research, Cloud, Collectives, OpenStack.

1. INTRODUCTION
Dance technology researchers and artists develop systems that: capture data from human bodies, provide personal embodiment using digital means, border-crossing between digital and physical domains i.e. causing the performance space to be changed by dancers or digitally embodied participants, and emergent behaviour from the developed systems.

Cloud systems allow dynamic creation of services for business infrastructure, platforms and applications. For example, cloud systems dynamically deploy virtual servers, storage and network configurations on request [4]. This flexibility provided by cloud services on infrastructure, platform and application deployment seems to match requirements of dance technology system.

A design science research approach is being taken to understand if a cloud service is suitable system for facilitating dance technology artists’ collectives. In this approach design and development of an artefact intended to solve an identified organizational problem is used as a focus [3].

2. BACKGROUND
A research system for a dance technology researcher and artist has been developed on a conventional private database system and a public 3D virtual world [1]. This has been a distance digital collaboration between an IT developer in New Zealand and a dance technology researcher and artist in Portugal over a three year period. The collaboration led to a short residency where the developer and the artist refined a system for collaborative dance performance. The system was then used in a performance that allowed dance in China and Japan to collaborate through video, a 3D Virtual World, and body data sensing transmission and re-interpretation [5].

The present system is beginning to be used by dance technology artists in different parts of the world. It meets requirements through close collaboration between the artist and the system developer. However, artist researchers want to express the relationship between dance or body data and effects in the system without having to go through a specialist computer programmer, and artists want to deploy their own 3D Virtual Worlds for their work.

Research is now heading towards developing a system that can be used by range of dance technology artists in a number of fronts. Body data sensing is being refined by the development of wireless network sensors that can be connected directly to the internet. For example: the “electricImp” [6] an Internet of Things microcontroller in an SD format with its associated cloud based development environment provided a possible pathway in the development of the system, however developing solutions with
this system requires a developer. Kitely [7] a cloud based 3D Virtual World system is being investigated to meet the 3D Virtual World requirement. Kitely and the electricImp constrain the researcher artist to deployment of their system where the internet is always available.

An alternative approach is to deploy an open source cloud system that can be run on a local area network (LAN) or on the internet. OpenStack [8] is an open source cloud infrastructure system that can be deployed on a LAN or on the internet. Hence it was proposed that individual artist’s personal computers could become nodes in a distributed infrastructural cloud implementing system requirements

3. METHOD
To develop our understanding of the constraints in the proposal a workshop on how to implement a 3D Virtual World in the Cloud (OpenStack) was treated as a way to develop an understanding of the issues when using OpenStack on individual’s personal computers. The workshop was also developed to meet requirements of a technical workshop for the Hong Kong OpenStack Users’ Group (HKOUSG). The organizers of the HKOUSG recommended either a render farm workshop or a virtual world deployment workshop as suitably interesting for digital professionals based in companies in the Cyberport incubation program or in their user group [2]. About twenty digital technology professionals from the HKOUSG participated in a 6 hour workshop where they deployed a 3D Virtual World on their personal computers. Participants were put into teams of about five participates with the aim to ask the teams to produce a Cloud on the team’s computers.

The first three hours of the workshop was spent preparing an OpenSim [9] 3D Virtual World server for deployment on a cloud. The second three hours was spent deploying the OpenSim onto the cloud.

4. RESULTS
Participants deployed the OpenSim 3D Virtual World on OpenStack clouds on their personal computers. However, due to a slow start to the day none of the teams produced a multimode version of their cloud. In the running 3D Virtual Worlds the latency was extreme, none of the systems – even those computers with highest performance specifications ran the virtual world in a way that would allow a dance technology researcher or artist to work.

Development of a cloud based system on personal computers has been abandoned. At a time in the future when personal computers have high quality and high volume disk drives, and sufficient RAM (at least 64GB or RAM) and processing power, the deployment of a cloud on personal computers will be revisited.

5. NEXT
Planning is being undertaken to deploy a fit for purpose – yet low cost computer – on a faster digital at the offices of an existing digital collective. OpenSim on OpenStack is still being used as a test case. Deploying on a sufficiently low cost fit for purpose machine will test the proposal that this configuration can be used to create a distributed cloud that connects or interconnects people working in dance technology collectives.

6. SUMMARY AND CONCLUSION
Developing systems for use by researchers and artists in an ongoing situation is treated as developmental research that is design focused, the artifact under development is the artists’ collaboration and system that enables collectives. The incremental and exploratory nature of the dance technology research also allows for design centred research. Theoretic frames with in dance technology influence and lead the design.

7. ACKNOWLEDGMENTS
Our thanks to Dr David Chun, Cyberport [10] Hong Kong for endorsing this research into development of a usable system for researchers and artists. Also to Alison Tan, Richard Chan and Bruce Lok from the Cyberport Technology centre and Katherine Lam from Incutrain Cyberport for facilitating and managing the process.

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Wireless Network goes bush: Wifi in Zealandia

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ABSTRACT
This poster paper describes an level 7 research project undertaken by two students in the Whitireia New Zealand Graduate Diploma students. Currently evolving conservation research technology makes use of tools that can generate very large quantities of data. In many locations, getting this data to a location for processing can be a challenge. The students worked with staff from the Zealandia Eco-Sanctuary in Wellington, New Zealand, to evaluate the feasibility of using standard wireless network technology to provide Ethernet connectivity into the Zealandia valley. Their research confirmed that a 5 GHz wireless bridge can be operated reliably over one kilometre into the native bush at Zealandia, and identified a range of locations from which devices could be connected to a wireless network.

Categories and Subject Descriptors
K.3.1 [Computers and Education]:

General Terms
Management, Performance, Design, Experimentation, Human Factors,

Keywords
Big Data, Conservation, Outdoors, Wildlife, Wifi, Wireless Ethernet, High Frequency,

1. INTRODUCTION
This poster describes a networking project developed by two second semester Graduate Diploma in Information Technology (GDIT) students at Whitireia New Zealand. This project was completed in fulfilment of the Level 7 Capstone Project paper at Whitireia. The first author was the academic supervisor for the project.

Zealandia is the trading name of the public resources operated by the Karori Sanctuary Trust of Wellington New Zealand. It is a community-driven eco-sanctuary project, comprising a valley of 225 hectares of regenerating native bush. It is less than ten minutes’ drive from the centre of Wellington. The valley is home to a large number of native New Zealand birds and animals found nowhere else on the three main islands of the country.

There has been much academic study in the valley since the Karori Sanctuary Trust was founded in 1995. The current research adds to a large body of literature build from research there.

2. OBJECTIVES
Zealandia provides an environment of interest to a range of people with different motivations. In the same way, this research can provide useful outcomes in a number of areas.

2.1 Research Data Volumes
As the New Zealand and Australian research community develops resources for processing vast quantities of data, there is demand for gathering richer data sets from remote areas. A number of research papers from the annual eResearch Symposia of New Zealand (http://www.eresearch.org.nz/) illustrate this growing need. The 2012 symposium included a paper that used data gathered in Zealandia [1].

2.2 Enabling Conservation Work
In order to continue a conservation agenda, Zealandia must undertake research to verify success of plant, bird, and animal introductions. Much of the work documented in the Zealandia research report (http://www.visitzealandia.com/research/) can be aided by provision of high-speed real-time data connectivity.

The day to day work maintaining the Zealandia valley can also benefit from staff being able to find creative ways to use high-speed connectivity.

2.3 Visitor Experience
Education and recreation opportunities are also provided by Zealandia. These parts of the operation are essential to build community goodwill, and funding. Provision of wireless network resources in the Valley will provide options to enhance visitor experience with resources such as the Wellington-developed Stqry.com electronic feature interpretation system. Additionally, some visitors will consider their experience is enhanced by being

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able to use their wireless network capable electronic devices in the valley.

3. THE CAPSTONE PROJECT
The students undertaking this project negotiated this project with marketing and visitor experience staff from Zealandia as their client. They undertook a number of stages in their research.

3.1 Installation of Access Points
Facilities Management staff from Zealandia assisted the students with installation of wireless Access Points (APs) for survey. The APs were supplied by Allied Telesis, and configured by the students.

3.2 Wireless Survey
Various surveys were undertaken with AirMagnet software, which provided an understanding of wireless penetration through bush, areas of good wireless signal strength and areas subjected to interruption.

Some of the areas surveyed can be found on a Zealandia map (http://www.visitzealandia.com/plan-your-visit/sanctuary-valley-map/) Areas surveyed included: Valley View Track; Top Dam; Round the Lake Track; Tui Glen Track; Heritage Area; Tui Terrace; Shag Tree; Round Lawn; Discovery Area; Tutara Research Area; Feeding stations for Kaka, Takahe, Kakariki, and Hihi;

3.3 Applied Wireless Trial
Another objective of this project was to test video quality over a wireless bridge. The students tested video at the Kaka feeders near the Top Dam, using the logical network structure illustrated in Figure 1.

4. CONCLUSION
In bush area wireless penetration makes difference because of obstructions especially when it gets wet. Some listed areas where Zealandia can put an IP camera and screening at visitor centre. Zealandia will be able to provide wireless internet connection for visitors.

5. FURTHER RESEARCH
This project tested the implementation of a wireless bridge, and evaluated potential for use of wireless access devices within the Zealandia valley. Further research could focus on detailed requirements for putting Access Points within the valley to provide significant areas with wireless coverage for high signal strength and high bandwidth.

In this way researchers and visitors could make use of public Wi-Fi to in the future.

6. REFERENCES
Keyboard Preferences: An Interactive Innovation

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ABSTRACT
This interactive poster collects information from participants, and displays it on a continually updating web page. It elicits notes from participants, indicating their preferred type of keyboard for a selection offered. The poster also gives the authors an opportunity to gauge the responses of participants to an innovative way of collecting data.

Categories and Subject Descriptors
K.3.1 [Computers and Education]:

General Terms
Design, Experimentation, Human Factors.

Keywords
Interaction, HCI, Surface, Hardware, Ergonomics.

1. INTRODUCTION
Recently Microsoft decided to significantly reduce the price of its “Surface RT” tablet computer. Whitirea School of IT took the opportunity to purchase several devices. These were offered to staff who had an interest in trying them out, and reporting back on their suitability for use in the organisation. The tablets were purchased with three Microsoft external keyboard options. Some staff prefer the printed ‘touch’ keyboard, others the limited-travel ‘type’ keyboard. Others are happier with a full-travel separate Bluetooth keyboard. There is a place for ‘soft’ onscreen keyboards, and this option is also considered.

The strength of feeling regarding keyboard preference was surprising. It was initially thought that one particular keyboard would be more popular, but preferences varied between staff.

This lends itself to researching what is behind this preference. A tool was needed to conduct this research. The School of IT has used Google Forms for various non-critical data gathering and reporting functions in the past, so this was an obvious option to consider.

Further consideration was given to the way people might interact with a survey such as this. The survey questions were chosen to elicit more information than just the headline choice of keyboard type.

2. THE MICROSOFT SURFACE TABLET
Surface is the name used for a range of tablet devices marketed directly by Microsoft. This section outlines some characteristics of the range.

2.1 Operating System
Microsoft Windows 8 was launched in October 25 2012, in a typically choreographed significant launch event [1]. Versions were showcased for PCs, notebooks, tablet computers, and phones.

2.2 Processor Options & Software
The Surface Pro [2] uses the traditional Windows option of an Intel® Core™ i5 Processor. This computer runs Windows 8 Pro, and can use most existing Windows software.


The Surface RT is used for the current research.

2.3 Keyboard Options
The Surface tablet can optionally use either of two Microsoft ‘covers’ [4]. A cover includes one of two types of keyboard.

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The ‘Touch’ cover is a flat, semi-rigid, panel, with key outlines printed on it. The key outlines are touch sensitive.

The ‘Type’ cover includes a rigid panel containing a keyboard with moving keys. The panel is 6mm thick.

Each cover includes a capacitive-sensing trackpad below the spacebar. The Touch cover is available in a variety of colours.

The Surface can be used with any Bluetooth or USB keyboard that works with a Windows PC.

For this research, the following keyboards are offered:
- A Type keyboard.
- A black Touch keyboard.
- A Microsoft Bluetooth Mobile keyboard 6000.
- Use of a tablet without a physical keyboard.

3. RESEARCH ENVIRONMENT
Participants in this research can be in the poster display location, or can post survey returns anonymously (although IP addresses will be tracked) from any location.

3.1 Google Form
A Google Form is available for participants to enter information about their keyboard preferences. Fields available include: Source IP, time of entry, & Google Account name (automatically collected – Google Account is optional); Keyboard type being commented on: Type of Device upon which the comment is based; Computer Use Environment relevant to the comment; User Preference Rating chosen by the participant; Other Participant comments.

3.2 Poster Medium
This poster takes the form of a web page designed to be displayed on a 23 inch screen. In the centre there is an automatically refreshing grid showing responses that have been entered. The research is described and explained around the poster. Text around the poster also invites further participation. A graphic displays an overall analysis of keyboard types, and the ratings they have been given.

The poster is accessible at: http://pcsupport.ac.nz/keyboards

3.3 Poster Display Location
Surface RT tablets will be available at the primary venue where the poster is being displayed. Participants can use these devices to try different types of keyboard, as they also fill out the form. Participants will be advised that their interaction with the poster is being observed.

3.4 ‘Remote’ Participants
Participation is encouraged from conference participants at the primary poster venue. Contributions will also be solicited from a wide range of other locations.

4. EXISTING LITERATURE
A review of the literature found considerable research on the effect of widespread availability of ‘soft’ keyboards on tablet and phone devices. There is, however, less relating to the preferences of computer users between different types of physical keyboard.

It was noted that there are a very large number of patents for different keyboards, leading the authors to ask if research into preferences between keyboard types is largely proprietary to keyboard suppliers, and not shared with the research community.

5. METHODOLOGY
Before the arrival of Surface tablets with a choice of keyboards, those selecting the equipment to be purchased by Whitireia School of IT expected there to be a clear preference for one or other of the keyboard options available. Experience has shown that preferences do vary.

This action research project will elicit a variety of responses. Those responses will be analysed in light of the extensive Human Computer Interaction literature available. That analysis will result in a matrix of the variables collected, and the keyboard that is preferred for a particular combination of variables.

As well as the information collected directly, the authors will observe interaction at the display location. That can be compared to responses entered, to look for correlations. Remote participants will have a different emphasis, and this too will be analysed.

The medium of this installation will also be explored further. In particular, it will be interesting to see if significant correlation exists between what participants see from previous comments, and their own subsequent comments.

6. FURTHER STUDY
Once initial results have been gained from this research, consideration will be given to wider factors affecting choice of portable computing hardware. Factors that could be studied in the future include: Operating System preferences; previous user experiences; relationship between a variety of computing devices used.

7. ACKNOWLEDGMENTS
Thanks to conference participants for hammering away on keyboards, some of which they will not like, and others who contribute to this on-going action research installation.

8. REFERENCES


AquaFORCE: Realtime Multiplatform Mobile Development

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ABSTRACT
AquaFORCE has developed a suite of applications which allow users to proactively monitor aquariums via mobile platforms.

Keywords
Realtime monitoring, mobile, capstone

1. INTRODUCTION
AquaFORCE solves the problem of users not being able to monitor and/or control their aquarium from their mobile phone. The existing solution only allows users to monitor and control their aquarium via a desktop browser located on their local network or requires users to be at the physical location of the tank when making changes and/or monitoring to the delicate environment. To solve this problem we created a multiplatform mobile application that allows the end user to control and monitor their tank from anywhere they have an internet connection.

We have developed a multiplatform mobile aquarium management tool which allows users to monitor and control their aquarium in real time from anywhere in the world. Our product allows users monitor and control any accessory that is attached and compatible with the aquarium controller. Accessories range from pumps to heaters, lights, skimmers, chemical and food dispensers plus many more. The product can be used anywhere where the user has an internet connection.

Another key feature of our system is a web based tool which collects, stores and displays the data produced by the aquarium. This allows users to spot trends and anomalies that occur within the environment of the aquarium. We have three deliverables in our project: The Android Application, The iPhone Application and the Web Service.

The system shall:

- send push alerts, when a criteria has been met defined by the user
- display historical data based on the users input and options
- report feeds without relying on a third party server for connections
- allow the user to turn on and off switches
- allow the user to adjust lighting based on a 0-100% scale
- support a range of different brand controllers
- give users a simple overview of parameters they wish to view most
- report feeds without relying on a third party server
- send push alerts to the phone based on specific error codes
- display the information in a graphical way
- be able to execute commands from the phone on the remote aquarium
- run at set intervals
- collect data from an aquarium controller
- display data collected
- warn users about the hazards of the system
- prevent unauthorised changes to the settings of the aquarium
- display graphs of records

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1.3 Technical Highlights

**Simulator** – We built an Aquarium simulator that produces an XML feed that is the same format as the one produced by each Aquarium Controller. This enabled us to test the parsing of the simulator without access.

**Graphing** – We were able to graph the data produced by the aquariums computers to make it easily understandable.

We wanted to have the most market share for our project because of how small the user-base is. We chose to make an iOS application because of the amount of people on the fish keeping forums asking for one. The web service was created to make a premium subscription service for the application, it also adds a lot of functionality to the application we had hoped to include in iteration one.

We have used three development platforms to create three mobile applications; Android, iOS and Windows Phone.

The AquaFORCE application has plenty of room to expand beyond its current feature set. If we are to continue work on this application we can add many more features such as:

- Integrating the remote IP camera feature that we produced a proof of concept for. The idea behind the camera is that users will be able to remotely view their aquarium from within the application, to visually check on their fish.
- We want to be able to produce more types of graphs based on the data provided via the aquarium controller.
- It would be great to offer support for a wider range of controller types and expand into monitor and controlling things such as water dispensing systems, pet monitoring etc.

AquaFORCE received the Award for best Technology in the Audacious Student Business Competition and were runners up in Technology at the Imagine Cup.
ABSTRACT
The farm environmental accreditation process is a time consuming, costly and document-laden endeavour. FarmBase enables efficient management and auditing by providing agribusiness and environmental data in an integrated system.

Keywords
Document management, accreditation, capstone

1. INTRODUCTION
Ian Brown Consulting has been using word documents and Excel spreadsheets to undertake the process of environmental auditing of farms that are using, or wanting to use the irrigation waters supplied by the irrigation companies in North Otago and South Canterbury. This is a time consuming and document-laden endeavour. The following document outlines the technical and developmental processes involved in developing our solution: FarmBase.

In developing FarmBase, we used the agile, iterative methodology. In this methodology development is split into three main iterations. Our first iteration consisted of building an understanding on the system our client wanted to build and creating a project proposal and a wireframe model to suit. This gave us some great feedback on how to proceed with the design and interaction into the second iteration.

The second iteration had us taking the proposal and feedback from paper based testing and creating a stable development platform to begin building towards the minimum viable product. Though before any sort of development could begin, we needed to define the function requirements for such a system. The process involved in developing these robust functional requirements involved creating user profiles, cases and stories to help build a picture on what tasks various user groups would want to undertake in the system. The results of this process can be found in section 4.3. Once the functional requirement we developed. Work on the system began, focusing on one functional requirement at a time. For the MVP we focused on the function requirements surrounding data management and auditing. On the 13th of July we went to the North Otago Irrigation Company’s offices in Oamaru and presented our MVP to Ian and various other interested parties.

Once MVP had been deployed and our client had given us feedback on the system, we began iteration 3. The first step of iteration 3 was taking a step back and evaluating what we wanted to deliver at the end of the year. It was shortly decided amongst the group and the client that we could not do this with the current system of vanilla PHP and HTML. So a YII framework was adopted.
2. Technical Highlights

2.1 Wizard Forms
Our first technical highlight is the multi-step wizard forms. Our application had a number of large forms for inserting data and after doing research into how to deal with large web forms it became apparent that we would need to split our forms up somehow to make them more user-friendly. There were several ways we could do this including splitting the forms across tabs, splitting sections using collapsible/expandable regions or splitting the form into multiple steps. In the end we chose to do the forms as a step-by-step wizard as this was better if the forms contained more than two steps and certain steps were dependent on previous steps being completed. We discovered an extension for Yii which provided the wizard functionality but had to adapt it to suit our application so that it could insert data across multiple tables in the database.

2.2 Dynamic form validation
Our second technical highlight is the dynamic form validation used on the farm creation form. Farms could have many different types of irrigation and agriculture but we only wanted to validate the form inputs for the types that the user had selected. Yii provided the validation for forms but no easy way of providing dynamic validation. In the end we were able to solve this problem by showing/hiding certain form fields using jQuery and by writing our own custom validation rules to only validate inputs for types that were ticked on the form.

2.3 I/UX Design
Our third technical highlight is the UI/UX design of our website. Creating a clean, simple and professional looking website for our client was important to our team, especially as two of our members were skilled in the area of UI/UX design. We started our design process through mock-ups using myBalsamiq and constantly improved upon designs through client and peer feedback. Carson designed the logo from scratch and Adam, who is a skilled photographer, provided the images for the site. We also used the Twitter Bootstrap CSS framework which not only provided user friendly input widgets but also helped bring all of the elements of the site together into one coherent design.

2.4 Database Design
Our fourth technical highlight is our database design. Designing the database was one of the first and most important technical tasks we undertook. The challenge was in converting the old document based audit system into a relational database that would interface with our application and provide all of the required functionality. Our database design went through many iterations to reach a stage where we confident it would satisfy our client’s requirements. We designed it in such a way that it interfaces well with Yii and complies with Yii conventions.

2.5 Audit Wizard
Our fifth technical highlight is the audit wizard. Our client wanted audit results to be automatically calculated at the end of the audit wizard and provided us with the criteria for calculating this. We implemented an algorithm to calculate these results based on the number of high, medium and low confidence ratings, which further simplified the audit process.
ABSTRACT
Undergraduate and postgraduate students learning to write literature reviews are having problems with citations, structure and synthesis. This is due to lack of experience in writing. Attempts have been made to address these issues by increasing the time spent on teaching these students how to write a literature review. In the first attempt with undergraduate students the students did not improve and were making the same mistakes. For the second attempt a more structured approach was taken, this approach was subsequently used with postgraduate students.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education -- collaborative learning, computer-assisted instruction (CAI), computer-managed instruction (CMI), distance learning.

General Terms
Documentation.

Keywords
Literature Review

1. INTRODUCTION
The literature review is an important part of the research process. It should inform the reader about the current state of research in a given topic. It should state the research question and why the research is important and what limits need to be placed on the scope (Creswell, 2012, 2014). However, polytechnic information technology students have little exposure to writing literature reviews. Research in other disciplines suggest that the traditional research methods class is seen by students as uninteresting and boring (Bos & Schneider, 2009). This poster describes how undergraduate and postgraduate students in Whitireia IT programmes are taught to write literature reviews.

2. BACKGROUND
Teaching undergraduate and postgraduate information technology students how to write a literature review can be fraught with all sorts of problems. This is mainly due to their having little or no exposure to writing academic papers, and little or no understanding of the importance of literature reviews in research paradigm. The educational “baggage” that students bring into the classroom also affects their learning ability.

The students at Whitirea fall into three specific groups: Maoris and Pacific Islanders, Pakeha and international students mainly from China and India. A large number of the New Zealand student did not achieve well at school for various reasons. Often they are ill-prepared for academic writing (Marr & Misser, 2008). Also students with English as a second language face problems in understanding what is required and in writing in language not of their own (Qian & Krugly-Smolska, 2008). The references are also in 9 pt., but that section (see Section 7) is ragged right. References should be published materials accessible to the public. Proprietary information may not be cited. Private communications should be acknowledged, not referenced (e.g., “[Robertson, personal communication]”).

3. TEACHING EXPERIENCES
A big assumption made when the author started teaching this paper was that students would understand what a literature review was and how to write one. However, for the above stated reasons this was not the case, the undergraduate students had little understanding of academic writing or literature reviews. They had written business reports and memos, but had not been exposed to academic literature. They knew how to create a reference list with the appropriate layout, but not how to cite work. The postgraduate students were similar, with little exposure to academic writing and little understanding of how to write a literature review.

The issue with the above problems is how to improve student literature review writing abilities. For the second year undergraduate students, the process was broken down into three distinct parts. First, there was a discussion on what a research question was, then they were given examples of a research
question, then they were given an assignment where they had to come up with a research question. They were allowed to have it checked by the tutor to see if it was suitable and once it was approved they submitted it. The main problem for the students was they tended to make their question too broad and imprecise. The second stage was the students had to carry out a literature search to find references for their topic of research. The reference list had to be in APA format for all the references. This is one area of the process where the students have had previous experience. The main issue here was the students did not always seem to know what to include in the reference and what not to include - students would often put in the search string that appears in the address window in a browser. Even when students were informed about this potential error many would include the search string in their reference list.

The final assignment was to write a literature review. To prepare for this the students were given PowerPoint presentation and participated in a tutorial which discussed what a literature review was, how it is structured, and the language students should and should not use. Students also had access to examples of literature reviews as well as online resources such as tutorials on how to write reviews. The most persistent problem with the students’ literature reviews is their lack of citing others work. Students also did not to understand the notion of synthesis: bringing together different references into one review. Students tended to either write a mini-review of each article that they had found so that each paragraph was on one article with no link either to the main question or to any the other article, or they tended to write short paragraphs with one or two sentences, which made a point but did not allow an argument to develop. Most of the problems arose because of their lack of experience of writing long pieces and getting feedback, also lack of exposure to academic articles or a model of how to write academic essays.

The postgraduate students had similar problems and similar assumptions were made about their abilities: they would be able to write a literature review with little input from the tutor. This assumption had proven to be incorrect; although one or two students do not seem to have problems writing a literature review, the majority of postgraduate students doing the Research in IT paper had problems with the structure, the citations and the synthesis of the articles. For this reason more time was given over to literature reviews by way of tutorials on how to write a literature reviews and how to carry out online literature searches.

4. CONCLUSIONS
Both undergraduate and postgraduate students have problems writing academic papers, their citations are inadequate and structure of the review and synthesis are lacking. This mainly is due to their having little experience writing academic articles. This author has observed that is a common problem with IT undergraduate courses both at Universities and Polytechnics. This leaves the question open: is there an effective way to teach undergraduate and postgraduate students the art of writing literature reviews?

5. REFERENCES
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Low-cost Rapid Authoring Tool for Moodle Quizzes

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ABSTRACT
This paper describes the motivation and development of a desktop application developed by the authors called Question Machine (QM). It rapidly creates electronic quizzes that can be imported into Moodle. It is being evaluated by students doing a user-interface design course.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education

General Terms
Experimentation

Keywords
E-learning, Moodle, Learning Management Systems, Computer software

1. INTRODUCTION
Moodle is a popular open source Learning Management System. It has a rapidly growing clientele with around 76,400 known registered sites in 232 countries [6].

Online quizzes and tests have many benefits, such as instant marking that saves time for teachers and provides immediate feedback to students. Many agree that prompt feedback to students after an assessment is very beneficial for learning [3, 5]. There has been much effort in finding ways to reduce the time taken for marking assessments.

Disadvantages of online testing relate to the need for classrooms with computers, computer anxiety for some users, or issues in monitoring an assessment from a remote location [2].

2. MOTIVATION FOR DEVELOPMENT
Creating quizzes in Moodle can be tedious and time-consuming. There are low cost desktop applications that can create importable Moodle quizzes such as: Hot Potatoes 6, eXe learning and Qedoc Quiz Maker 2.7.1. However the authors found that it required time and experience to learn how to use these applications and decided it is beneficial to provide a tool specifically for Windows that can create quizzes quickly and simply by a novice computer user.

3. QM FEATURES
Question Machine version 1.7.7.3 can be downloaded from the SoftwareMachine.co.nz website. The one click installer is easy-to-use and the fact that it is installed in the User area of the file system ensures that it is not affected by a lack of administrative rights in a corporate environment.

It can create multi-choice single answer, multi-choice multi-answer, matching, true/false, short answer, numerical and cloze question. It is currently the only application that can create cloze questions with the option of providing a short text answer, numerical, or dropdown menu for the gap combinations in one question. Users can have different question types in one quiz and they can be created and edited on one screen.

Images can be easily inserted and resized in questions. Spell-checking and quiz printing options are also included.

Newer versions are automatically detected when the application is run, and the user just clicks ‘OK’ to have an immediately update.

Question Machine was first available at the end of 2010 and has been downloaded approximately 741 times in the last year (1/8/2012 to 31/7/2013). Google Analytics [7] gives a visual idea (figure 1) of the countries where it has been downloaded.

Question Machine is currently being evaluated by students who have participated in a user interface design course.
4. USAGE
Question Machine was first available at the end of 2010 and has been downloaded approximately 741 times from 1/8/2012 to 31/7/2013 [4]. Google analytics gives a visual idea (figure 1) of the countries where it has been downloaded. QM is currently being evaluated by students who have done a user interface design course.

Figure 1: countries where users have downloaded QM from 1/8/2012 to 31/7/2013 (Google Analytics, 2013)

5. CONCLUSION
Moodle is a popular open source LMS. However creating online quizzes can be tedious and time consuming. Question Machine is a desktop application for Windows that easily and rapidly creates quizzes that can be imported into Moodle. Its ease of use and features make it unique. A user evaluation is currently underway that will give more insight into the ease of use and functionality.

REFERENCES
1. INTRODUCTION
Cycling Otago has time wasting issues because some rider will not commit to emailing entries, attend without pre-entering, or pre-enter and then do not attend.

Handicap races are not a new phenomenon: organisers of horse races have been using it for centuries. Horses are weighted or less commonly, time penalised to slow the horse to ensure it finishes the race at the same time as the others. In sports where humans are the athletes, an individual may be started later to enable the individual to finish at a closer time to his rivals. Handicaps races are commonly held by cycling clubs in Australia and New Zealand.

Formulas are based on a number of variables. Some are based on the athlete and can include: past performances, age, gender, specific athletic qualities. Others are based on the qualities of the course the race is held on and can include: length, gradient profile, wind direction, indefinable qualities like how easy it is to make a gap.

I have made an online entry system that the client can use to add an entire race season calendar into, make changes as necessary to the races, or add and edit races one at a time. A rider registers their profile on the system, then can enter races, and see who has entered before them. Races with a date in the past show a result button, which when clicked, takes the rider to the result of that race.

The system meets the client’s business problem. Because riders can see who else has entered a race and they know other riders can see they have entered, it introduces an aspect of community to entering a race. This has led to a steady increase in the percentage of riders entering online and a decrease of riders attending on the day without pre-entering. If the current trend of entering online continues, my client believes they can make entering online compulsory. Solving the lack of commitment issues also solves the time wasting issue, which is the symptom of root cause.

Comparing the user experiences of a rider before and after my system was deployed illustrates how it increases the commitment a rider feels toward entering races. Consider a rider entering via an email. A rider must send an email with the race they want to enter and their name. The Cycling Otago website instructs the rider to enter online with no mention of what that email should contain. The rider then trusts that their email is opened by someone and they should just turn up on the day. That communication method is essentially private and impersonal because entering@cyclingotago.co.nz doesn’t reveal who might read your email. No confirmation reply email is received by the rider. A few days later, on race day, it’s raining. The rider knows that nobody else but the race organisers know that he has entered. The rider then decides to stay home because nobody knows he is letting them down by breaking the commitment.

Now consider using my online solution. A rider has already has a secure login he made when he registered previously. He logs in and sees a race is happening in the weekend. The rider enters the race and chooses his grade. Once entered, he has the reassurance that he has entered by a message and seeing his name on a list of entrants. He may or may not be the first to enter but it is obvious that other riders can or will see he has entered. The removal of some of the privacy around entering has been removed leading to a sense of community leading to commitment. There are many barriers participation in sport, but by removing the privacy around entering races, hopefully my project will increase participation of members and attract new ones.

This poster paper appeared at the 4th annual conference of Computing and Information Technology Research and Education New Zealand (CITRENZ2013) incorporating the 26th Annual Conference of the National Advisory Committee on Computing Qualifications, Hamilton, New Zealand, October 6-9, 2013. Mike Lopez and Michael Verhaart, (Eds).
<table>
<thead>
<tr>
<th>FR1</th>
<th>The system shall record race results</th>
<th>FR10</th>
<th>The system shall display future events to enter</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR3</td>
<td>The system shall store the grade or handicap a rider normally or last rode in</td>
<td>FR11</td>
<td>The system shall display past event to view results</td>
</tr>
<tr>
<td>FR4</td>
<td>The system shall allow riders to enter races online</td>
<td>FR12</td>
<td>The system shall sort riders by ability</td>
</tr>
<tr>
<td>FR5</td>
<td>The system shall store profiles of racecourses</td>
<td>FR13</td>
<td>The system shall determine time gaps between bunches</td>
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<tr>
<td>FR6</td>
<td>The system shall let an event be created from a selection of racecourses</td>
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<tr>
<td>FR7</td>
<td>The system shall store a list and display of entered riders for an event</td>
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<tr>
<td>FR8</td>
<td>The system shall send email notifications to riders of race events, results</td>
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<tr>
<td>FR9</td>
<td>The system shall enable a list of entered riders to be printed out</td>
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<tr>
<td></td>
<td>The system shall record who has prepaid for races</td>
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</table>

The system already addresses the race organisational, social and commitment, and the symptomatic time wasting aspects. The next step is to address the storing and display of race results. My application already has the capability of storing race results and displaying them.

My MVP that was deployed on 24 November 2012 has been used for 24 races to the end of season on 25 May 2013. The system was used by less than ten riders on the first race. Now more than 40 riders are using the system. The client will be soon making online entries mandatory due to the success of Rouleur. The final robust delivery was used for the Club Captains’ Ride on 29 June 2013.
Head Office System - Web Application Upgrade

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ABSTRACT
The Head Office System is a web application designed and built by Glassbox Limited. The system is designed to show a high level summary of data gathered from many point-of-sales, which is stored in a multi-tenanted SQL Server database. The system takes information from the database and displays it in an ASP.NET webpage using four widgets. Each widget has a separate function and displays its data in a unique manner. Glassbox wished to upgrade the system to provide a richer user experience and remove the reliance on JavaScript. The objectives of this capstone project were to convert the existing widgets into Silverlight widgets, and display the new Silverlight content within the ASP.NET web application. Additionally, Glassbox required a widget template be developed so new features would be easier and quicker to implement. The project was a success with all widgets being converted to Silverlight and deployed to the Glassbox production server. The widget template has provided Glassbox with a quick, easy way to add new features to the Head Office System.

Categories and Subject Descriptors
D.2.7 [Distribution, Maintenance, and Enhancement] – Corrections, Documentation, Enhancement, Extensibility, Portability, Restructuring, reverse engineering, and reengineering
H.3.5 [Online Information Services] Commercial services, Data sharing, Web-based services

Keywords
System Upgrade, Silverlight 5, C#, XAML, MVVM

1. INTRODUCTION
Glassbox Limited is a software development company based in the Bio-Commerce Center in Palmerston North. Glassbox started operations in 2009. Glassbox has designed and built a system to facilitate the management of product and sales information, from the head office to the point-of-sale. The main customers of Glassbox Limited are in the petroleum sector. Glassbox Limited wished to upgrade their Head Office System, or HOS for short, by integrating Silverlight into the web application. The original system was implemented with ASP.NET and JavaScript, using widgets to display data retrieved from a SQL Server database to the user.

2. OBJECTIVES
The capstone project objectives were:
• Design and build Silverlight widgets, based on original widgets available in the web app (Top Selling Items, Department Summary, 24 Hour Summary, Nett Profit)
• Design a Silverlight widget template. Allowing for fast and easy creation of new features desired.

3. METHOD
3.1 Analysis
Analysis of the existing web application included a read through of the code and understanding the SQL Server database. The code read through provided an understanding of the business’s coding standard and coding practices. The SQL Server database uses the ARTS data model. The Association for Retail Technology Standards (ARTS) of the National Retail Federation, has developed standards for the retail industry since 1993, and is an international membership organization [1].

3.2 Design
Use of the Model-View-ViewModel pattern was a requirement. The MVVM Light Toolkit was provided. The toolkit is a software plugin for Visual Studio created and maintained by GalaSoft [2]. The toolkit provides code snippets and item templates to help accelerate the design of programs using the MVVM pattern.

Telerik’s RadControls for Silverlight 5, were also provided for use [3]. RadControls is a collection of libraries and controls designed for rich business applications using Silverlight.

3.3 Development
An iterative approach was taken to development, with widgets initially being prototyped in a test application. The test application used WDSL web services to extract the data from the database. On a weekly basis the widgets were demonstrated to the project team before being deployed to the production server.
sponsor and feedback was used to improve or redesign the demonstrated widgets.

Once the prototyped widgets were approved by the sponsor the code from the test application was integrated into the web application.

Figure 1. Original web application

4. RESULTS
Six widgets ended up being designed and integrated into the web application, as well as a dashboard that contains the widgets. Each widget and the dashboard has a View and an associated ViewModel. The four existing widgets in the web application were redeveloped in Silverlight and two new widgets were created. The six deployed widgets were:

- Top Selling Items
- Department Summary
- 24hr Summary
- Nett Profit
- Nett History (new)
- Nett Comparison (new)

All data is retrieved from the database through a WDSL web service, and the web service utilises stored procedures.

The widget template was created allowing all widget ViewModels to inherit from a base widget class (vmWidgetBase). For the template, the colour scheme and button styles are stored in a resource dictionary (rscWidgetDictionary.xaml) so all widgets look similar and any changes to the resource dictionary are reflected in all widgets. Creating the View and the ViewModel for the templates will automatically create a widget with basic minimise and menu animations. A widget template user guide was also created.

Figure 2. New web application

5. CONCLUSION
The homepage dashboard in the Head Office System has been redesigned in Silverlight utilising the MVVM pattern. Many of the features of the original application have been retained, while also creating a better user experience through animations. A similar interface to the original was implemented so to aid existing users with using the new system. The widget template provides Glassbox Limited with the means to quickly produce a blank widget that has animations, speeding up the implementation of new features.

6. ACKNOWLEDGMENTS
Our thanks to Phil Jobson and Mike Mudford at Glassbox Limited for their time and providing a valuable learning experience

7. REFERENCES
Programming Goes to School

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ABSTRACT
The “new” Digital Technologies curriculum in New Zealand Secondary Schools, now in its fourth year, offers Computer Science – Scratch, JavaScript and Python. Because of how the NZ Ministry of Education takes and manages student statistics, the numbers are not readily available but it is understand that the uptake in Computer Science (Programming) is not as high across the country as Digital Media (web development and multimedia) or Infrastructure (hardware, operating systems and networking). One reason given is calling it Computer Science instead of Programming or Coding. Certainly young women are not encouraged by this nomenclature. An American study shows that results can be improved to 50/50 female to male school students. This poster paper explores the lessons that can be learned from this US study to benefit the New Zealand environment.

Categories and Subject Descriptors
K.3.2 [Computers and Education]: Computer and Information Science Education – Computer science education, curriculum

General Terms
Programming, Coding, Digital Technologies, High Schools.

Keywords
Programming, Coding, Digital Technologies in New Zealand High Schools.

1. INTRODUCTION
Ever since Camp (1997) talked about the incredible shrinking pipeline of the decline of women graduates in IT, educational environments have tried to increase women in computer science education by making programming more exciting and more accessible (Repenning, 2012). Camp (1997) maintained that female students were losing interest in computing at elementary (intermediate) school age – if they ever gained the interest in the first place. Long before NZ high schools began thinking of whether students should learn IT – and when the only IT course was Keyboarding, which had, in those days, a high uptake from young female students, the University of Colorado (CU) began researching into the teaching of coding to local elementary school students. Using AgentSheets (see Image 1) CU studied the supporting of students with game design and simulation building through drag-and-drop interfaces.

Image 1: Elementary school students learn about life science topics such as food webs and ecosystems by designing their own animals. Groups of students put their animals into shared worlds to study the fragility of their ecosystems.

CU had success with AgentSheets and later, AgentCubes (see Image 2) to explore the idea of 3D fluency. Because of their success almost 20 years ago, they became more concerned with why coding was not taught in middle (elementary) schools throughout the US despite such success with such tools. From the CU research into activities, or lack of them, in other elementary schools throughout the US (Repenning, 2012) it was found that if programming was found at all, it was usually offered as an after-school activity. Middle school is deemed by both Camp (1997) and Repenning (2012) to be an important period in the life of young people, especially females, as they make many decisive but often unfortunate decisions as “science is not for me.” Repenning (2012) asks how can we shift middle school computer science education from isolated after-school efforts from some to a full model where computer science is integrated into the school curriculum and taught in required classes at local and national levels?
2. PUTTING IT INTO PRACTICE
CU’s Scalable Game Design Initiative with over 8,000 participants throughout the middle schools of Colorado is showing great success. According to Repenning (2012) one of the Initiative’s middle school teachers was using AgentSheets to introduce game design as a programming activity into his regular keyboarding and PowerPoint class. When the research team from CU visited this teacher’s class they immediately noticed a completely different class composition. Instead of the single girl found in the computer club, 50% of the students were female. When the class was asked by the research team if they liked the game design component of the class, they all responded “Yes.” When asked if they would also go to a computer club or after-school programming activity, most said “No.” The universal excitement about game design in a required class suggested a strategy to increase the exposure of students’ interest in computer science and broaden participation.

Since then the National Science Foundation (NSF) through its Innovative Technology Experiences for Students and Teachers (ITEST) programme enabled CU to expand this experience into a complete strategy for middle schools computer science education (National Science Foundation, n.d.). Studies were made on the effectiveness of this program in the way of teaching students computational thinking. The result being a set of advanced game design activities for middle school students, ranging from basic arcade games such as frogger (see Image 3) to far more advanced games such as the sims.

This finally led to the development of the Scalable Game Design Framework. The Framework has four main goals:

- Exposure - produce a highly adoptable and usable curriculum so a very large group of students were exposed.
- Motivation - motivating students to create a scalable set of game design activities ranging from low threshold to high ceiling activities.
- Education - build computational instruments that analyse student produced projects for Computational Thinking (CT) skills so that learning outcomes can be objectively measured (see Image 5).
- Pedagogy - systematically investigate the interaction of teaching approaches and motivational levels so that teachers could broaden participation.

3. THE RESULTS
This certainly appears to be working throughout the state of Colorado and the results of dramatically increased young middle school female students being involved has come to the attention of the National Centre for Women and Information Technology. The Centre has supported and funded “AgentCubes in a Box” - a complete example curriculum that introduces Computational Thinking with the Scalable Game Design process! Students use the freely downloadable version of AgentCubes program to make a working 3D Maze Craze game.

4. CONCLUSIONS
This highly successful scheme has many lessons for the New Zealand education environment. Scratch is currently being used to some extent, but it does not have the game design and associated computational thinking as demonstrated by the AgentSheets and AgentCubes systems and the Scalable Game Design Framework. Certainly worth looking at as an alternative to Scratch in New Zealand schools – at any level.

5. REFERENCES
A Novel Spell Checking Algorithm for Non-Segmented Languages

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ABSTRACT
This work describes for the first time a novel approach to implementing a successful spell checker for non-segmented languages such as Chinese. The design combines a novel technique that we call First Character Identifier Approach (FCIA). FCIA elegantly side steps the widely reported problem of how to segment text into words in a timely fashion. It does this by using a list of incorrectly spelt words to search for word matches in the text using the first character of the incorrect word. The design has been successfully implemented into a children’s email application that can be downloaded from http://www.mifrenz.com.

Categories and Subject Descriptors
F.2.2 [Nonnumerical Algorithms and Problems]: Pattern matching.

General Terms
Algorithms, Performance, Design.

Keywords
Non-segmented languages, spell checker, Mifrenz.

1. INTRODUCTION
An accurate spell checker is a part of most modern word processing applications. Although this has long been the case for languages that delimit the words in a sentence with a space, there is still on-going research into how best to segment sentences of languages that do not use spaces between words such as Chinese, Thai and Japanese.

This work describes for the first time an original design, development and implementation of a spell checking algorithm for the Chinese language called First Character Identifier Approach (FCIA). A critical point of difference of FCIA from other spell checkers is that the issue of segmentation is circumvented by designing a simple approach of using the sentence characters as keys to look up a dictionary of words. This approach is combined with the use of a dictionary of incorrect rather than correct words, something that other studies have used, but taken together results in a novel approach that is fast simple and robust. The algorithm was implemented using the Java programming language and integrated into the Mifrenz email application for children [2].

2. THE PROBLEM
One of reasons behind the lag of the development of a Chinese language spell checker is complexity caused by two facts: the first is that Chinese text has no natural delimiters such as spaces between words and it is possible for a sentence to be segmented in several legitimate ways [4], the second is that there is the problem with unknown words [5] which are not predefined in a dictionary but can be created by combining characters or words.

2.1 Segmentation
The widely used approaches in creating a Chinese spell checker usually include two steps: 1) work out an algorithm to segment the text and then 2) detect any errors. Grammatical rules are also sometimes used to detect errors [4]. The first obstacle people encountered in finding a solution for a Chinese spell checker was segmentation, that is identifying the correct combinations of the Chinese characters in a sentence or, in other words, finding a way to correctly group the characters in a sentence. The complexity of segmentation leads to a very large number of segmentation possibilities, which in turn gives the problem of how to examine all those possible segmentations efficiently, a task yet to be solved. The number of possible segmentations (N) for a sentence of length (L), with a maximum word length (m) is given as:

\[ N_L = \sum_{i=1}^{m} N_{L-i} \]  

Equation 1.

where \( N_{L-i} = 0 \) if \( L - i < 0 \); and \( N_{L-i} = 1 \) if \( L = i \).

Figure 1. A plot of equation 1 (using a typical maximum word length of 7) showing that the number of possible segments increases at an exponential rate with phrase length.

From Figure 1 it can be seen that the maximum number of segmentations increases exponentially when the phrase length increases, and this leads to the potential risk of “combinatory explosion”. Generally speaking, when checking a normal document which has several thousands of words, segmentation alone could cause some delays even when the most of the sentences are normal length and could cause long delays when working on many long sentences [4].
2.2 The Unknown Words
A unique nature of Chinese language is that every character, which is the basic elements in forming a word, has meaning; this is different to the letters in English. This means that new words can be arbitrarily created. Although new words are continually being created in the English language, the effect is much more noticeable in Chinese. Historically, Chinese words mostly consisted of single characters, however more recently the trend has been to create multi-character words that deliver more meaning than single character words. As each Chinese word is built on characters each of which have standalone meaning, it is not practical to define all Chinese words in a dictionary just like it is not practical to pre define all the sentences in English. Another issue is that traditionally, Chinese is a poem like language, especially in writing, and instead of using spaces, people use the rhythm as a natural delimiter. In order to achieve a certain rhythm, it is not unusual that a writer eliminates or adds extra characters in a sentence, and it could be challenge for computer based spell checker to examine these sentences, in other words, a spell checker cannot assume that a sequence of characters that are not in its dictionary are a spelling error. This is one reason that some of the existing Chinese spell checker results in a poor end user experience.

3. A New Approach
Most spell checkers use a list of known correct words to check against, basically all the words in the dictionary. However as already seen, a complete list is impossible to create for a language such as Chinese that continually has new words added and variations for the existing words created. Another approach is to use a list of the most common spelling mistakes. For a language such as English this approach will not be as accurate but for Chinese it has been shown to be a reasonable technique [3]. In fact when Chinese children are learning to write, they are taught a list of around 2000 common spelling mistakes – as experienced by one of the authors. As mentioned above, in the Chinese language, each character has its own meaning and Chinese words are the combination of a variable number of characters, hence, people only make certain kinds of wrong combinations. According to a study [1] there are four main kinds of errors:
1. Misuses of characters due to the same or similar sounds
2. Misuses of characters due to similar shapes;
3. Misuses of characters due to similar meanings
4. Typing errors related to Chinese input methods.

4. THE SOLUTION
4.1 Segmentation
To circumvent the problem of segmentation we have developed the First Character Identifier Approach (FCIA) method. In the first step, the text is scanned one character at a time starting with the ‘pointer’ pointing at the first character. This character is used to lookup an ordered list of words indexed by their first character. It is possible that the list contains multiple words starting with the same character and this ‘sub list’ of one or more words is used in the next step. In the second step, the first word in the sub list is used to determine if it matches with the characters at the current position of the text (i.e. starting at the key character). For example given the text AFCDEAEGKRN and the pointer pointing at the first character A, a sub list of [ABHC, AFC, ACE] might be returned. The word, AFC matches the text. In the third step, the text is now segmented up to the end of the matching word. So now we have the text AFC SDEAEGFRN.

4.2 Combining FCIA with list of known spelling errors
In this work we use a list of incorrect words. If in the previous section a match is made, i.e. a known misspelling is found, the user is then given a choice (from the database) of correct words to choose from. The incorrect word is then replaced by the user’s selection or the user can choose to override the system causing the suggested misspelt word to be removed from the list. This removal is done on a per user basis. Note that the misspelt word will be replaced by a word with the same number of characters.

4.3 Moving the Pointer On
If as just described a misspelt word was identified then once the word has been replaced, the pointer is moved on to the next character after the word, S, in this example and the process repeats from this position. If no misspelt word was found, then the pointer just increments one position, to F in this example and the process repeats from there.

5. DESIGN AND IMPLEMENTATION
The algorithm described in section 4 was successfully implemented into the children’s email application called Mifrenz (Hunt, 2008) which can be downloaded from http://www.mifrenz.com. Mifrenz implements object orientated and 3 tier design patterns where the classes for: 1) the GUI, 2) the logic and 3) the data storage, input and output, are kept in separate packages. This work followed the same design patterns. Also a number of Use Cases were developed to capture different user scenarios. In order to ensure that the response time for the user was kept to a minimum, the list of words were loaded into a normal Map programming structure as supplied by the Java language instead of using a conventional database.

6. REFERENCES
ABSTRACT
This paper outlines a study to investigate the effectiveness of Pair Programming (PP) on a small group of first-time programming students. Participants in this study were enrolled in a Level 4 Information Technology (IT) qualification at a New Zealand Institute of Technology. Numerous international studies have recommended PP as a pedagogical tool for first year tertiary level programming students. Anecdotal evidence confirm that students’ performance in programming classes at the entry level requires improvement. Consequently, it was deemed crucial to investigate the effectiveness of PP on this group of students. Participants in this study confirmed that pair programming reduced their anxiety during the programming classes however little improvement was observed from their assessment marks. Factors that may have contributed to this include pairing of students with different ability levels, random pair selection, and negative pair pressure.

Categories and Subject Descriptors
K.3.1 [Computers and Education]:

General Terms
Measurement, Performance

Keywords
Pair programming

1. INTRODUCTION
First year programming students in New Zealand tertiary institutions face similar challenges as their counterparts elsewhere in the world. Teague [3] questioned “Is programming really that difficult – or are there other barriers to learning that have a serious and detrimental effect on student progression?” and concluded that paired students outperformed non-paired students in exams. Studies of pair programming in university programming classes have shown that pair programming yields better design, more compact code, and fewer defects for roughly equivalent person-hours. Studies have also noted that pair programmers exhibit greater confidence in their code and more enjoyment of the programming process [2]. PP is a technique whereby two individuals use a single computer as they work together to complete an assigned programming task [1]. In this study, the researchers have been involved in teaching first year information technology (IT) students for over a decade. Anecdotal evidence suggested that first year programming students find the challenge unbearable which leads them to ‘disappear’ from the course. For those that attempt computer programming for the first time find it rather a stressful experience demanding long hours spent in the computer labs completing laboratory exercises and programming assignments. Consequently, the researchers were interested in how PP may motivate first-time programming students at a New Zealand Institute of Technology.

2. METHOD
This study investigated how pair programming may positively influence the attitudes of students in an introductory programming course. The class consists of two hour lecture and three hour lab. In the lecture, the basic theory and logic were explained. In the lab, a few of basic practical exercises were taught in a traditional way in the beginning, and then each pair of students practiced some advanced questions. In the first trimester of 2012, a total of 38 students were enrolled in the programming course. The first 20 students who enrolled for the CiC programme were allocated into the group A while the remaining students were placed in the group B. The researchers decided that the group A would be the pair programming group while the group B were the individual programming group. However, in 2013, the participants decided their own groups and partners. Therefore, we refer to the 2012 group as the Compulsory Group and the 2013 group as the Voluntary Group.

3. PROCEDURE
During the lab sessions, the pair programming group worked on the lab exercises in pairs while the individual programming group worked on the same exercises individually and assisted by the researchers. Course assessments were strictly an individual effort for each group and were not to be completed in pairs. Students
were advised that pair programming was only to be used for the lab work and not for the assessment. There were five major assessments for the course and three MSLQ questionnaires. Half an hour was allocated during the lecture session to undertake the questionnaire administration. Students were advised that pair programming was only to be used for the lab work and not for the assessment. There were five major assessments for the course and three questionnaires.

4. FINDINGS 2012

When we compared the participants between the pair programming group and the individual programming group, there was no noticeable difference in the two groups in terms of the scores for the internal and external motivations. Participants in the individual programming group recorded high scores for their confidence in completing assessment work and their understanding of the delivered learning materials. The individual programming group’s assessment and learning confidence remained constant while the pair programming group’s assessment and learning confidence declined slightly. In the learning strategies section, the critical thinking measures of participants in the individual programming group remained consistent at the middle score while the pair programming group declined during the trimester. The only measure that showed a slight decline was the satisfaction by the participants in the individual programming group.

The average academic performance of the Individual group was higher than Pair Programming group from the first week of the trimester, but the results of Pair Programming group were improved up to the same level of Individual group’s in assessment 2 and 4.

Even though there were two big drops in assessment 3 and 5, we can see a big potential to improve students’ academic results using Pair Programming if we investigate more variables influencing Pair Programming and improve the way of how to apply them in the classroom.

5. FINDINGS 2013

Compared to 2012, the internal and external motivations were very similar, but the assessment and learning confidences in 2013 were interestingly increased steadily during the trimester, which were exactly opposite in 2012. The same results occurred in the areas of interest and curiosity of the course, Learning Time management and Organizing ability.

For the Satisfaction section, it was steady all the way through the trimester, but the level of the satisfaction of Pair Programming group was higher than the individual programming group.

Participants in Individual Programming group recorded higher scores for their assessment and learning confidence than Pair Programming group and they remained constant while the pair programming group’s assessment and learning confidence improved slightly which was different from 2012.

In the learning strategies sections that are Interest and curiosity, Learning Time management and organizing ability, they were constantly steady all the way through the trimester, but there was a noticeable improvement in Pair Programming Group.

Participants in Individual Programming group recorded higher scores for their assessment and learning confidence than Pair Programming group and they remained constant while the pair programming group’s assessment and learning confidence improved slightly which was different from 2012.

In the learning strategies sections that are Interest and curiosity, Learning Time management and organizing ability, they were constantly steady all the way through the trimester, but there was a noticeable improvement in Pair Programming Group.

While the average academic results were decreasing throughout the trimester, the students from Pair Programming Group achieved almost same results in assessment 2 and 4.

6. RECOMMENDATIONS

The following issues must be considered for better understanding the effectiveness of Pair Programming to encourage entry level IT students into programming courses in the future:

1. Thorough explanation of how PP will work in the first class.
2. Monitor and control periodical role exchange and equal time spent on each role as driver or navigator by the participants.
3. Early identification of pairs mismatch in terms of motivation and academic abilities.
4. Due to Peer Pressure, we recommended having Individual work 50% and Pair work 50% in the lab.
5. It is recommended that the students do a skill level test in the first week and assign a pair with equal skill level because students want to work with a partner with similar or better skill level.
6. For Pair Programming in the classroom, the tutor’s role is very important. They should remind and explain about the pair programming protocol in each class because students are not used to collaborate on work with their peers and they easily fall back to the traditional way of learning.

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INFO330 – Applied Information Systems Project

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ABSTRACT
This poster presents a summary of a 3rd year Information Systems internship that was completed at a Chartered Accountants firm that was in the process of converting their client management systems to a cloud based solutions. The student who completed the internship was completing a double major in Information Systems and Accounting. The poster presents an outline of the project that was worked on as part of the internship, a summary of the new system that was implemented and other work that was completed, along with the skills developed from past courses and the new skills learnt as part of the process.

Keywords
System Conversion, Internship

1. THE PROJECT
As part of an Information Systems paper at the University of Canterbury tasks were completed for Smith McCoy Alford to assist them during the implementation phase of their new practice management system CCH iFirm. This switchover meant that they had a system that was more adaptive, updated regularly and took strain off their servers by utilising cloud technology. The other part of this project involved detecting errors in a client job management system called simPro which were not producing accurate reports. As well as these two projects other tasks were completed using MYOB and Xero with the aim of exposing the student to a wider variety of accounting information systems and to help Smith McCoy Alford in the day to day running of their company. Skills learnt from previous courses (see Table 1) were able to be applied to real-life tasks enabling these tasks to be completed more efficiently and to a higher standard. A range of new skills were also developed (see Table 2).

2. CONCLUSIONS
The internship was a valuable experience and enabled the student to develop existing skills and learn new skills. While the course was an Information Systems course, the placement in an Accounting firm enabled the students to gain experience relating to both majors (Information Systems and Accounting).
ABSTRACT
The introduction of ICT into Early childhood education has had a prominent impact on childhood learning. According to New Zealand Council for Educational Research, there are three reasons why ICT matters in early childhood education. First is that ICT has already has an impact on people and environment that form young children's learning. Second is that new technologies have given new opportunities for parents and teachers to strengthen many aspects of early childhood practice. Third is that there is a growing support and interest across the whole education sector for the continuous development and integration of ICT in education policy, curriculum, and practice. This project evaluated software available for early childhood education and recommends five products that meet the needs of the children and also of the early childhood educators.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education

General Terms
Management, Measurement, Human Factors,

Keywords
Software evaluation, early childhood education

1. INTRODUCTION
The main focus of this project was to evaluate software suitable for early child hood education. We evaluated 12 software products and have recommended five of them which we believed are most closely suited to early childhood education. Our recommendations were based on practical observation of children using the software on tablet PC at the child care centre and also through academic research of journals, books and websites.

The first part of this paper contains the methodology we used for the project. The methodology contains the literature, frameworks used, the checklist that was developed and the observation. The second part of this paper describes the five recommended software products. The software products that were analysed were both free products and non-free products. We then describe the five chosen software products, why we choose the software, what it does, what parents and teachers should know about the software before allowing their children to use it and why children like the software.

This poster paper appeared at the 4th annual conference of Computing and Information Technology Research and Education New Zealand (CITRENZ2013) incorporating the 26th Annual Conference of the National Advisory Committee on Computing Qualifications, Hamilton, New Zealand, October 6-9, 2013. Mike Lopez and Michael Verhaart, (Eds).
### 2.4 Observation
For the practical observation we attended the CPIT childcare centre and observed children between the ages of two and four using software we had chosen. The software was used on an android tablet. Permission was needed from the parents for us to observe their children. The observation included recording the children’s comments and reactions. The children were shown the chosen software on the tablet and were asked to play with it. Our observation was based on the usability and the functionality of the software.

### 3. RECOMMENDATIONS
After analysing the 12 software products and evaluating them according to the Haugland framework we recommend the following five products that are the best fit for children’s learning:

- Alpha Tots
- Kids Paint Free
- Kids Numbers and Math
- Table Tots
- Tally Tots

The reasons we chose these applications are as follows.

- **Problem Solving:** Children will be able to think logically and process large amounts of data. The children liked interactive apps and not passive, this helps them with their problem solving skills. As the chosen apps are interactive in nature, it focuses the attention of the child hence increasing the sense of awareness and be intrinsically motivating.

- **Hand eye coordination:** Software such as kids paint is free, and an open ended software product that enables children to paint freely and interact with the software on their terms where by improving their hand eye coordination.

- **Strategic Thinking:** Applications such as kids numbers and maths helps children gauge their own performance and have a chance to self evaluate by understanding their strengths and weakness as the application gives them instant feedback.

- **Logical levels of learning:** These apps in general are also aimed to improve their logical levels of thinking.

- **Positive reinforcement:** It helps them find a solution to a question through trial and error, hence they do not have to feel discouraged if they do get the right answer immediately.

- **Affordable:** We have chosen these apps as they are cheap to download or free.

### 4. CONCLUSION
After the analysis of the software for early childhood education, it is clear that children need quality applications and software for them to stay focused and enjoy their learning. Hence through this project we chose five high quality software products which met all the criteria that proves they will be beneficial for children between the ages of two and five years.

### 5. ACKNOWLEDGMENTS
Our thanks to the CPIT Early Childhood Centre for their help and support.

### 6. REFERENCES
ABSTRACT
In this poster paper, core knowledge and concepts of designing, developing and delivering mobile software (apps) onto apps markets are presented. The poster covers the definition of app, the OOP concept, GUI design principles relevant to mobile devices, a summary of the app development lifecycle and in the last section, a teaching approach being taken by the authors of this paper. The aim of the poster is to promote the idea that apps store/market can be used as tool to encourage BIT students to develop mobile apps.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education

General Terms
Design, Experimentation.

Keywords
Mobile apps, OOP, GUI design

1. INTRODUCTION
Mobile computing has become mainstream in recent years and will keep on growing, according to The Economist. Research indicates that the volume of data traffic will be 21 times greater within five years [4]. The software industry must keep pace with technology growth in this area. A new strategy has been put in place to facilitate this evolving software eco-system where software products can be directly delivered to a customer's mobile device on demand. For example, Microsoft has “Windows Phone Store”; Apple has “App Store”, Google started off with “Android Market” but has now repositioned their product as “Google Play”.

The purpose of this research to find out what is required for education institutes and the next generation of IT professionals to catch up with this new trend [2, 6]. This paper describes the knowledge and concepts needed by learners in order to develop and publish software (apps) onto apps store or apps market.

2. APP (SOFTWARE APPLICATION)
App is actually another name for application software used in computing device, like a smartphone or hand-held device, to enable it to perform a specific function [5]. The concept of app is from a word-formation method linguists classified as back clipping. Clipping take place when a word is reduced into one of its parts, it also can refer as truncation or basically shortening. Another type of clipping called front clipping has been applied in the word blog instead of weblog which are used virally in recent years. As these examples have demonstrated, the words in clipped forms are easier in terms of spelling and pronunciation. Therefore, they are a lot more widespread than their longer equivalents and commonly surpassing them in daily usage. So people these days will use the term app and instantly make a mental connection to the little icons shown on the screen of a smartphone or device with a similar level of sophistication.

3. OOP DEVELOPMENT
The first stage in the design and development of an App is to learn the concept of OOP and the framework for different technologies such as IOS, Android and Windows that meet with the industry standards. The frameworks are discussed in the app development lifecycle (section 5 below). OOP involves writing code as class definitions that have data attributes and procedures (methods) to process the data attributes. Instances of such classes are called objects. Example: Class Member. It can have many instances like m1, m2.

4. GUI DESIGN FOR MOBILE DEVICES
The design parameters of an app are very important. Good usability is achieved through good user interface design. Good design in turn depends on understanding the user needs and the
Another important aspect is understanding the principles of good screen design, particularly for mobile devices. Design principles of predictability, simplicity, responsiveness, efficiency and optimization are essential to take into account when developing system menus and navigation schemes. This involves selecting the proper kinds of windows, device-based controls and screen-based controls and requires careful consideration of proper meaningful graphics, icons and image colours with appropriate organization and layout of windows and pages as interaction space in mobile devices are very limited. Text and messages need to be concise and clear to provide effective feedback, guidance or assistance. After all, prototyping and test, test, and retest in the targeted platform device is the road to success.

5. APP DEVELOPMENT LIFECYCLE
In brief, the process of developing an app is not much different from developing a traditional computer program. The key differentiator is the publishing process. In general, the following steps comprise the app development lifecycle:

1. Have a design idea or vision, it may be for a good cause to help people in some way
2. Choose a platform: iPhone, Android and windows phone are mainstream platforms.
3. Elucidate requirements and establish the requirements for the design idea
4. Sketch the idea for the visual aspect of the interface: how it looks, how it flows and what information it will present.
5. Refine the sketched idea using design principle to break it down into more specific considerations
   - Information architecture – organizing the content in the app.
   - Interaction design – how a user can move from different screens if necessary to accomplish task using the app.
   - Visual Design – overlay controls that focus on usability and key task of the app.
6. Validate the refined prototype with potential users (and go back to step 5 if the design goal is not meet).
7. Download the IDE for the chosen platform such as:
   - Xcode for iOS app
   - Eclipse for Android app
   - Microsoft Visual Studio for Windows app
8. Start the physical development such as coding and follow the consideration list below for the specific platform:
   - Frameworks – low level library; available classes and methods; data structures and protocols.
   - Design Patterns – templates for design that determine the programming language and existing architectures. Such as Model-View-Controller design pattern
   - Human Interface Design – direct manipulation; feedback and communication; user control, consistency; aesthetic integrity; metaphors and mental model;
9. Locate the development centre website for the chosen platform to sign up for a developer account. Some documentation will have to be completed during the sign up process and this is an essential requirement for the app to be released to the public.
10. Test your app (using an emulator and physical device(s)) for unexpected outcomes such as:
    - Logical errors
    - Runtime errors
11. Submit the app to the App Store/Market and wait for approval. This process will be slightly different for different platforms but in general, after app submission, all apps are required to undergo a review process under the development centre by the app store/market. This involves internal staff member(s) from the store/market who produce a comprehensive evaluation report and make recommendations and/or requirements for the App to qualify to be published on the market. Feedback from the evaluator(s) can help the developer to make appropriate modifications for resubmission. This process will be iterated until the app has met all requirements or standards of the app store/market.
12. App is released to the general public for download or purchase.

6. CONCLUSION
Academics in New Zealand institutes of technology endeavour to provide up-to-date industry experiences to the learner. The authors encouraged their students to attend a Windows phone development workshop offered by Microsoft and to experiment with using app stores/markets to publish Windows App. In future we plan to use app stores in the HCI course as tools for GUI-based assessments involving Android or Windows phone development not only to deliver real world experiences but also to encourage and challenge learners to apply their knowledge and ideas on OOP and HCI related concepts.

7. REFERENCES
ABSTRACT
This poster presents a summary of a 3rd year Information Systems internship that was completed in the Project Management Office (PMO) at the University of Canterbury. The PMO is undertaking an upgrade from Windows XP to Windows 7 and the internship project involved the creation of a communications plan to ensure that all staff are kept informed of what is taking place with the project and the writing of a report to summarise the benefits of moving to a managed software environment. The poster also summarises the key learning and experience for the student involved.

Keywords
Operating Systems, Upgrade, Communications Plan

1. THE PROJECT
The University of Canterbury was using Windows XP with an unmanaged software environment for staff. As Windows XP will not be supported after April 2014, computers will need to migrate to a later version of Windows. Computers will be moved to a Windows 7 Standard Operating Environment. A part of the upgrade will mean users move to standard user accounts and a managed software environment. The new managed environment will enable users to be able to get the software they need in a controlled fashion, while ensuring that software updates are applied uniformly across the campus.

The communications plan that was created outlines how the team can best and most effectively communicate with key staff and those affected by the upgrade. The plan ensures that people have access to the information they need and receive it in the best way, while making sure that they do not get bogged down with information they do not need which turns them off.

The software benefits report outlined the many benefits from moving to a managed software asset environment from an unmanaged one. These include cost savings from having bulk and volume licenses on a per user basis rather than having everyone use an individual license. There are also a number of security and time saving benefits that result.

2. STUDENT LEARNING
The key outcomes of the internship were:
- Gaining experience of working in a proper organisational environment.
- Highlighting the benefits and necessity of project management methodologies in large projects and organisations.
- Gaining tools and skills needed for going into a career with a formal organisation.
- Gaining experience of work that was largely open ended, in contrast with University level work and assignments which are often very close ended with a definite result.
- Learning how to go about work and using the feedback of others to shape it.

3. CONCLUSIONS
The internship was a valuable experience and enabled the student to develop existing skills and learn new skills, in particular relating to project management in formally structured organisations.
Aligning Rubrics: Improving the Relevance and Quality of Higher Education

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ABSTRACT
This paper proposes that explicitly aligning scoring rubrics with assessment criteria for tertiary learning outcomes (knowledge, skills and application), that are aligned with graduate outcome demands of industry and other employers, will improve the social relevance, quality, transparency and transferability of qualifications.

Categories and Subject Descriptors
K.3.1 [Computers in Education]

Keywords
Rubrics, Qualification levels, Graduate and Learning outcomes, Learning resources. Assessment criteria

1. INTRODUCTION
Too many Aotearoa New Zealand tertiary graduates continue to be unemployable in the disciplines they qualify in. According to International watchdogs, the quality of New Zealand tertiary education continues to decline, and while the NZQA policy (in non-university tertiary institutions) has started to focus on graduate outcomes, that policy has not yet translated well into education provider practice [7].

To be socially relevant, qualification learning outcomes (knowledge, skill and application), in universities as well as non-university institutions, should be better aligned with those demanded by industry and other employers. To foster relevant, fair and accurate assessment standards, scoring rubrics should align explicit assessment grading criteria with an appropriate level of qualification standard, learning outcomes and resources - that can be a better basis for effective teaching and learning, self-evaluation, reflection, and peer review.

2. HIGHER EDUCATION ISSUES
There are three distinct stages in the development and delivery of tertiary programmes and courses in New Zealand - design and development, approval and accreditation, delivery [3].

The issue of poor academic standards has been the elephant in the room for a number of years in universities, especially in business faculties. Many international students struggle to meet the academic standards and expectations of overseas universities [5], as indeed do many domestic students.

It has been concluded that rubrics seem to have the potential of promoting learning and/or improve instruction. The main reason for this potential lies in the fact that rubrics make expectations and criteria explicit, which also facilitates feedback and self-assessment. It is thus argued that assessment quality criteria should emphasize dimensions like transparency and fitness for self-assessment to a greater extent than is done through the traditional reliability and validity criteria [2].

As many economies acknowledge the necessity for increasingly skilled workforces, the compatibility of learning levels and the transferability of credits between qualifications are becoming an increasingly important factor to facilitate lifelong learning [8].

While evaluative rubrics look beguilingly simple they are hard to do well. However, when done well, evaluative rubrics can substantially increase the use and credibility of evaluation. [4]
“The mismatch between job requirements and the qualifications of graduates is a growing concern globally” [6].

3. RECOMMENDATIONS
The current distinct three staged process of tertiary course development [3] needs to be reviewed and improved to better effect policy translation into practice, and both the policy and practice need to be optimized to rationalize and align rubrics for improved tertiary qualification relevance and quality in New Zealand.

Aligning scoring rubrics with other rubrics and learning resources that encapsulate the demand for socially relevant learning outcomes, that are compatible and transferable to support the demand for an increasingly lifelong skilled workforce [8] should be put into practice, sooner rather than later.

That means aligning scoring rubrics with explicit assessment grading criteria that are aligned with an appropriate level of qualification standard, learning outcomes and resources, that are aligned with employer graduate outcome demand.

4. CONCLUSIONS
Aotearoa tertiary qualification learning outcomes can be more socially relevant to satisfy employer demand in New Zealand and abroad, be of better quality, transparent and transferable, by using scoring rubrics aligned with other rubrics and learning resources that encapsulate the demand for social relevance and quality of learning outcomes.

Future research and effort should be put into evaluating the most effective rubric practices and integrating/modelling them into Aotearoa tertiary rubric practices for improved learning outcomes.

5 ACKNOWLEDGMENTS
My thanks to Sarita Pais and Susan Warring of Whitireia Community Polytechnic for encouraging me to extend my interest in rubrics into this research report and to Donald Joyce for his report writing quality assurance.

6 REFERENCES
Abstract
Locations become places through the sharing of stories. Loci is an Android social media app for location based story telling.

Keywords
Location, mobile, story, capstone

1. INTRODUCTION
In this report, an Android mobile application is presented. The key features are that people can visit any location world-wide and tell their stories and share their experience with anyone. Users must physically be at the location to share their story or to experience other stories. We feel we have worked hard to try and meet the metrics defined in our value proposition. People can now use our app to visit a location and tell their story, or people can go and experience other stories at the location. This really shows the ability for location based story telling. We have downloads on the Google Play store, with stories told world-wide. This demonstrates the value that our app can bring to the community. With Loci, locations are now places.

A table giving an assessment of the deployed system against functional requirements is shown below.

<table>
<thead>
<tr>
<th>Number</th>
<th>Requirement - The system shall</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR1</td>
<td>Provide user post locations</td>
<td>The user will need to know their post locations</td>
</tr>
<tr>
<td>FR2</td>
<td>Provide a way to post text based messages</td>
<td>The user will be able to use the phones keyboard to input text based messages</td>
</tr>
<tr>
<td>FR3</td>
<td>Provide previous post locations</td>
<td>The users will be able to find where previous posts are using a map</td>
</tr>
<tr>
<td>FR4</td>
<td>Provide mobility</td>
<td>The user will be able to use the system anywhere with maximum portability</td>
</tr>
<tr>
<td>FR5</td>
<td>Provide a way to post drawings</td>
<td>The user will be able to draw pictures on their screen and then post that picture</td>
</tr>
<tr>
<td>FR6</td>
<td>Provide a way to upload pictures to a post</td>
<td>The user will be able to upload pictures</td>
</tr>
<tr>
<td>FR7</td>
<td>Provide a way for users to login</td>
<td>The user will be able to login to the system, or use facebook or twitter to login to the system</td>
</tr>
<tr>
<td>FR8</td>
<td>Provide a way to update account details</td>
<td>The user will be able to update their personal details</td>
</tr>
<tr>
<td>FR9</td>
<td>Provide a way to share post locations via social media</td>
<td>The user will be able to share post locations via facebook or twitter</td>
</tr>
<tr>
<td>FR10</td>
<td>Provide an alternative to physical graffiti.</td>
<td>The users will be able to use the system to perform virtual graffiti</td>
</tr>
</tbody>
</table>
1.3 Technical Highlights

API – We have created a solid infrastructure for our system written in PHP and using JSON as the data interchange format. Our API is well documented and scalable enabling any future development with ease.

Library Uses – Facebook SSO for logging in, making a seamless experience and a good technical skill demonstration. We are adding other log in options for the future. Actionbar Sherlock for the consistent Google Design Guidelines to flow natively across all versions of Android. Google Maps integration to display our stories, with images in a balloon style overlay.

Web Portal – For initial testing of our application and current administrative purposes and features, we have an online interface to insert data into our application. We can add users, stories, locations and edit all of these. This is useful in moderation as we can delete or edit objectionable stories that are told. Our moderation system for the future will coincide with this. Users can now go to our website to view all the stories being told without the need for a mobile device.

Locations become places through the sharing of stories. Loci is an Android social media app for location based story telling. We are addressing the opportunity of letting people tell stories and share experiences around the globe. Loci is an Android app which is available for free download from the Google Play Store. Since our release we have attracted users from all over the world, from Korea, USA, and China to name a few. This shows the use and potential that this app can bring to the community.

There are millions of places, with stories waiting to be told. Share your experiences, and leave only footprints. Loci is a sustainable and clean option to leaving behind your memories. Our app has extensive library use and support to maintain a consistent standard across all Android devices. We have worked hard to ensure a good and seamless user experience. Our API is built to scale, which opens the potential for further platforms or devices such as the Google Glass Project.
Web Site Evaluation: Towards a Validated Instrument

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ABSTRACT
In this poster paper, we describe the development and initial validation of an instrument for Web Site Evaluation. The instrument is a questionnaire with 61 questions organised in seven scales. The instrument was trialled with 33 level five computing students. Overall, the instrument was found to be reliable. Four of the scales demonstrated acceptable coherence. However three scales require further work.

Categories and Subject Descriptors
K.3.2 [Computers and Education]: Computer and Information Science Education

General Terms
Measurement, Performance, Reliability, Standardisation.

Keywords
Web site evaluation, technology acceptance.

1. INTRODUCTION
Our project had its origins in work carried out by a third year computing student in which the student developed an evaluation tool for web sites [Jason Hsiao, personal communication, 2012]. Using this as a starting point, we created a pilot instrument that was more solidly grounded in theory and in extant standards such as the W3C accessibility guidelines. Our instrument has seven major scales.

We tested the instrument in a level five course in a three year computing degree. Students were asked to use the tool to evaluate three major Web sites (Microsoft, Vodafone and Snap).

We then used their evaluations to analyse the psychometric properties of the instrument. The instrument appears to have strong psychometric properties overall, but issues were found with some subscales. We plan to trial the instrument in other contexts and with a wider range of web sites. We also plan to develop the instrument further by refining the questions asked and creating simplified and extended versions.

Once the instrument is validated we will use it to inform the rubrics we use for web site assignments. The instrument may also have a wider use in industry. We plan to use the instrument as a research tool to investigate cultural and gender differences in perceptions of web sites. Finally, a key goal in creating the instrument was to encourage our students to think critically about Web sites and to help them develop professional judgement about what makes a Web site effective. We plan to evaluate how well this goal has been achieved.

There are several parts to this project. This poster describes the initial validation of the pilot instrument.

2. THEORETICAL FRAMEWORK
The technology acceptance model [1] provides a useful conceptual framework that explains acceptance of technology. It identifies two key components: perceived usefulness (PU), and perceived ease of use (PEU). However, the TAM assumes that technology is used to achieve a useful task. On the Web, appearance is also an important factor so we have extended TAM to include this.

The Web Accessibility Initiative (WAI) from the W3C gives standards and guidelines for accessibility [4]. We used these as the basis for the accessibility scale.

There are numerous instruments that focus on usability. Tullis and Stetson give a summary of five instruments [3]. Our approach was to bring together these various perspectives into a single comprehensive instrument.
3. METHOD
The pilot instrument is a questionnaire with 61 questions organised into seven scales. Responses are on a five-point Likert scale. We tested the instrument with 86 evaluations from 33 students. No instructions were given to students on how to carry out the evaluations or interpret the questionnaire items.

To validate the instrument, we fitted the data to a linear measurement model [2]. Model fit was assessed with the Rasch infit and outfit statistics [6]. Following guidelines given by Wright and Linacre [5], we classified an item as degrading if either the infit or outfit statistics exceeded 2.0.

We calculated reliability both for the original instrument and for an improved instrument in which we removed the items that were classified as degrading.

4. FINDINGS
We use Cronbach’s alpha to report the reliability of the instrument and scales. The estimated reliabilities of both the original and improved scales are shown in Table 1.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Original</th>
<th>Improved</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Alpha</td>
</tr>
<tr>
<td>Content</td>
<td>9</td>
<td>.773</td>
</tr>
<tr>
<td>Appearance</td>
<td>12</td>
<td>.854</td>
</tr>
<tr>
<td>Navigation</td>
<td>9</td>
<td>.862</td>
</tr>
<tr>
<td>Usability</td>
<td>11</td>
<td>.760</td>
</tr>
<tr>
<td>Accessibility</td>
<td>12</td>
<td>.722</td>
</tr>
<tr>
<td>Performance</td>
<td>3</td>
<td>.376</td>
</tr>
<tr>
<td>Compatibility</td>
<td>5</td>
<td>.727</td>
</tr>
</tbody>
</table>

Overall: 61 .937 52 .946

Note: N is the number of items. The improved scale is after culling degrading items.

5. DISCUSSION
Initial indications are that the pilot instrument has strong overall psychometric properties. The content, appearance, navigation and usability subscales seem acceptably coherent, with alpha above .8. The remaining three sub-scales need improvement.

Work on construct validity, discriminant validity, convergent validity and factor analysis of the results is on-going. However, we need more data before we can confidently report on these.

6. CONCLUSION
This early pilot stage achieved strong overall reliability and satisfactory reliability in four of seven sub-scales. This gives us confidence that we will be able to develop a comprehensive reliable instrument for Web site evaluation.

7. REFERENCES
ABSTRACT
In this poster paper, we present participants’ perceptions of three web sites collected as part of a trial of a new instrument for Web Site Evaluation. The instrument is a questionnaire with 61 questions organised in seven scales. The instrument was trialled with 33 level five computing students. We report means and standard errors of all scales. Participants gave low ratings for accessibility to all three sites, suggesting that the W3C standards for accessibility are not being fully implemented.

Categories and Subject Descriptors
K.3.2 [Computers and Education]: Computer and Information Science Education

General Terms
Measurement, Performance.

Keywords
Web site evaluation, technology acceptance.

1. INTRODUCTION
Our project had its origins in work carried out by a third year computing student in which the student developed an evaluation tool for web sites [Jason Hsiao, personal communication, 2012]. Using this as a starting point, we created a pilot instrument that was more solidly grounded in theory and in extant standards such as the W3C accessibility guidelines. Our instrument has seven major scales.

We tested the instrument in a level five course in a three year computing degree. Students were asked to use the tool to evaluate three major Web sites (Microsoft, Vodafone and Snap).

We then used their evaluations to analyse the psychometric properties of the instrument. The instrument appears to have strong psychometric properties overall, but issues were found with some subscales. We plan to trial the instrument in other contexts and with a wider range of web sites. We also plan to develop the instrument further by refining the questions asked and creating simplified and extended versions.

Once the instrument is validated we will use it to inform the rubrics we use for web site assignments. The instrument may also have a wider use in industry. We plan to use the instrument as a research tool to investigate cultural and gender differences in perceptions of web sites. Finally, a key goal in creating the instrument was to encourage our students to think critically about Web sites and to help them develop professional judgement about what makes a Web site effective. We plan to evaluate how well this goal has been achieved.

There are several parts to this project. This poster describes the participants’ perceptions of the web sites.

2. SAMPLE AND DATA
We asked 33 students to evaluate three technology Web sites, namely Microsoft.co.nz, Vodafone.co.nz and Snap.co.nz. The data from the 61 questions were organised into seven scales. Responses were on a five-point Likert scale. These are reported in this poster as percentages, with 100% representing strongly agree and 0% representing strongly disagree.

The means and standard error for each scale and for each site overall across all the questions, were calculated.

3. ANALYSIS
Our findings are shown in Table 1 and graphically in Figure 1.

Snap had higher values in several scales and in the Overall site score. Of interest is the variation in the mean values for differing scales.
4. FINDINGS
Of note were the low mean values for all three sites on the Accessibility scale compared with other scales (Figure 1.) The variation between sites for Accessibility, Browser compatibility and Performance was not significant. Significant differences (p<.05) between all sites were recorded for Navigation.

Microsoft was rated significantly lower in the Navigation, Appearance and Usability scales and Overall than the other two sites (p<.05). The Overall mean values for Vodafone and Snap were not significantly different.

Figure 1: Mean percentage per site for each scale

5. DISCUSSION
The low mean values across all sites for Accessibility suggests the W3C standards for accessibility are not being fully implemented. The more simple structure and content of Snap appears to have been rewarded with higher scores across several scales while Microsoft's more complex site was disliked.

It will be interesting to see if students who are at a later stage in their study produce changed patterns as they progress with their study.
Web Site Evaluation: Student Perceptions and Impact

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ABSTRACT
In this poster paper, we describe the feedback we received from students collected as part of a trial of a new instrument for Web Site Evaluation. The instrument is a questionnaire with 61 questions organised in seven scales. The instrument was trialled with 33 level five computing students. In addition to questions on the web site, we asked students about whether they believed they knew enough to be able to judge web sites, whether they found it difficult to judge the sites with our criteria, and whether they found this evaluation a useful exercise. Students believed they were able to judge web sites and could use our criteria. They also believed the exercise was useful.

Categories and Subject Descriptors
K.3.2 [Computers and Education]: Computer and Information Science Education

General Terms
Measurement, Human factors.

Keywords
Web site evaluation, technology acceptance.

1. INTRODUCTION
Our project had its origins in work carried out by a third year computing student in which the student developed an evaluation tool for web sites [Jason Hsiao, personal communication, 2012]. Using this as a starting point, we created a pilot instrument that was more solidly grounded in theory and in extant standards such as the W3C accessibility guidelines. Our instrument has seven major scales.

We tested the instrument in a level five course in a three year computing degree. Students were asked to use the tool to evaluate three major Web sites (Microsoft, Vodafone and Snap).

We then used their evaluations to analyse the psychometric properties of the instrument. The instrument appears to have strong psychometric properties overall, but issues were found with some subscales. We plan to trial the instrument in other contexts and with a wider range of web sites. We also plan to develop the instrument further by refining the questions asked and creating simplified and extended versions.

Once the instrument is validated we will use it to inform the rubrics we use for web site assignments. The instrument may also have a wider use in industry. We plan to use the instrument as a research tool to investigate cultural and gender differences in perceptions of web sites. Finally, a key goal in creating the instrument was to encourage our students to think critically about Web sites and to help them develop professional judgement about what makes a Web site effective. We plan to evaluate how well this goal has been achieved.

There are several parts to this project. This poster paper describes the impact of the evaluation exercise on students.

2. METHOD
We asked students in a level five computing course to evaluate three Web sites with the instrument we designed. As part of this evaluation, we also asked students whether they believed they knew enough to be able to judge web sites, whether they found it difficult to judge the sites with our criteria, and whether they found this evaluation a useful exercise. Responses were coded on a five-point Likert scale and there were 78 responses in total.

3. FINDINGS
Most students believed they know enough to be able to judge Web sites (Figure 1).

The majority were also able to judge the Web sites with our criteria (Figure 2).

Finally, most students found the exercise useful (Figure 3).
4. DISCUSSION

Most students reported that they found the exercise useful. One student commented: “Evaluating other's creation (Website) is a good way of getting ideas for our own product and avoid the mistakes they have made.” Anecdotal evidence also suggests at least some students valued using the criteria. One student comment was “This form would be useful for our own project work”.

However, we do not yet have sufficient information to address the question of whether we have achieved our objective of encouraging our students to think critically about Web sites and helping them develop professional judgement about what makes an effective Web site.
ABSTRACT
In this poster paper, we present a content analysis of open ended comments collected as part of a trial of a new instrument for Web Site Evaluation. The instrument is a questionnaire with 61 questions organised in seven scales. The instrument was trialled with 33 level five computing students. Part of the instrument asked students open ended questions about what they liked best about a site and how it could be improved. We analysed these comments against the key dimensions of the instrument. We found that visual appearance was the most important dimension for students, followed by navigation.

Categories and Subject Descriptors
K.3.2 [Computers and Education]: Computer and Information Science Education

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There are several parts to this project. This poster paper presents a content analysis of student’s qualitative perceptions of the Web sites.

2. METHOD
We asked 33 students to evaluate three Websites. As part of this evaluation we asked students two open-ended questions:

- What do you like best about this site?
- What could be done to improve this site?

We received 86 evaluations.

For each of these questions, we analysed student responses and coded them according to which aspects of the Web site they mentioned. We then counted the number of times each of these aspects was mentioned.

3. FINDINGS
Our findings are shown in Table 1 and Figure 1. It can be seen that appearance was mentioned most often, followed by navigation and content.

A full ranking of the aspects is shown in Table 2.
4. DISCUSSION

It is clear that visual appearance is the most important aspect of a web site for these students. We plan to test the instrument with students who are at a later stage in their study to see if this pattern changes as they progress with their study.
ABSTRACT
In Web design, there is confusion over the "page fold" concept and the significance of keeping the most important information within a webpage's initial viewable area. This is most significant in web delivered course material. This poster examines the changing views about the sanctity of the “above the fold” concept.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education

General Terms
Performance, Design, and Human Factors.

Keywords
Above the fold, page fold, scrolling.

1. INTRODUCTION
Above the fold originates from the newspaper industry where positioning a story or photo “above the fold” on the paper could increase readership. Since newspapers are displayed and sold flat - if the headline or photo was compelling it could increase sales [1]. Above the fold is now used in web development to refer to the portions of a webpage that are visible without scrolling [2].

2. EARLY DEVELOPMENT
During the Web's early years, users often didn't scroll at all. Users simply looked at the visible information and used it to decide whether to stay or leave. In studies during that period (1994–1996), websites often failed if they placed important information below the fold as most users didn't see it. Web users spent 80% of their time looking at information above the page fold [3].

3. NEW THINKING
Today, users will scroll. However, you shouldn't ignore the fold and create endless pages for two reasons:

• Long pages continue to be problematic because of users' limited attention span. People prefer sites that get to the point and let them get things done quickly. Besides the basic reluctance to read more words, scrolling is extra work.

• The real estate above the fold is more valuable than below the fold for attracting and keeping users' attention. [5]

In fact, if you have a long article, it's better to present it as one scrolling canvas than to split it across multiple page views. Scrolling beats paging because it's easier for users to simply keep going down the page than it is to decide whether or not to click through for the next page of a fragmented article. The fact that users scroll doesn't free you from prioritizing and making sure everything really important remains “above the fold”. [5]

4. ATTENTION FOCUSED AT THE TOP
Nielsen's chart (Figure 1) shows the distribution of user fixations along stripes that were 100 pixels tall. The bars represent total gaze time, as opposed to the number of fixations. Even though 5% of users' total time was spent past the 2,000-pixel mark, they tended to scan information that far from the top fairly superficially: some pages are very long (often 4,000+ pixels in Nielsen’s sample), and thus this 5% of user attention is spread very thinly. Nielsen used an eye-tracker with a resolution of 1,024 x 768 pixels. These days, many users have somewhat bigger screens and Nielsen conducted many usability studies with larger resolutions. Although using a bigger monitor wouldn't change my conclusions, it would somewhat increase the percentage of user attention spent above the fold simply because more info would be available in the initially viewable space.
In Nielsen’s 2010 study, user viewing time was distributed as follows:

- **Above the fold**: 80.3%
- **Below the fold**: 19.7%

These 2010 results almost totally parallel his 1996 studies – 80% never looked below the fold. [3]

### 5. MAJOR DETRACTORS

For years, Nielsen had faced considerable argument over the validity of his findings. Gilbertson (2009) argued that while web standards, such as Nielsen’s heuristics and others, gave developers a way to build websites so that anyone could access them, these standards didn’t cover difficult problems such as how to make sure people can find what they wanted on your site. According to Gilbertson [4] a UK-based design agency, CXPartners, had done a study of 800 user testing sessions and on only three occasions did the page fold confuse users.

Part of the reason for the shift can be seen in CXPartners’ hotspot study, which used eye tracking software to reveal that users nearly always spend some time glancing at the scrollbar to judge page size. Now, that doesn’t mean you bury your best content below the fold, but it does mean that you shouldn’t worry too much about things that simply don’t fit above the fold. [4]

Schwartz & Yavilevich [5] conducted an extensive study using the services of ClickTale and had a subset of about 120,000 page-views dated November 2006 to December 2006. In this research they analysed only vertical scrolling behaviour which recorded the height of the web pages, the height of the window (screen) and the bottom-most location the users scrolled to. The outcome of their research showed that 91% of the page-views had a scroll-bar, 76% of the page-views with a scroll-bar were scrolled to some extent and 22% of the page-views with a scroll-bar were scrolled all the way to the bottom.

Schwartz & Yavilevich [5] believed that these statistics demonstrated that the vast majority of web designers are designing web pages with scrolling requirements, that the majority of users do scroll and that a significant number of them scroll to the very page bottom. The next chart (Figure 2) shows that users are equally likely to scan the entire page no matter the page size.

Still, Schwartz & Yavilevich [5] agree that it is a good idea to place important information above the fold of the web page. But where exactly is this fold? Unlike newspapers, the fold of a web page has no fixed location. Each user sees a different height of the viewable area depending on his screen size, window size, browser and browser add-ons. The next chart shows that the fold area is concentrated around three peak areas – 430, 600 and 860 pixels. (While this might have been 2006, and variations in screen size and resolution have increased, the concept at least remains the same.)

### 6. CONCLUSIONS

It is now acceptable to scroll – everyone does, and most users mind much less now about the concept of scrolling. Anecdotal reports from students have changed considerably over the years to a point where now the common comment is “don’t mind either way”.

### 7. REFERENCES

Towards Industry Focused Testing Courses

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ABSTRACT
Software Testing had been taught on the Bachelor of Information and Communication Technologies (BICT) degree at Christchurch Polytechnic Institute of Technology (CPIT) as part of a level 6 course covering broader software engineering topics including Agile, Project management, etc. Only three weeks were devoted to coverage of Testing and the teaching material used was based upon traditional University texts covering the topic. Essentially it was very theoretical with a few simple practical exercises. Upon reflection now, it was similar to teaching programming with minimal and only very simple code being written. This paper describes the original plan and the refinements made and new courses introduced over three semesters.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education

General Terms
Verification.

Keywords
Software testing, Computing Education.

1. INTRODUCTION
It was recognized that BICT graduates especially in the specialisations of software development and interactive multimedia development. The topic of Software Testing had been taught as part of other courses however two years ago it was recognized that this should be a separate course. In order to gain a better understanding of software testing, one of the authors attended a Software Testing Industry conference. These appear to be rarely attended by academics as academic conferences that can gain credit towards a PBRF rating are preferred. This led to us becoming aware that testing as practiced by leading professionals was very different and much broader than the texts implied and a review of the testing course that was being offered was necessary.

2. ANZTB
Discussions with the Australia and New Zealand Testing Board (ANZTB), a sub-group of the International Software Testing Qualifications Board (ISTQB) revealed that their biggest concern was a big shortage of suitably trained graduates for jobs as test analysts. Their experience had indicated no Tertiary institution in NZ provided appropriate training for graduate positions. The employers’ only option was to recruit staff and provide training themselves or through placing their staff on expensive courses offered by corporate training providers.

Tracking of job vacancies advertised on Seek [2] reveals software testing vacancies to be consistently amongst the most in-demand job roles consistently exceeding vacancy numbers for web developers, network and system administrators, and help desk vacancies. As one of the core roles of an Institute of Technology and Polytechnic (ITP) is to meet the needs of industry [3], clearly we had a responsibility to address this need.

Consultation with ANZTB also identified the existing ISTQB Foundation Tester curriculum as an excellent source of core theory and this to be taught in conjunction with applied testing workshops introducing the students to the main techniques and tools used in Industry. This level 7, 15 credit semester-based course had two occurrences to ‘bed in’ and refine its delivery.

Following the success of these two occurrences, a wider consultation with the testing industry occurred. Christchurch enjoys a strong professional network of software testers (TPN) who meet bi-monthly. CPIT hosted one of these meetings and used it as a forum to gain feedback on our course and to what extent it met the needs of industry. A very healthy discussion followed this presentation with many recommendations but an overwhelming appreciation of the work put in by CPIT and the alignment of our course with the current needs of industry.

3. INDUSTRY FEEDBACK
The feedback from industry confirmed some of our suspicions but also gave valuable advice which then became the basis for a re-design of our Software Testing curriculum. There is an on-going...
debate amongst industry experts as to the most appropriate testing approach. One camp is very supportive of the highly process-driven and structured approach promoted by ISTQB in their curriculum. The other camp is very much against this and strongly prefers the context-driven and exploratory testing approaches.

As educationalists, our view is that the context-driven and exploratory approaches require significant testing experience and expertise before they can achieve the effectiveness they claim. We used the Kaizen in Vocational Education model, see Fig 1. For this reason, an entry-level tester is unable to be effective in fact could prove to be a liability for the employer. We have decided to base our courses on the ISTQB structured processes but also introduce context-based and exploratory testing as concepts.

The other main feedback gained from the Testing industry was the need for more practical testing experience and exposure to the Testing tools in common use in NZ.

4. NEW COURSES DEVELOPED
Based upon the interaction with the ANZTB and the industry feedback we now re-designed our Testing curriculum. The previous level 7 Testing course was redeveloped as a level 6 courses however it still covers the ISTQB Foundation Tester curriculum but be a little easier and have more practical Testing workshops. These workshops will introduce the students to common tools used throughout the Testing lifecycle. In addition, a new course will be offered at level 7. This course will cover agile Testing, context-based Testing and more in-depth application of Testing tools and have the level 6 course as a prerequisite. It will have a large project component requiring them to test a software application.

5. CONCLUSION
This paper reviewed the development of two Software Testing papers that were introduced into the BICT at CPIT. The development of the first level 7 paper was a collaboration with industry however by further industry involvement and the contribution of the ISTQB and the ANZTB along with conference attendance and collaboration with the Canterbury network of professional testers, a very strong well developed and pedagogically sound series of courses has been developed. These two courses will be offered in the BICT and the Graduate Diploma in Information and Communication Technologies in both semesters in 2014 at CPIT. They will also be available for our partner institutions.

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ABSTRACT
This poster looks back over a decade of final year projects carried out by BIT students. The aim was to see how the projects had changed and progressed over that period of time. The students carry out the project within groups, normally three within a group over the last year of study at SIT. The projects can be sourced by the students or by the staff, but the end goal is to create a working design for the customer. There have been a wide variety of projects over the past ten years but there has always been a pattern of the types of projects the students choose.

Keywords
IT Education, Project, Collaboration

1. INTRODUCTION
The project module for the bachelor of Information Technology is compulsory for final year students taking the Bachelor of Information Technology at SIT. This module is run over two semesters in their final year making up 30 credits towards their degree. Normally the project is carried out within a group environment of three or sometimes four students, all taking specific roles within the team [3]. Each team tenders for the project that they believe suits the skills that particular team possess. All teams have a tutor who will act as a mentor. This allows the tutor to keep track of the team and the progression of the project. During the project there are many key milestones that the teams have to accomplish within the project, such as presentations, reports and monthly status updates [2].

2. RESULTS AND FINDINGS
Between 2003 and 2006 many of the projects chosen were database designs for management systems and inventory systems using Jade. This was the approach taken by many polytechnics, for example, Otago Polytechnic at the same time had software projects to support the business infrastructure [3]. Between 2007 and 2009 the projects moved away from Jade and started using Visual Studio and C# as the programming language of choice. Most of the projects during this period were focused on web presence for customers. This was different from other polytechnics that were looking at software and hardware projects [4][5]. From 2010 onwards there has been a big influence on the projects from the pressure on industry to become mobile and this led to many projects producing mobile and cloud based apps along with the dynamic website for the company.

The change from using Jade to Visual Studio as a platform was due to a change in staffing and the new staff member not having knowledge of Jade but having in-depth knowledge of Visual Studio. From 2007 onwards the industry advisory committee started to have a bigger involvement within the degree and our approach to IT, which had an impact on the types of projects that the students produced. Many other polytechnics around New Zealand were also moving towards this type of software infrastructure [1]. There has always been an underlying pattern within the projects to produce front-end design such as a website and a database back-end to manage the data from the site. This type of project made up the majority of the projects over the last five years. Seven out of the 20 final year projects in the last two years, have integrated mobile applications within their design either for smart phones or tablets.

3. CONCLUSIONS
With the change in technology over the past couple of years and the introduction of the tablet and smart phone, students and customers are increasingly moving into this mobile world. There is always a diverse output of projects from all the polytechnics carrying out projects within bachelor degrees and the types of project depends on the location and industries available. We expect that we will always have database and hardware system projects for customers but in the coming years more projects will be focused on mobility and the customer expectation, rather than just the web presence. The final year projects are driven not only by the staff’s knowledge of cutting edge technologies but also by the industry advisory committee and the customer, who in today’s market need to have a point of difference from their competitors. Customers need to stand out in a very congested environment, so anything that can put them above the competition is a bonus.
4. REFERENCES


ABSTRACT
In 2012 Christchurch Polytechnic Institute of Technology (CPIT) upgraded to a full Windows network environment and introduced Microsoft Lync as part of the upgrade. The seamless integration of Lync in the Microsoft Windows/Office environment has enabled distributed staff in community learning centres to effectively use online video calls and sharing, to reduce travel costs both in terms of dollars and time and allows for rapid information sharing at short notice. However, experience has shown that Lync cannot always replace face-to-face meetings – especially when discussing contentious issues.

Categories and Subject Descriptors
H.4.3 [Communication Applications]: Computer conferencing, teleconferencing, and videoconferencing

General Terms
Management, Documentation, Economics, Human Factors

Keywords
Lync, online meetings, video conferencing, costs.

1. INTRODUCTION
CPIT switched from a Windows environment running on a Novell network to a full windows network in 2012. One software package that came with the Windows environment was Microsoft’s Lync video conferencing software. Lync is fully integrated within the MS Office suite and you can make calls via Lync, from Outlook contacts or calendar appointments. The software also allows IM, audio only calls, online status visibility, the sharing of desktops and even allows remote access for desktop control in meetings.

2. Life before Lync
Campus Connect has five community based branches (one at the main campus), each with a Team Leader and the Head of Campus Connect is based at the main campus. The management team for Campus Connect (Team Leaders and Head of Campus Connect) meet once a month to discuss the business, issues and planning that is required. Prior to the introduction of Lync, the meetings were held in-person, usually at the main campus. At times, extra meetings might be required for urgent issues.

3. The cost of doing business
Meetings were usually scheduled for Friday afternoons, as this was the easiest time for the Team Leaders to leave their branch and travel into the main campus. For some Team Leaders, at least an hour would be allocated to travelling into the main campus, finding a car park etc. and they would also claim for petrol costs. Two of the Team Leaders are in a part time role, and the meetings were often outside their normal hours, so they would claim for the time of both travelling in for the meeting and the time for the meeting. Post-earthquakes (especially the February 2011 quake), travel around Christchurch has become more difficult and more time is required to get from place to place, and now with the rebuilding underway it is sometimes even harder to get around than before.

4. Life after Lync
MS Lync was introduced to little fanfare at CPIT. It was put onto the system and some links to training materials were provided. Campus Connect was an early adapter of Lync as we immediately saw the potential in being able to hold meetings and video conferences across our branches, saving both time and money.

We trialled a few one to one meetings to try it out and while it worked well (good audio and video), it took quite a while to get used to being on camera and seeing yourself and the other person on your screen. We had some humorous moments too trying out different camera positions and noticing things in the background of each person’s room!

We can schedule a Lync meeting as an Outlook appointment and send it out to the team members. At the appointed time, you open the appointment in your calendar and click on the link to the online meeting. Once in you can set up your video and microphone (we use Logitech headsets and webcams) and talk to the other people attending the meeting. When there are more than two people in a Lync meeting, you only see the person talking at the time. This sometimes causes odd moments when someone is talking and another person coughs or makes a loud noise and the video suddenly switches to them! Another issue to deal with is microphones rubbing on things or otherwise picking up ambient noise (you can mute people if required).

As mentioned previously, running online meetings where you are on camera takes a bit of getting used to. During the first few meetings people felt very self-conscious and awkward and found
it hard to treat it as a “normal” meeting. After a few weeks of using it people become used to it and it became a more natural part of our roles. Another factor that became apparent was the ability to schedule online meetings at short notice and at times that were more convenient than face-to-face meetings. Friday afternoon meetings were scheduled then primarily because we were all available to travel into the main campus at that time. Now we hold Team Leader meetings on Tuesday mornings when we are much more awake and productive! We have also arranged several short notice meetings with all or some Team Leaders to cover urgent issues that arise.

5. Cost reductions
The cost of face-to-face meetings for businesses can be high (one estimate of $7 billion a year in the pharmaceutical industry [1]. In our case the costs are not massive, but they are still significant, especially in the time taken for travel. When we hold face to face Team Leader meetings, each person can claim petrol costs for the travel to and from the meeting as per IRD’s guidelines. For one meeting this cost was approximately $86 (Table 1). Travel time and disruption could also account for up to one hour either side of the actual meeting.

<table>
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<th>Return Distance</th>
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<tr>
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6. Other Useful Lync Features
Lync software allows one-to-one calls, many-to-many calls and online meetings. During meetings you can allow remote access to your desktop. It is also integrated into Outlook so you can check a person’s availability based on their Outlook calendar. If someone is busy they show as red, if they are available they show as green and if they are away from the keyboard (“inactive”) they show as yellow. While this might make some readers think of this being used to monitor your work activity to ensure you are working, in practice it is useful in determining how you interact with other staff. If I need to contact someone urgently, I can see at a glance if they are available and then either give them a call or go to their office or if they are unavailable, write them an email or make other arrangements. For outside participants or staff working from home, there is a freely available Lync has a web app that allows them to join in a meeting.

7. Sharing
Lync allows the meeting owner (or caller in one-to-one calls) to share their desktop and even allow the remote person to control the environment. This can be useful in meetings when another person is discussing a document that they have produced or when you are showing/helping someone with a feature or program that they need assistance with. An example of this is when I might be the meeting owner, but another member of staff wants to discuss a new process. I would call up the document on my screen and then allow the other person control of my computer. They can then take the meeting participants through the document and scroll through the pages, zoom in and out and highlight particular items. They are also able to edit the document based on discussion feedback.

8. What not to do with Lync
Lync video calls/meetings are not quite like “being there” in a face-to-face meeting. For this reason it can be hard at times to judge the mood of a meeting and to determine how other people in the meeting are feeling. We have tried a couple of Lync meetings where contentious issues were discussed and the outcome was that we needed to have a follow up face-to-face meeting to resolve the issues. Why? Because, with Lync calls (current version), you only see the person talking at the time. If person A says something that persons B and C do not like, then you cannot see how they are reacting and facial expressions can sometimes be misunderstood. If two or more people get into an animated discussion about something, it can be difficult to hear and see everything that is going on. Another issue is that people like to interrupt and cut in on others when they are talking. This is not in an attempt to shut them out of a conversation as it often occurs in brainstorming sessions where everyone is actively contributing to get ideas out. Because of variable connection speeds sometimes video and audio will pause or cut out so you might miss a part of a conversation. Essentially Lync meetings/conversations work better when the participants talk one at a time –this is not easy for smart, active thinkers.

CPIT has two main campuses and a number of staff travel between them for meetings. Greater use of Lync’s online meeting features could reduce travel times and cost and potentially allow for more, rather than less, communication between them.

9. Future Focus
Lync 2013 has some new features with the ability to see all members of a meeting and the ability to connect with Skype users. The Skype connection may enable online connections with other stakeholders

10. Conclusion
Lync is a useful tool that has allowed for flexibility in organizing our business communications, for easily checking availability of staff and for sharing and discussing ideas at a distance. Using an online meeting/collaboration tool such as Lync can save costs and time and increase flexibility in communicating at a distance. More research, reading and discussion into making effective use of Lync needs to be undertaken with the aim to encourage other staff at CPIT to look at the possibilities of using Lync in their day to day work.

11. REFERENCES
Wordle – Visualising Student Feedback

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ABSTRACT
How can student evaluation survey responses be used to create engaging and meaningful feedback to the stakeholders? Analysing and displaying trends in large numbers of comments from student evaluation surveys can be problematic. Wordle provides one solution by producing word clouds based on text strings. The ability to quickly, easily and freely produce word clouds from large numbers of student responses enables fast analysis of text and visually interesting and attractive posters to stimulate conversation. Backed up by quantitative data, Wordle provides a powerful, rapid, and visually engaging method of displaying text based data. We have used this to analyse student feedback comments and present them to staff during Performance Evaluation Reviews (PER).

Categories and Subject Descriptors
H.6.1 [Project and People Management]: Staffing

General Terms

Keywords
Wordle, online, images, content, analysis, student course evaluation surveys, pictograms, research tools, qualitative, quantitative, word clouds

1. INTRODUCTION
CPIT Campus Connect runs a community based Computing for Free programme that includes ACE computer courses (Adult and Community funded) and the National Certificates in Computing at both Level 2 and 3. Computing for Free averages around 6000 enrolments per year across approximately 2000 individual students. The programmes are offered in a self-paced environment, where students book themselves into two or more classes per week and their learning is supported by Facilitators. At the end of each course, students have the opportunity to provide feedback in the form of an online survey. The survey engine provides charts of the numeric data and the comments from the students can be downloaded as a .csv file. At the end of each term we review the comments from the students looking for any common themes, issues and also for the things that they value and gain from completing their courses with us. Each year CPIT conducts a Performance Evaluation Review (PER) and student feedback from the online survey is analysed and presented to give their perspective on how we are doing. With many hundreds of individual comments answering several different questions, how can we possibly summarize that amount of data into meaningful information? It turns out, that there is a way to do this using an online tool called Wordle.

2. HOW DOES IT WORK?
To quote the Wordle creator [1]:
Wordle is a toy for generating “word clouds” from text that you provide. The clouds give greater prominence to words that appear more frequently in the source text. You can tweak your clouds with different fonts, layouts, and color schemes. The images you create with Wordle are yours to use however you like. You can print them out, or save them to the Wordle gallery to share with your friends.

3. HOW DID I USE WORDLES?
For our PER, I gave a presentation using PowerPoint that included a number of Wordles generated from our student survey (1151 responses). The overall feedback from our students is that they are satisfied or highly satisfied with the service that we provide. The Wordle images allowed me to convey that message in powerful way to the people at the PER - many of whom were unfamiliar with Campus Connect and its students. Along with the Wordle images, I included quantitative data from the student course evaluation survey and specific quotes to highlight both what students valued and what they did not value in our learning environment. Without the Wordle images, it would have been much harder to present that information to the audience.

This poster paper appeared at the 4th annual conference of Computing and Information Technology Research and Education New Zealand (CITRENEZ2013) incorporating the 26th Annual Conference of the National Advisory Committee on Computing Qualifications, Hamilton, New Zealand, October 6-9, 2013. Mike Lopez and Michael Verhaart, (Eds).
4. HOW EFFECTIVE ARE WORDLES?
In a word "very". The word cloud generated for the question "Do you have any comments you would like to make about our enrolment process?" generated this Wordle.

![Figure 1 - Wordle image generated from a student survey question on the enrolment process](image1)

As you can see it is a positive "image" of how students find our enrolment process (1151 number of student responses). Words like "easy", "helpful", "fast" are good indicators of a positive and efficient enrolment process.

As you can see the word cloud for the question "Would you like to make any comments about the Facilitators?" also gives a positive response. Words like "helpful", "patient", friendly, great, always indicate a positive experience for the students and that they feel supported and encouraged in their learning.

![Figure 2 – Wordle of question 15 Feedback on Facilitators](image2)

Wordle clouds can also be manipulated by grouping synonyms to emphasize patterns of response. Figure 3 shows a Wordle image that has the words “learning” and “Learning.”

![Figure 3 – Wordle generated from “What have you found most valuable about this course?” comments](image3)

You can remove some words or make all words upper or lower case. In the image below this would have added all the occurrences of “learning” and “Learning” together, increasing its prominence. By default Wordle removes common words e.g. “a”, “the” etc. It can also be used to look at outlier comments, ones made by a few students, to uncover other perceptions. This can be done by removing the most frequent words and their synonyms and making a new cloud.

5. SUPPORTING EVIDENCE.
In addition to the comments, we have quantitative questions such as “How do you rate the service provided by our Facilitators?” (Figure 4). The answers use a four or five point Likert-type scale, and are used to substantiate responses. McNaught and Lam (2010) also suggest that Wordle is a useful tool for preliminary analysis and validation of previous findings when used in conjunction with other research tools.

![Figure 4 – Question 13 Student rating of Facilitator assistance as an example of quantitative supporting evidence for the Wordle images](image4)

6. GENERATING DISCUSSION USING WORDLE
Wordle is an excellent tool for generating discussion on an evaluative or reflective forum. PER meetings can sometimes be stymied as stakeholders, including the facilitators themselves, are not always ready or willing to start a discussion. Presenting a Wordle image is a good way to kick off and sustain a discussion. For example in the Wordle image generated for the question on the enrolment process (Figure 1), I started the conversation by saying that our students found the process “easy”. From there we discussed why this was the case (fast process, few hold ups for the student, little paperwork).

7. CONCLUSION
Wordle is a powerful, easy to use and useful tool and I encourage others to consider it (or other similar tools) as part of their analysis of student course feedback to stimulate evaluation, reflection and discussion on the findings. It can be used to motivate discussion on emerging themes and to visualise quantitative data. In writing this poster, I also found other word cloud tools (such as Text is Beautiful) which warrant further investigation. For example the website Text is Beautiful generates concept clouds using linked text concepts rather than word frequencies.

8. ACKNOWLEDGMENTS
Our thanks to Jonathon Feinberg for developing the Wordle tool and making it freely available.

9. REFERENCES
ABSTRACT
This paper discusses various data models. The prominent data models like Entity Relationship (ER) and Unified Modelling Language (UML) have industry standards. Various other types of data cannot adopt ER and UML models. Hence there is a need for another type of data modelling. The different systems and the relevant data models are discussed. There is a need for data interoperability for sharing data with various systems or devices. Possible solutions in this direction are discussed. Finally the relevance of these data models to IT education is discussed.

1. INTRODUCTION
Information Systems consist of data from operational transactions that are managed and used for decision making. Data is stored in a database as a data model which describes the type of data and its organisation. Data modelling is important because a good data model offers significant savings in coding cost, data reusability, scalability and performance. It can model the business requirements. The most common data models are Entity Relationship (ER) and Unified Modelling Language (UML).

2. ER and UML
ER models became dominant in the 1990s with relational databases. Earlier, flat files were used. UML, too, is gaining popularity as it models data and related processes. Object-oriented databases can be implemented from UML. Although the object-oriented programming languages are prominent, the back-end databases are still relational. Thus, ER and UML are the main data models. However, there is a requirement for data models for various other systems. Smart phones have the capability of processing data, including complex spatial data. Businesses also want to store huge data, like from video surveillance, which is termed as big data. Earlier, these topics were discussed in academic research. They are now being used in business information systems. ER and UML cannot model the complexity of these types of data.

3. OTHER DATA MODELS
Various data models are discussed in academia and some are used in industry. There is need for further research in this area. Concepts like data warehousing and data sharing over the Internet have gained industry standards. Emerging data models which evolved from academic research are now a reality with advancement in technologies like smart phones.

3.1 Data Warehousing
Data warehouses date back to the 1990s. In a data warehouse, data models like star schema will collate and aggregate operational data in data marts which are easy to query and offer improved performance [10].

3.2 Extensible Markup Language (XML)
With the advent of the Internet, client computers can send and receive data between applications. XML defines data in a well-defined structure. XML-based protocols like SOAP and WSDL are used by web services to support the exchange of data and have industry standards from W3C.

3.3 Geographic Information Systems (GIS)
GIS involves storing and analysing spatial data. Today most smart phones have GPS with location based applications. Spatial data has distinct position defining attributes and relationship to each other attributes. Location, temporality, complex, thematic, fuzzy are some of the characteristics of spatial data. Conceptual data
models like rasters and vectors are commonly used, while there are others, like networks and triangulated irregular networks.

3.4 Mobile Databases
Advancement in portable and wireless technology has led to mobile computing involving data communications and processing. Some of the challenges from distributed databases like data management, transaction management and database recovery are seen in mobile databases [1]. The challenges here are of limited wireless connectivity and changing topology of the network. The architecture needs to address these issues.

3.5 Multimedia Databases
Multimedia data comprising text, images, video and audio need a data model with constructs that allow a user to specify links. These links will have large descriptions associated with them [1]. Further research is required in this direction.

3.6 Big Data
Companies like Intel, Google and Wal-Mart have petabytes of data. Such huge data needs to be economically stored with high processing speed. There are ethical issues to be considered where consumer behaviour is identified from purchasing trends and employees’ performance is monitored in the workplace. Privacy issues need to be taken care of while modelling this type of data.

Data governance practices are currently being considered by organizations to manage data at economical levels under three categories: structure, operational and relational [11]. Data ownership and legal standards for protecting and using data are covered under structure. Operational covers policies regarding retention, backup, recovery and migration. Relational practices include educating users and non-IT managers.

Although new technologies pose challenges for data models, data and their applications are now spread across various devices and there is a need for data convergence and/or sharing. Cloud based solutions are used to store data in a central location. With the growth of the semantic web, GIS, mobile data and big data there is a need to share data between different systems. Data interoperability could solve the issue of using data at various locations.

4. DATA INTEROPERABILITY
In order to use data in another system, metadata are required. Schema definition languages like XML schema, SQL–DDL, RDF and ontologies are different ways to achieve this [5]. However this is not easily achieved and there are operational issues. Various XML standards used in Business to Business (B2B) interoperability were discussed by Lampathaki et al [7]. The Clio project [3] provided algorithms to map data from source schema to the target schema. Such declarative schema mappings have been used in related research in the past [2, 8].

Kataria and Juric [6] researched semantic technology to retrieve data from heterogeneous sources. Their solution was building layers of ontology to manage semantic heterogeneities. Ontologies are a promising technique to get data schema from various systems. They can give the semantic meaning of various terms which could relate to the target attribute.

The concept of ontology has been used in artificial intelligence. It is now being used to represent domain knowledge for different disciplines. Google, Twitter and Facebook are also adopting the ontologies concept. Amazon uses it to classify categories. Researchers like Nikolov and Motta [9] surveyed available ontologies to link it to a new repository.

5. Data Modelling in IT Programmes
Students in Whitireia IT programmes are taught data models like ER and UML at undergraduate level. XML is taught in programming and web application development papers. The concept of other data models for various other systems can be taught to Post Graduate students. A Level 8 paper called Data Modelling will cover the various traditional and emerging data models providing students with a wide knowledge of the latest developments in this field.

6. Conclusion
Existing and emerging data models were discussed in this paper and their relevance at undergraduate and post graduate levels was stated.

7. ACKNOWLEDGMENTS
Special thanks to first author’s supervisors for instilling the concepts of data models and data interoperability.

8. REFERENCES
11 Tallon, P. P. 2013. Corporate governance of big data: Perspectives on value, risk and cost, Computer, IEEE Computer Society, 46(6), 32-3
ABSTRACT
Assistive Technology is being used to enhance the care of elderly people. This paper introduces describes an Android application developed by the authors as part of the assisted living research projects at Wintec. The application allows a care-giver (carer) to check the wellness of their service user(s) at regular intervals. With user permission, information can be sent and stored on the cloud and Short Message Service (SMS) messages sent to a carer if needed. Basic testing of the application functionality is completed.

Categories and Subject Descriptors
K.3.1 [Computers and Education]:

General Terms
Design, Human Factors, Experimentation

Keywords
Assistive technology, cloud computing, mobile applications, Android, elderly care, disabled care, alerts.

1. INTRODUCTION
The term Assisted Living (AL) relates to Information and Communication Technology (ICT) used to help people who wish to have their daily living requirements monitored by a ‘Carer’. There are some challenges that need to be taken into account [7] but it is deemed beneficial.

The authors have started a series of AL projects that use some of the latest developments in technologies, particularly cloud computing, mobile devices and sensors, with the aim to find cost effective solutions and useable products. Though there are specialised solutions available, the long term goal at Wintec is to provide a range of solutions that people can choose from. These projects also focus on technology that can be bought ‘off-the-shelf’ and are affordable. One of these AL projects is the ‘Are you ok?’ (RUOK) android application.

2. APPLICATION DEVELOPED
The original idea was suggested to the authors at a ‘Choice in Community Living’ forum in Hamilton. It was raised that in some cases wearing a medical alert/alarm bracelet in public was not ideal, and an application on a mobile phone which can easily be attached to a wheelchair would be preferred.

A prototype application called “Are you OK?” (RUOK) has been developed for an Android smartphone (Figure 1). It triggers an alert dialog box at regular intervals set by the user. The user can select ‘yes’ or ‘no’ to indicate if they are well or not. If ‘no’ is selected, an SMS message is sent to a carer’s mobile phone if defined by the user. If the user misses an alert, a notification dialog box is shown, displaying the number of alerts consecutively missed and prompting the user to answer when they next check the phone. If three or more alerts are missed then an SMS is automatically sent to the carer. This value of three can be changed by the user to a convenient value. There is also an ‘Alert’ button that immediately sends an SMS to a carer. Menu items used to configure various parameter are also provided. User data can be filtered based on a device id number that is automatically detected by the application and sent to the GAE as ‘readingValue’.

3. THE CLOUD
Initially Microsoft Azure was used successfully. However the Google app engine (GAE) database which is free of cost for less than 1GB of data per day [1] is a more cost-effective solution at present. Application data is recorded on the phone’s micro secure digital (SD) card and sent to the cloud if Wi-Fi or 3G is enabled by the user. RUOK will prompt the user and direct them to the appropriate settings if not enabled.

Data is sent to the GAE when the user clicks ‘yes’, ‘no’, the ‘alert’ button, every time an alert has been missed and when an alert has been retracted. The application also records the date and
time that each application was started or stopped on the GAE. Figure 3 captures an example of data received by the GAE.

4. ETHICAL CONSIDERATIONS
There are concerns that technology which monitors people can be intrusive [3]. Some propose that data should only leave the customer’s premises with user consent [4, 5].

The RUOK application takes this into consideration allowing users to specifically enable Wi-Fi/3G before data is sent to the GAE. If the user chooses not to connect to the Internet the data will only be recorded locally on the phone’s SD card. However once enabled it does not prompt the user every time a piece of data is sent to the GAE as this is impractical. There could be an issue if the user does not want to send data to the GAE but does use 3G or Wi-Fi on their phone for other applications.

5. POSSIBLE ISSUES
If the phone’s battery is not charged regularly the phone may automatically turn off, unaware to the user. Cellular coverage is also required and depending on the users location this may be an issue e.g. in some rural areas. There is reasonable coverage in most New Zealand cities [2]. In addition, the carer’s phone also needs be working, with battery charge and cellular coverage.

Assistive technologies are an additional support and it would not be wise to rely on them completely. It is recommended that carers contact their clients regularly as well. However AL will hopefully reduce some of the carer’s workload.

6. FUTURE WORK
The application needs to be tested over a longer period of time to ensure that that the application retains its current state, values and functionality over time.

Testing the application with an elderly or disabled person and experienced carers would give more insight into what features would be beneficial in a real-life setting. The authors are in conversation with the Community Living Trust in Hamilton and there is a possibility of real-life testing later this year. Each person is unique and needs are widespread, however there may be specific cases identified which could be targeted.

A feature that is already being developed is the application’s ability to record GPS location information. This would only be activated when the user enables GPS on their phone.

7. CONCLUSIONS
There are research and commercial products that use Android applications for elderly healthcare. The ‘Are you OK?’ application developed by the authors appears to have unique functionality. Short term testing indicated that the application was largely working as expected and all errors discovered have now been addressed. However long-term and real-life user testing will give more insight as to whether additional features are required to make the application commercially viable.

8. REFERENCES
Local Government ICT Portfolio Management

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ABSTRACT

The ONE DCC ICT Portfolio Optimisation Process - IPOP has addressed the problem of projects with little or no value entering the portfolio. This improved process which has been in use since June, results in an Optimised Portfolio which benefits the Council with projected savings of $37,440 and an increase in Portfolio value of 20% ($400,000).

Keywords

Project management, portfolio, local government, capstone

1. INTRODUCTION

The Business Information Service (BIS) department of the Dunedin City Council (DCC) require a system to select an Optimal Portfolio from competing projects. Information Technology Portfolio selection is an integral decision in many organisations. It must make justifiable and informed decisions on investments where the effective application of limited resources is as essential as the process itself.

This paper discusses the implementation of a structured framework for IT Portfolio selection through a decision support system (DSS). This is called the Information Technology Portfolio Optimisation Process (IPOP).

The DCC Mission statement is: To be one of the world’s great small cities; we will be a city of connected people, cohesive communities and quality lifestyle. Strategic Management at the highest levels in the council namely the Councillors and the CEO set this mission to provide a sense of direction for both internal and external stakeholders. The aim of the CEO, CFO and CIO (collectively named the C-suite) is to operate and manoeuvre the Council with mission and vision in mind.

The Dunedin City Council (DCC) is a Municipality comprising over six hundred staff; it is responsible for the local governance to the Dunedin City Area of a total of approximately 120,000 residents. The area of the organization that handles all things Information Technological is the Business Information Services (BIS). The BIS is experiencing pressure from various sources, both internal and external to “Do more for less” and to be more effective with what they do have.

With an increased awareness of spending and a limited amount of resources to work with, the BIS have more Projects requested than resources to accommodate them which is a big problem for them. If BIS has 60 project requests in a yearly budget cycle then they have $^{60} (11,529,215 \times 10^{11})$ possible project selection choices, of which most are not optimal; but is a large amount never the less. The problem can be coupled with conflicting strategic management priorities, dictating projects and priorities to BIS. These projects sometimes referred to as “Pet” or “Squeaky Wheel” projects, where the loudest or most noticed project gets priority and valuable Portfolio resources, thus resulting in not doing the most important projects, ending up in a less effective Portfolio.

Project portfolio selection is a periodic activity that’s objective is to meet company’s objective without violating constraints such as budget and time. The successful application of selecting a project portfolio results in an increase in value added to the organisation, efficient use of resources, higher project completion rate and higher staff morale from “Doing the right projects” instead of just “completing them”.

2. Technical Highlights

The One DCC project has addressed the problem of projects with little or no value entering the BIS portfolio, this improved process results in an optimal portfolio which benefits the Council with better decision making capabilities, saving time and money.
The process used (IPOP) was created through an iterative collaboration and supervision with two senior staff at BIS, where the understanding the problem space changed and narrowed with time into a strong and robust process which could be rolled out to solve any general project portfolio optimisation.

The ICT Portfolio Optimisation Process (IPOP) starts with the Requestor, this is a Council employee, it could be from any council functional business unit like Parks and Recreation, Roading, Museums or Libraries etc.

The Requestor wants a project undertaken and submits a business case, the business case is structured in a way to ensure they have their supervisors sponsorship this ensures accountability. If the Requestor can’t finish the business case for various reasons some of which can be things like not having all the required information, the Requestor sends a partially filled out or fully filled out business case to BIS.

BIS receive the business case and if incomplete they Communicate with the Requestor to finish the business case. Once the business case is completed, BIS undertakes a Review of the business case to make sure it is accurate and paints a realistic view of the need or opportunity for needing a project in the first place. The Review is where BIS Collaborate with the Requestor to alter the business case to reflect the most accurate picture and Verify its contents to make sure it doesn’t contain any false information.

Once BIS have finished its Review and Verification, it submits the business case for a Cost Benefit Analysis (CBA) check, the reason for this is to be a first stage cull where projects with costs outweighing there benefits don’t progress to the potential portfolio. With business cases with a positive CBA check moving forward to the pool of passed projects, at this point whether passed or not, feedback should be given to the Requestor.

Once in the pool the decision makers can view the contents of these projects, this affords the decision maker not having to go through potentially up to 100 business cases. The portfolio optimizes the projects by maximizing the value and keeping within certain constraints like budget and hours.

The Decision makers have the optimal portfolio and should have the ability to mix the portfolio to see different scenarios, the final decision is up to the decision makers but with staff view open on the portfolio any large deviations should have to be justified, this ensure transparency and accountability by making the process as visible as possible.
ABSTRACT
Software testing is important to the software industry, with over 50% of the cost of managing the software lifecycle spent on test and quality assurance, yet it receives little attention in universities and polytechnics. This poster paper identifies the gap between industry demand and technology education and outlines a postgraduate (Level 8) course offering that is exclusively devoted to software quality assurance and testing.

Categories and Subject Descriptors
K.3.1 [Computers and Education]

General Terms
Reliability, Verification.

Keywords
Software testing, postgraduate courses.

1. INTRODUCTION
Software testing is an important and critical activity in delivering quality software products. It is needed continuously at every stage of development and deployment and costs over 50% of software management cost, yet it receives little attention in universities and polytechnics.

In 2002, a study conducted by the National Institute of Standards and Technology reported that software bugs cost the US economy an estimated $59.5 billion annually and that more than a third of that cost could have been saved by improved software testing [6]. Recent software-related problems that have caused many social problems and financial losses are largely due to lack of testing. It is expected that software testing will play an even more vital role, as software complexity and related legal complications increase [4].

2. STATE OF PRACTICE
Myers [3] identified attitude (psychology) and economics as major obstacles to software testing. Besides attitude, testers must also have superior technical skills. Whittaker [5] also confirms the need for testers to have technical sophistication with good development skills (coding skills) and knowledge of formal languages, algorithms, decision tables and graphics. Harrison [1] has acknowledged that software testing requires two different attitudes – that of a developer as well as a tester. This means that for software engineering students to become good developers or testers, they must acquire the necessary knowledge, skills and attitudes.

According to Osterweil [4], technical approaches to testing have been widely published, yet the gap between research and industry practice show the need for improvement in both development and testing disciplines. Whittaker [5] suggested that software testing research should be less academic and more practical to better satisfy industry demand. Finally, educators should equip students with these skills and attitudes to deal effectively with software quality concerns.

3. QUALITY ASSURANCE COURSES
Whitireia Community Polytechnic has a software quality assurance component embedded in a level 5 introductory programming courses. However, there has been no course offered separately at a higher level. The intention is to deliver a software quality assurance course at Level 8 to emphasize software testing in depth.

The need for highly skilled IT personnel has been widely discussed over the past few years. However, a discussion about the need for software testing skills has not been touched on. In fact, the need for software testers and their special skills has been discussed in industry, but very little attempt has been made by the universities and polytechnics to deal with this issue. In New Zealand, level 6 courses are provided by Unitec [2] and by Weltec, and it seems that no other level 8 quality assurance and testing courses are offered at universities and polytechnics.

4. THE PROPOSED LEVEL 8 COURSE
The proposed course will focus on providing students with in-depth understanding of the methodologies and techniques used in software testing and quality assurance. The contents will mainly focus on methodologies and techniques of software testing and...
quality assurance, software metrics and software quality improvements.

The IT industry needs software testing practitioners, and researchers should lay the foundation for best practice of software testing [6]. Therefore, the contents will focus on covering technical aspects with a research perspective. The assessments will be designed to cover both aspects and teach students two approaches – an industry approach and research approach.

The assessments will be designed to align with the following learning outcomes:

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Critically evaluate methodologies and techniques used in software testing and quality assurance.</td>
<td>Literature review on methodologies and techniques used in software testing and quality assurance.</td>
</tr>
<tr>
<td>2. Analyse software testing techniques and select optimal solutions for different types of projects.</td>
<td>Research report on suitability of particular software testing techniques for different types of projects.</td>
</tr>
<tr>
<td>3. Apply suitable software testing techniques and quality assurance methodologies to a specific project.</td>
<td>Report and presentation on the application of suitable software testing techniques and quality assurance methodologies to a particular project.</td>
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</tbody>
</table>

The assessments were designed to focus on testing strategy, tactics and metrics for different project environments. The purpose of these assessments is to understand particular software testing techniques and their suitability for different types of project. This involves developing a test plan, executing that plan on the given system, reporting the results of these tests, and recommending the changes needed to correct the errors found in the system.

5. CONCLUSION

The preferred approach to teaching software testing is to integrate testing experiences into the curriculum to provide students with an appreciation of the practice of software testing as part of their education experience. The course will also be designed to guide the students (who have acquired a basic set of testing skills from their undergraduate courses) to advance their testing and quality assurance knowledge. The course will focus on methodologies, techniques and principles that can be taught as essential software skills that will serve as a sound basis for expansion over their future career.

The approach presented in this poster paper, while not comprehensive, deals with important aspects of both the practice and research dimensions of software testing at a postgraduate level (Level 8).

6. REFERENCES

Student Mistakes in Introductory Programming: Sample Problems
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ABSTRACT
Learning to program is a challenging task for novice learners. This study aimed to investigate students’ concepts as they were being formed. To capture these, we chose to focus on students who made some mistakes in basic concepts. Our study sought to capture students’ conceptions at a very early stage in their study: five weeks into an introductory programming course. We invited students who did not pass an early mastery test at their first attempt to participate in a diagnostic and remedial session. In this paper we look at a sample of the original problems given to these students and an analysis of the number of questions incorrectly answered by each of the students that failed the early mastery test.

Categories and Subject Descriptors
K.3.2 [Computer and Information Science Education]: Computer Science Education – programming misconceptions and mistakes.

General Terms
Human Factors.

Keywords
Misconceptions, alternative conceptions, novice programming, programming mistakes.

1. INTRODUCTION
Learning to program is a challenging task for novice learners [2]. Beginning programmers need to master a wide range of concepts [1] and consequently, it is not surprising that many wide scale studies have found that novices are struggling at the early stage of this learning process.

The present research takes its starting point from a phenomenographic study on novice students’ understanding of the concepts object and class [2]. This poster gives a visual perception and a quantitative view of the results gathered so far. We believe that it is important to recognise the types of mistakes that students make at an early stage of their learning so that remedial action can be taken as soon as possible to allow students to develop robust program code and apply “best practice” to the design of the solutions to problems.

2. METHOD
In the first five weeks of the course, the Scratch programming language is used in tutorial sessions to introduce fundamental concepts that underpin programming: variables, sequence, selection, repetition, recursion, and message passing. At the end of this segment, students take a test which assesses their ability to trace and analyse code. The test has six questions; for each question, the student has to indicate the correct output of a short program. Students are expected to carry out hand execution (by way of formalised desk checks taught during the first five weeks of the course) of the code to determine this output.

We approached the students who did not pass the test at their first attempt and invited them to participate in a diagnostic and remedial session. All students chose to participate in this session. Members of the teaching team were assigned to students and worked with them on a one-to-one basis. The assigned teaching team member reviewed the student’s test answers with the student and asked the student to demonstrate how they carried out the desk-checking tasks that gave rise to the answer they had submitted.

One of the six questions is shown below:
What is the output of the code?

```plaintext
when  randint(0, 4)
set numbers to 4
set count to 0
repeat until count = 4
set count to 0
repeat until count2 = 3
say number for 2 secs
change count by 1
change number by 1
stop script
```

Choose one answer.

- a. 1 1 2 2
- b. 1 2 2
- c. 1 2
- d. 1 1 2 3 3

![Figure 1: Example Question](image)

### 3. FINDINGS

In this section we present an analysis of all six students’ results from the original test and an analysis of the results of the four students who sat the resit test. (C = Correct and I = Incorrect).

<table>
<thead>
<tr>
<th>Student</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>Q6</th>
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</table>

### 4. DISCUSSION

How a student attributes the reason for lack of success is important because it affects the student’s motivation to remedy the lack of success by engaging in further learning. For example, an attribution to luck which is external and uncontrollable would create little motivation to learn. Similarly, an attribution to internal stable factors such as personality would create little motivation. However, all of the students attributed the reason for their lack of success to an internal locus of control, believed that the outcome could be modified, and believed that this was under their control. This combination suggests that the application of remedial techniques could be effective and supports the approach of offering students who did not succeed on their first attempt the option of attending a diagnostic session with subsequent remedial instruction.

A student is also affected by their motivation for the subject. For example one of the students has a previous degree outside the computing field and was doing the course to develop their understanding of computing rather than to gain accreditation. They has not yet decided on further study. A second student subsequently chose a study path leading to a major in Information Systems, while a third student chose a study path leading to a major in Software Engineering.

### 5. CONCLUSION

We found that the technique of inviting students who do not succeed in a test to participate in an in-depth diagnostic interview and one-on-one remedial instruction was useful, even though no major misconceptions were identified. Indeed, we found that the lack of success in the test was attributable more to application of process than to conceptual misunderstandings or alternative conceptions. However, our diagnostic interviews focused closely on performance in the test and it is possible that a more broadly focused interview would have discovered alternative conceptions.

We plan to continue to explore and refine the use of this technique. In particular, we will use a broader approach in our diagnostic interviews to attempt to elicit alternative conceptions.

### 6. REFERENCES


ABSTRACT
How can technology affect narrative structures? I hypothesize that with all types of media a language develops through which this media communicates. To demonstrate this I consider the way motion graphic techniques have altered narrative structures. I describe motion graphics as a hybrid medium that utilises design and formal content to communicate graphical, moving image solutions. This project is an investigation of how a film that sits between motion graphics and dominant cinema (another hybrid medium) may work. In order to understand how the motion graphic film story will best communicate, I needed to explore the relationships between what motion graphics is (its form) and how it works (its function). This investigation follows, what technology can do to moving image footage. I source examples of work demonstrating how this has evolved and seek to explain and find new directions through theory and practice.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education

General Terms
Design, Experimentation, Human Factors, Theory, Documentation Languages.

Keywords
Motion graphics, Hybrid medium, Motion graphic design, Moving image design, new narrative structures

1. ANALYSIS OF EXISTING WORK
Through analysis of definitions and descriptions of what motion graphics is, I have considered its potential in relation to storytelling. I considered techniques such as paint-on, multiple layers, typography, time-remapping, symbols, animation, and a whole range of effects in the development of my screen play.

However, as research has revealed, the motion graphic film will be dependent on far more than computer generated techniques. This project has used some areas of film theory to consider how narrative systems are currently functioning within existing works.

I have engaged in interplay with other media as a means of conceptual development of my motion graphic film. Then I continued to develop my ideas through storyboarding and later tests. If motion graphics utilises design and formal content to communicate graphical, moving image solutions, we must reconsider how a story could develop that would sit between something that is style-centred, but has a story structure that accommodates some form of plot, and themes. The answer will likely reside in a multi-layered narrative system that employs techniques found within Soviet montage theory.

2. MODELS
I began with an interpretational method of investigation of the motion graphic film, I then developed models to support how the narrative may shift in function as it develops. These models include: a timeline of fine art techniques from which motion graphics very likely evolved, a description of principles from Soviet montage theory and the application of McLuhan’s tetrad to consider the negatives and positive of the influence of this new media.

3. PROCESS
These ways of thinking guided me as I conceptualised, storyboarded, work-shopped and scripted my screenplay. A significant realisation was that throughout its existence, motion graphics has demonstrated a conceptual form of communication that has in recent times sometimes been presented through visual structures. I developed a specialised script structure to support my layering of ideas. This supported the development of my multilayered screenplay and sits somewhere between a style-based and a conventional form.

As I worked my final model emerged. It describes a narrative system including three dominant spheres, through which strands of narrative could weave. The first sphere relates to gestalt theory, particularly the concept of closure. We make our audiences fill the gaps. The second, comes from the discipline of semiotics and relates to the concepts of denotation and connotation, the idea being that one strand dominates whilst the others provide richness and broader associations. The third sphere relates to Eisenstein’s third meaning and is demonstrated in the films I studied. It is the concept that idea A plus idea B equals new idea C. Because these concepts work both narratively they help support ideas relating to both the style-based and the story-based narrative systems. I used
the principles from this model to guide my ideas as I workshopped, storyboarded, filmed and finally as I enter the postproduction phase. This model should support motion graphic designers and filmmakers with what I consider to be the greatest challenge: resolving the problems associated with the layering of content and effectively communicating through interweaving simultaneous narrative lines.

4. TESTS
Finally I developed some tests and briefly evaluated them. They lead toward a small test sequence clip. This clip demonstrates the mood and concept of my story. It also shows a range of the film techniques discussed in Soviet montage theory. This rough little test demonstrated to me the potential of Soviet montage techniques within the motion graphic film. I see this project and the clip as a beginning, not as an end. There is much more I would like to explore. Nevertheless it had become apparent that the greatest challenge for film makers and designers using graphic techniques to tell stories is going to be resolving the problems associated with the layering of content and effectively communicating through interweaving simultaneous narrative lines. For motion graphics to bridge the gap between content and form, all elements must be essential to the narrative, emotive stylistically or otherwise.

5. FUTURES
Through a cross-pollination of the disciplines design and film, I have placed motion graphics in a greater theoretical context. For me this is a foundation on which to build. I look forward to finishing my film.
ABSTRACT
The Peace Foundation has identified a need for an interactive tool to complement their Cool Schools programme, which is aimed at primary school students to learn skills required to confront and solve their problems in everyday life. The team have developed a computer game that aids in the teaching of problem solving skills. The game has been available on www.pandaisland.co.nz since 27th of September 2012 and has been used by students from primary schools throughout New Zealand.

Keywords
Conflict resolution, gamification, capstone

1. INTRODUCTION
The Peace Foundation has identified a need for an interactive tool to complement their Cool Schools programme, which is aimed at primary school students to learn skills required to confront and solve their problems in everyday life. The team have developed a computer game that aids in the teaching of problem solving skills. The game has been used by students from primary schools throughout New Zealand.

Panda Island used an iterative, agile approach which consisted of three iterations: conceptual, functional delivery and robust delivery. The use of this methodology allowed for constant client communication and input, ensuring functional requirements match the client’s requests. Panda Island’s interaction design was focused on user testing feedback along with common game principals found through research.

The software architecture of the project took advantage of several open source Java libraries which allowed for an extendable and easily modifiable game engine. The XML system created for the Panda Island engine takes advantage of the engines extendibility and allows for instant content updates.

Feedback from testing has also reinforced the effectiveness of the deployed system. The game is ready to be included in the Peace Foundation’s ‘Cool Schools’ programme. There is room for future improvements but so far it is proving to have a positive effect on students using it.

The Peace Foundation addresses the problem of conflict resolution and attempts to teach primary and high school students the skills to resolve their conflicts peacefully. Their method for this is to teach a select few students in each school how to mediate conflicts between two parties. These students are called peer mediators and are there to help once a conflict has arisen in an effort to resolve it peacefully. The issue with this is that only a few students, the peer mediators, know the skills to deal with conflict peacefully.

2. GAMIFICATION FOR TEACHING
The term gamification denotes the use of video games for non-game applications; during the last several years the use of video games as a teaching tool has become more acceptable and has demonstrated the ability to capture the attention of students more effectively than the use of traditional methods such as pen and paper. Why digital gaming, simulations, and social networking? Simply put, these technologies afford us the ability to convey concepts in new ways that would otherwise not be possible, efficient, or effective, with other instructional methods. In other words, these technologies don’t just help us teach the old stuff in new ways – they can also help us teach new stuff in new ways.

Gaming is already a widespread activity in our culture — more than 45 million homes have video-game consoles. It seems only natural that using it to teach would be effective given its high attraction.

Our solution to the client’s problem is a game which teaches techniques for solving conflict/problems in the real world. Panda Island is an interactive teaching aid in the form of a game which reinforces the learning of conflict resolution skills in an enjoyable way for all students. Previously this problem has been addressed using non digital media such as brochures and training seminars. The functional requirements for this project have been met with extras added to future proof the product. Each aspect of the game improves on the functionality of the game and the end user experience. The use of ‘gamification’ to engage students and teach them peer mediation skills shows as a technical achievement. The cross platform product also allows for any user
to enjoy this game, built in Operating System detection makes sure every school can use this software without a hassle. To further ensure the products on-going use an update web-side system makes sure the product keeps up to date with the client’s current material.

3. Platform/Technology Justification

During the initial planning it was determined that a game would be the best way to convey the information from The Peace Foundation’s Cool Schools programme to a larger audience. The client used Mac OSX, so it had to work on that, most computers run windows which meant that the game had to be cross platform. A requirement from the client was that the game was able to be easily scaled and extended to meet future needs. Right from the beginning the team focused on a modular design of the game engines which allows game engines to be removed or created without affecting the rest of the game.

### 3.1 Game Engine

Panda Island consists mainly of engines and entities. The main controlling class, engine room, is responsible for controlling and passing information to each engine. Each engine/entity consists of a lot of built in methods which make it quick and easy to create new screens/games. The use of XML allows for extendibility however its use for controlling what NPC’s do isn’t as nice as it could have been, had a dedicated scripting engine been implemented from the start. The Panda Island game engine controls the loading of resources from the XML system, the audio system and keeps track of all progress the player makes within the game. The engine also uses its online update system to grab the latest quiz questions and answers from the webserver.

**FR1 - The System shall teach skills used in conflict resolution**

Panda Island makes use of quiz ‘minigames’ to teach conflict resolution skills, the player is taught the correct answer if they answer the question incorrectly.

**FR2 – The system shall inform users of different personalities**

Both the quizzes and a few NPCs (Non Playable Characters) teach the player about different personality types. When the player interacts with various NPCs they are informed of a particular personality type e.g. The Fox.

**FR3 – The system shall be cross platform**

Panda Island is programmed in java, a cross platform runtime environment, and has been tested on Windows, Mac OSX and Linux.

**FR4 – The system shall record the users’ progress**

Panda Island automatically saves the users’ progress when they enter and exit a ‘minigame’ which prevents any data loss. There are also options to save and load a player’s progress in the menu.

**FR5 – The system shall provide customised user profiles**

Panda Island allows the user to name their profile/save. This name will also be used on their automatically generated certificate of completion.

**FR6 – The system shall have unlockable content**

Panda Island uses boat parts as an incentive to play through the game, you unlock boat parts by completing ‘minigames’. Players can use these boat parts to build a boat and race against NPCs.

**FR7 – The system shall have customizable content**

Panda Island through the use of XML allows for new characters and events to be added, as well as content to be changed without having to recompile the source code. The client wanted to be able to alter the questions of each quiz, to make this possible we created an easy to use web interface from which the game downloads the XML for each quiz when it launches. Ensuring that the game always has the latest content.

### 3.2 Technical Highlights

#### 3.2.1 Created an extendable game engine

Panda Island’s game engine is made up of the best parts of two LWJGL based game engines, Slick2D and MarteEngine. The adaptation of these engines allows for easy creation of multiple ‘minigames’ to be run within the main game engine.

#### 3.2.2 OS Detection

Although Java is designed for wide cross platform support, some parts of Java, such as path detection and the way that graphics are rendered differ per platform. While LWJGL attempts to handle some elements of this Java shortfall, the team had to adapt the game engines to handle these differences as well. Panda Island has been engineered to run under Microsoft Windows and Apple Mac OS X, but also runs under most common Linux distributions.

#### 3.2.3 Active Listening

The team has managed to create a digital model of the active listening concept, without using sound. Feedback is provided throughout the game; players can choose to use or ignore this feedback, but from research, to encourage the use of this feedback, a viewport has been added to parts of the game, to obstruct the view of the player, this restricts the visual feedback, making the player resort to other sensors to navigate; it has been noted that players very quickly work out that the feedback makes the game much easier to play, so adapt to utilise this feedback.

#### 3.2.4 XML Content Management

Extensible Mark-up Language has been used to handle all the interactive objects contained within the game. This allows for rapid update of game elements as well as providing an easy system for a non-developer to change the content of the “minigames”.

#### 3.2.5 Web Management

A requirement that the Peace Foundation came up with late in the second iteration was that they require the ability to change the game content as their material changes. Since XML was already being used to store this content, a system was created using a PHP server to make changes to XML files. Each time the game launches, it checks the website for new game content and updates the values that are stored in the game.
ABSTRACT
In this paper, we describe the process we went through in creating the EcoExplore framework and in implementing the NZ Marine Metre Squared mobile application from this framework. We also demonstrated the ease at which a new application can be rapidly produced from our framework by implementing the PestWatch mobile application.

Keywords
Citizen Science, mobile, capstone

1. INTRODUCTION
EcoExplore is a flexible and scalable framework built to be a foundation for mobile applications that aim to engage members of the public in the exploration of the natural environments of New Zealand, and enable sharing of their discoveries. The NZ Marine Metre Squared application is an implementation of the EcoExplore framework we developed for the New Zealand Marine Studies Centre that enables members of the public to contribute organism population data, view trends in this data and overall learn more about the marine environment. At the end of development we implemented PestWatch using the EcoExplore framework, an application that focuses on enabling the community to track invasive species in New Zealand. It took a total of seven and a half hours to develop this new application that addressed a new problem space. Three and a half hours were spent on the configuration of the application; the remaining four hours were spent on data sourcing and data entry. This successfully demonstrated how rapidly a new application, that satisfied a new problem space, could be developed from the EcoExplore framework.

2. INTERACTION DESIGN
Imagine this: You and the family are down at the beach exploring the rock pools when the kids discover an interesting looking crab you haven’t seen before. The kids want to learn more about what they’ve found so you take out your smart phone, open the NZ Marine Metre Squared application, and use the Rocky Shore Guide to identify the species. Within moments you have learnt the organisms name and classification, about its feeding and breeding behaviors and that many others, like yourself, have discovered these interesting looking crabs in your area. You also decide to share you finding with the NZ Marine Metre Squared community knowing that your contribution will help in building up a profile of that organism’s population and that area’s ecology.

The above scenario describes one possible use of EcoExplore. The EcoExplore citizen science application is multi-faceted: a visual field guide; helping your family contribute to discussions; enabling contribution to science through collection of field data; and helping your family formulate scientific questions – developing a healthy curiosity and a community level science programme.

The original concept of the EcoExplore application was designed to engage visitors to the Otago Peninsula in the exploration of the rocky shore by contributing their findings in a consistent format to a single project, the NZ Marine Metre Squared project. In order to provide a tool for the NZ Marine Metre Squared project our application was divided into the EcoExplore framework and an implementation of that framework, the NZ Marine Metre Squared mobile application.

To ensure EcoExplore truly was framework we developed it so it would be easy to plug in new organism datasets and to configure the application to offer different functionalities. We also developed it so that new ways to collect organism population data, as well as new ways to report trends in this data could be developed and easily implemented.
At the end of development we demonstrated the flexibility of the EcoExplore framework and how rapidly a new application with new goals could be produced from the framework by implementing PestWatch, an application that focuses on enabling the community to track invasive species in New Zealand.

3. CITIZEN SCIENCE
The project was aimed to bring the scientific community and the public together in collaboration by enabling participants to record, share and discuss observations and questions while also facilitating the collection of scientific data.

The concept of citizen science, members of the public participating in the large scale collection of scientific data, has been used by many mobile applications to encourage the exploration of natural environments, but few have facilitated true collaboration between the public and the scientific community [1, 2]. EcoExplore is then more than a database of rocky shore plants and animals.

4. PLATFORM
EcoExplore was built as a native iOS application. This was client preference, but also to allow core application functions to be accessible offline. A separate database was developed to push information to the mobile application.

The deployed EcoExplore in the Metre Squared project contains species identification (Fig 1a), data collection (Fig 1b), and user driven data analysis (Figs 1c & 1d). The analysis screens show dynamic trends in populations of organisms using the data collected from users. The parameters of the mapping of abundance and diversity are easily selected by the user. Unfortunately (despite being functional), the deployed EcoExplore in the Metre Squared project does not contain the ability for users to create projects. To demonstrate this functionality, Figure 2 shows PestWatch, a demonstration application that focused on enabling the community to track invasive species in New Zealand.

5. REFERENCES
BUSINESS CONTINUITY AND THE CLOUD

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ABSTRACT
This paper seeks to examine the concepts of Business Continuity Management, Disaster Recovery and Cloud Computing. It explains the theory behind each of these concepts and attempts to show how they are or can be related. The paper shows that business continuity management and disaster recovery are related insofar as disaster recovery is a subset of business continuity management practice. The paper relates cloud computing to disaster recovery and business continuity management by examining the implication, benefits and risks of adopting cloud computing from a continuity standpoint. This is considered from two sub-perspectives: issues in continuity management for cloud computing from a continuity standpoint. This is considered from examining the implication, benefits and risks of adopting cloud computing from an organisational perspective, are caused by human error, 39% by power failure, but only 9% are related to natural disasters. ICT systems are vulnerable to a large number of possible “continuity incidents”. These incidents can be man-made or naturally occurring, and can originate internally or externally to the organisation. They range from natural disaster to hacking and data theft.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education – collaborative learning, computer-assisted instruction (CAI), computer-managed instruction (CMI), distance learning.

General Terms
Management, Documentation, Performance, Economics, Reliability.

Keywords

1. INTRODUCTION
An organisation’s Information and Communications Technology (ICT) infrastructure is now one of its most important assets. The prolonged failure of ICT systems or the extensive loss of data can determine whether an organisation is able to continue to operate with the same level of success, or continue to operate at all [2]. Organisations now rely on ICT systems to carry out tasks that were traditionally manual, meaning that even short periods of downtime can be disproportionately damaging [11]. These tasks range from the traditionally IT based, such as accounting functions to the traditionally analogue, such as telephony and customer communications. ICT systems are now integral to many, if not all, of the business processes in many organisations [6]. This means that any ICT failure can have effects that spread throughout an organisation. The external parties that an organisation has dealings with, such as its customer, vendors and shareholders, all have expectations of organisational continuity. ICT disruption can have serious continuity consequences and these consequences can damage the organisation by affecting its relationship with external stakeholders [6]. Brandabur [5] argues that the current economic climate has led firms to look for accurate and reliable valuation data, to attempt to cut costs and to seek competitive advantage. These are areas in which ICT can be valuable, and as such ICT has become of even greater importance to organisations. Furthermore, the importance of ICT is borne out by the finding that some 90% of organisations that lose data in a disaster close within two years [2].

2. BUSINESS CONTINUITY: AN OVERVIEW
The critical and vulnerable nature of ICT systems means that their preservation and continued operation in adverse conditions is essential to an organisation’s efforts to remain viable. Business Continuity Management (BCM) and Business Continuity Planning (BCP) -the terms are frequently used interchangeably- attempt to provide organisations with the tools and concepts to enable this.

2.1 Possible Continuity Incidents
The broadness of possible causes of continuity incidents is illustrated in the literature. It identifies, at the very least, the following:

- Naturally occurring: events such as hurricanes, floods, earthquakes, wildfires, heat waves, blizzards and epidemics [8] [2]
- Man-made: crime, conflict, embargo, blockade, war, terrorism, sabotage, poor training, data destruction, data integrity, data security, transportation accidents and the like [10] [2]

The man-made causes can be further broken down into internal and external threats. Threats like arson and embargo usually result from actors external to the organisation, whereas human-error related threats, such as poor training leading to data loss, frequently come from within. External threats can be further broken down into conflict and non-conflict types [10]. Conflict types include war and war-like circumstances as well as riots, extreme political change or strikes. Non-conflict types include economic issues, corruption, attacks on reputation and so on.
Al Badi et al [2] report that 43% of disasters, as defined from an organisational perspective, are caused by human error, 39% by power failure, but only 9% are related to natural disasters. ICT systems are vulnerable to a large number of possible “continuity incidents”. These incidents can be man-made or naturally occurring, and can originate internally or externally to the organisation. They range from natural disaster to hacking and data theft.

This poster paper appeared at the 4th annual conference of Computing and Information Technology Research and Education New Zealand (CITRENZ2013) incorporating the 26th Annual Conference of the National Advisory Committee on Computing Qualifications, Hamilton, New Zealand, October 6-9, 2013. Mike Lopez and Michael Verhaart, (Eds).
3. THE CLOUD AS A BUSINESS CONTINUITY TOOL

The intention of this paper is to consider the suitability issues surrounding the use of cloud computing as a business continuity tool. As such it is important to gain an understanding of what we mean by “cloud computing” and what the key concepts are.

3.1 Definition

Even a cursory examination of the extant literature will reveal a large number of definitions for the term “cloud computing”. A number of these are presented below:

- “the essential characteristics of cloud computing: on-demand self-service, broad-network access, resource pooling, rapid elasticity, and measured service” [1]
- “both the applications delivered as services over the internet and the hardware and systems in the data centres that provide those services” [3]
- “a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” [9]
- “Cloud computing is the use of computing resources, hardware as well as software, that are delivered as a service through a network, typically the Internet” [7]

3.2 Cloud Computing Benefits

Wood et al identify a number of benefits of using the cloud for Disaster Recovery [11]. Cost savings may accrue for applications that require only warm site levels of functionality. Applications that only require a loose Recovery Point Objective will accrue even greater savings. Cost savings may be realized through the pay-as-you-go model, with the elasticity of the cloud meaning that users can gain access to and pay for resources only as they need them, rather than traditional models that involve provisioning for the greatest expected load [11]. It may also lead to lower management and maintenance costs, with these functions being handled externally by the cloud provider.

Adoption of cloud services for everyday functions may have the benefit of “warming” any recovery site that an organisation may need. By utilizing cloud administration applications, such as word processing and email services, an organisation may be able to maintain the appearance of “business as usual” despite being forced from their regular premises by a localized event like a fire. It is possible that many operations could continue with as little as a computer and internet connection, allowing the organisation to at least maintain contact with stakeholders.

Many large organisations already use thin clients and data centres to gain cost advantages. The expansion of cloud services has the potential to spread this to smaller organisations, not only reducing their capital costs but reducing the cost of continuity by necessitating the replacement of much less expensive equipment.

The cheapest way to utilize the cloud for DR/BC is simply to use it for data backup. Backup can be done to local drives, and then these drives can be mirrored to cloud storage. This is especially useful if the disaster situation is a localized one, and not a region-wide situation. The procedure can also be automated, and done at off-peak hours, at no extra labour cost [4].

Furthermore, organisations may be able to generally reduce their RTOs through the ability to rapidly provision in the face to mounting needs. If a live local server is affected they may be able to rapidly, if not automatically, failover to a cloud service that already contains their backed-up data, rendering their RTO mere minutes.

4. CONCLUSION

Cloud computing is, briefly, the provision of computing resources via the internet. These resources can be provided on a private or public basis, or a combination thereof. A number of benefits and risks are argued to accrue from cloud computing adoption. The benefits range from cost reduction to management effort simplification. The risks encompass issues from performance to security to data lock-in. These risks and benefits have significant consequences for business continuity planning.

5. REFERENCES

Private Cloud: A Teaching Case for a Multi-campus Systems Administration Course

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ABSTRACT
This paper describes a private cloud system that centrally manages and runs virtual machines in protected environments. The approach attempts to address some of the limitations of teaching degree-level systems administration course using VMs running on individual lab desktop computers. The system enables the possibility for every student to learn and simulate operating environments similar to those of real-life works. The result is a high performance and availability system that has flexible and scalable configurations to support management and isolation of VMs environments in a multi-campus setting. It also enables alternative students’ progress monitoring and eases submission logistics.

Categories and Subject Descriptors

General Terms
Design, Experimentation.

Keywords
Teaching systems administration; virtual machine; VMware; private cloud; centralised system.

1. INTRODUCTION
Teaching a degree-level systems administration course in a way that provides students with real-life work experiences is important, giving them the first-hand experience and skill set required to move successfully into the systems administration role. It is especially useful in the current cloud-computing and virtualisation driven environment. However, it is often impractical and expensive to set aside computers and network devices for individual students for this course in a tertiary environment. As a result, the use of virtual machines (VMs) running on individual lab computers is now very common. Nonetheless, this approach has some limitations, which may include reduced computer availability, lack of computing power, difficulty in monitoring students’ progress and tedious submission logistics. Teaching staff would tend to accommodate these by altering the ways they assess students work. This situation also potentially denies students the opportunity to gain the first-hand experience they need to move successfully into a systems administration role.

This paper describes a design of a private cloud system that centrally manages and runs VMs in protected environments. The approach attempts to address some of the limitations of teaching the course using VMs running on individual lab desktop computers. The design aims to enable use of the system by students in multi-campus setting. The course’s current semester is still ongoing, therefore no final conclusions could be drawn yet for the moment.

2. METHODOLOGY
2.1 The Infrastructure
The institution has 338 IBM blades (hosts) that together formed a High Performance Computing Center (HPCC) that provides the potential for more than 2000 GHz of processing power and 2.6 terabytes of volatile memory. In this private cloud system design, a total of 42 hosts were used and installed with VMware ESXi. More hosts could be added should demand for higher processing power arises. Local disk drives and iSCSI NAS were used across all hosts to store VM files.

41 hosts were used to run students’ VMs, with 8 VMs assigned to each student. One remaining host was dedicated to run 3 VMs. First VM had VMware vCenter Server (vCenter server) installed for management and access control of all other hosts, with Microsoft Windows 2008 Server as the base operating system (OS). Second VM had Remote Desktop Protocol (RDP) server and VMware vSphere Client software (vSphere client) installed to give remote desktop access and to connect to vCenter server, respectively, with Microsoft Windows 2008 Server as the base OS. Third VM had pfSense server installed to act as router for all students’ VMs, with FreeBSD as the base OS.
2.2 Connection Design

The RDP server was set as the central contact point for all connections between the VMs and students’ client computers, accessed through RDP thin-clients. This created a single-point incoming access management configuration that helped to simplify network isolation. Remote sessions from RDP thin-clients to RDP server could be established either directly from the Faculty’s local area network or via Faculty’s Secure Shell (SSH) tunnel connection over the Internet. Once connected to the RDS server, students could launch vSphere client from within the remote session to connect to vCenter server to gain control over their assigned VMs.

The pfSense server was logically positioned in the middle of all other VMs in the system, routing data traffics between hosts, vCenter server, RDP server and all students’ VMs. This created a single-point data traffic management. With 1 of its virtual network adapters (vNICs) listening to all Virtual Local Area Network (VLAN) tags (trunk mode), it enabled easier VLAN data traffics routing and DHCP assignment, if needed.

The logical configuration of the private cloud system is shown in Figure 1 below.

![Logical configuration of the private cloud system](image)

**Figure 1. Logical configuration of the private cloud system, showing relationship between different nodes within and outside of the system.**

VMs operations, such as client OS installation would need to be done directly through this vSphere client. However, access to installed and running client OSs may be done via RDP connection or web browser, whichever supported by the installed client OSs.

2.3 Network Isolation

Each student’s set of VMs were grouped to 2 unique VLAN tags, one acted as a test environment using 3 VMs and another was used to simulate a production environment using 5 VMs. This resulted in a large overall operating environment with many VLANs. This setup enabled configurations in such a way that students from one campus could use the system concurrently with students from other campuses without network interference.

2.4 Unified Access Permission

There was a two-stage logon process for students to gain access to their assigned VMs to perform OSs installation and configuration, i.e. to RDP server and vCenter server. An additional initial logon to an SSH tunnel was required when connecting from the Internet. Unified logon accounts unique to each individual student were created across SSH tunnel, RDP server and vCenter server using Microsoft Powershell scripts.

2.5 Logon Recording

A logon recording tool was installed to record students’ logon activities to find indication whether students took advantage of the system access availability to continue to work outside of class time. The tool ran each time a student logged-on to the system.

2.6 Submission and Marking

On the first day of class, all students enrolled to the course in the current semester were given their access accounts and informed about the access methods, general system configurations and the presence of the logon recording tool. Students were given a set of lab class exercises to be worked on using their 3 VMs as a test environment, and a set of assignment tasks to be worked on using their 5 VMs as a production environment.

At the end of the course, on the due date of assignment tasks, all accesses to SSH tunnel, RDP server and vCenter server will be disabled to prevent students from making any further changes to their assigned VMs. Teaching staff will access students’ VMs directly and mark their work, no longer relying on screen-shots, portable media submissions or the time-consuming challenge of marking “on the spot” in class time.

3. CONCLUSION

The course is still ongoing, and no final conclusions could be drawn yet from this study at the moment. In the interim, the study found that all VMs assigned to students ran successfully. Every student was able to run concurrently all 8 VMs assigned to them, and was working on assignment tasks using the VMs as intended. Current entries retrieved from server logs indicate that students continued to access the system after class time, including occasional access in the weekends and at nights. At the end of the course, when students complete assignment tasks, it is hopeful that accessing and marking students’ VMs directly will simplify submission logistics.
ABSTRACT
Whitireia New Zealand was one of the few polytechnics to retain Level two uncontestable funding, as there was still some money available we were tasked to develop a Level two course which we could access this funding. This poster looks at the creation, the structure, first iteration of the course challenges and successes.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education – collaborative learning, computer-assisted instruction (CAI), computer-managed instruction (CMI),

Keywords
Level 2 NCC, Programming, Hardware, Applications, Internet, Android, Odroid,

1. INTRODUCTION
Whitireia New Zealand was one of the few polytechnics to retain TEC Level two uncontestable funding, as there was still some money available we were tasked to come up with a Level two course which we could access this funding. The idea was to run a Level two National Certificate in Computing [1] but not the standard NCC which is more geared towards end user products and office systems based. With the uncontestable funding this is a free course for those who do not have any qualification at level two.

2. THE EXPERIMENT BEGINS
One of the academic staff, Sue Chard, had an Odroid device [3] at home as a media centre and liked the idea of students using this as a learning tool due to the higher use of android devices currently on the market. Geoff was tasked at finding a suitable device to fulfil the needs required to meet the criteria. So the ODroidU2 device was the preferred device the specifications of these devices were

- ULTRA COMPACT 1.7GHz QUAD-CORE BOARD
- 2GByte Memory
- Full metal enclosure
- 10/100Mbp Ethernet with RJ-45 LAN Jack
- Android and Ubuntu
- PCB Size : 48 x 52 mm
- Other accessories consisted of a WIFI module, HDMI cable, keyboard and mouse

3. COURSE STRUCTURE
We looked at Level two certificate requirements and then broke down the appropriate units to fit with the development of the new certificate. The standards were matched with the idea of going through a development process style course. The length of the course was twelve weeks and was broken into four blocks

- Hardware/Operating Systems
- Applications
- Internet
- Programming

The students must do literacy and numeracy (LLN) at the start and finish as per all NZQA unit standard requirements certificates Level one – three, followed by introduction to the devices setting up and basic use of the devices loading operating systems making the Odroid operational. The next stage was to load and use applications followed by Internet applications creation and searching and using the sound and visual capabilities. Lastly they had to create android programs using APPInventor [2] a block building program created by Massachusetts Institute of Technology (MIT) used to create .apk programs. MIT also had a series of resources geared towards development.
4. CHALLENGES
There were several challenges that we had for the first iteration of the course:

First the majority of courses we run are above level five, so it was getting our heads around unit standards again as some staff had some knowledge this was used.

Second the time limit to get this course up and running within a short timeframe which included the various Boards of Study and Academic Board approval.

Third getting enough students to make it viable.

Fourth finding staff to run course.

Fifth without advertising we started with nine students.

5. SUCCESSES
Four of the five students who completed the course have enrolled in the Certificate of Information Technology. One of the other bonuses was the successful students could buy the devices they had built, three student took this opportunity. The other success was that existing students wanted to do the course

6. CONCLUSION
Overall this is a successful experiment at creating a course with modern technology which also has a pathway for students into higher level courses. The students built a device from scratch into a working android device with a working knowledge of different applications and also building applications from scratch to be used on any android device. So this experiment in the view of the author was a success and the second iteration has started with 12 students.

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2. MIT APPInventor, Android Block Retrieved on 15 Sep 2013 from http://appinventor.mit.edu/
ABSTRACT
On 24 June, 2011, US President Barack Obama announced the National Robotics Initiative with a budget of $US70 million. This initiative focuses on developing robots that work with or beside people to extend or augment human capabilities, taking advantage of the different strengths of humans and robots.

Categories and Subject Descriptors
I.2.9 [Computing Methodologies]: Robotics – Commercial robots and applications, Kinematics and dynamics, Manipulators, Operator interfaces, Propelling mechanisms, Sensors, Workcell organisation and planning

General Terms
Performance, Design, Human Factors, Autonomous, Humanoid.

Keywords
Robotics, Autonomous Humanoid robots, National Robotics Initiative, Geminoid

1. INTRODUCTION
Often when we think of robots, we think of the popular imagery of our youth – C-3PO & R2D2 (“Star Wars”), Robby (“Does not compute!” from “Lost in Space”), The Terminator, and Robocop. They almost always had two arms and two legs, a torso, and a metallic head (see Photo 1). Real world robots, however, have largely failed to live up to these expectations. Factory assembly arms and planetary rovers (see Photo 2), although designed for work that is either highly dangerous to humans or require a high level of technical work, are a far cry from the Asimovian androids like Sonny in Asimov’s I, Robot (see Photo 3), that we had come to hope for [7].

Photos 1, 2 and 3 – from left to right – “Star Wars” characters R2D2 and C-3PO, a planetary rover, and Sonny the robot from Asimov’s I, “Robot”.

2. THE NEW INITIATIVE
The purpose of the National Robotics Initiative (NRI) program is to develop the next generation of robotics, to advance the capability and usability of robots, and to encourage existing and new communities to focus on new and innovative areas for the use of robots. The initiative is to address the whole life cycle from basic research and development to manufacturing and deployment. Developers are to particularly carry out the research required to gain a better understanding of the long term social, behavioural and economic implications of robots across all areas of human activity [4].

3. THE PROBLEM
While roboticists have had considerable leaps forward in near-humanoid robotic development, such as Honda’s ASIMO robot that employs a breath-taking array of sensors to detect and respond to external stimuli (Honda, 2013), people and robots just don’t seem to mix, according to UK roboticists Dr Tony Belpaeme [cited in 7] According to Belpaeme, robots still have trouble assessing and responding to human’s behaviour and humans feel uncomfortable around robots. Describing a project he has been working on in a children’s ward in a hospital in Milan, Belpaeme says that although children are less discerning of the robots’ structure, adults are more sensitive to their build and would only briefly see them as entertaining, then recognize them...
as machines [6]. Roboticists call this problem, or phenomenon, the “uncanny valley” (See Figure 1) –

![Figure 1: The uncanny valley is the region of negative emotional response towards robots that seem "almost human". Movement amplifies the emotional response.](image)

the hypothesis, created by Japanese roboticist Masahiro Mori, which holds that when robotic or animated human features look and move almost, but not exactly, like natural human beings, it causes a response of revulsion among human observers. If an “entity” (robot) looks sufficiently nonhuman, its human characteristics will be noticeable, generating empathy. However, if the “entity” (robot) looks almost human, the nonhuman characteristics will be noticeable, giving the human viewer a sense of strangeness. A robot stuck inside the “uncanny valley” is no longer being judged by the standards of a robot doing a passable job at pretending to be human, but is instead being judged by the standards of a human doing a terrible job at acting like a normal person [8].

4. HYPER-REALISM

Professor Hiroshi Ishiguro, director of the Intelligent Robotics Laboratory, at the Department of Systems Innovation in the Graduate School of Engineering Science at Osaka University in Japan, made a robot, called a Geminoid, that was a direct copy of himself in 2005 [2]. This was soon followed by two more – a female made by Ishiguro as a copy of a young 20-something woman; the other was constructed to look exactly like Associate Professor Henrik Scharfe of Aalborg University in Denmark and built by Ishiguro along with Japanese company Kokoro in 2011 [1]. All these Geminoids (see Photo 4), as Ishiguro calls them, have been built to test his theories of “emotional affordances” in human-robot interaction, as well as to study the perception of robots between different cultures [5].

5. CHALLENGING THE “OLD” THINK

Hanson [3] experimented with real-looking robots against real people subjects (only the faces of the robots were visible – “heads on a stick”) and a range of facial expressions were tested. Two robots were used in the test - “Eva” and “The Pirate” (see Photo 5). 73% found both robots appealing, 0% said that the humanoid robots disturbed them and 85% said the robots looked lively – showing no sign of the repulsion that defined Mori’s uncanny valley – that Ishiguro is taking into account in his modern work. According to Hanson, there no longer appears to be any valley.

![Photo 5: Eva and “The Pirate” - the Hanson humanoid robots](image)

Hanson believes that is it important to push the science of the art as well as the art of the science. He further believes that for realistic robots to be appealing to people, robots must attain some level of social responsiveness and aesthetic refinement – and integration of artificial intelligence, robotic engineering and art.

6. CONCLUSIONS

In Hanson’s experiments, the robots clearly demonstrated that realistic robots can be seen by humans as appealing. This conclusion maintains that rendering the social human in all possible detail into the robot can help us to better understand social intelligence, both scientifically and artistically – and fully comply with the National Robotics Initiative.

7. REFERENCES


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ABSTRACT
This poster describes my recent internship at Herbert Harrison and Associates. It shows an overview of the company, my role within the company, and what I have learned from working there.

Keywords
IT, Hardware, Software, EIT, PC Repair, PHP

1. INTRODUCTION
I have been working as a part-time employee for Herbert Harrison and Associates since February 2012, and will continue being an employee after this internship. I am also an EIT student finishing a Bachelor in Computing Systems at the time this is written. HH&A is a small IT business operating in Havelock North. They deal with computer and printer repair, CakePHP applications, commercial on-site repairs, computer and component sales, and IT consultancy. This internship has been a good way for me to structure my workplace training, and to realise what I have learned and still need to learn over the course of my career.

2. COMPANY POLICY
Herbert Harrison and Associates operate on a mainly ‘Open Source’ policy [1]. As a result most of the computer systems we use in the shop and for the internet café are Linux-based, and the applications that we develop use open-source plug-ins and platforms. We also operate on a ‘We specialise in everything’ policy, which means my work colleagues are experts in very diverse fields. As a result, HH&A operates as three separate businesses running out of the same premises, providing the partners in the business with social contact and different approaches to problem solving. Test bench repairs, sales, and the internet café are the only truly shared responsibilities.

3. AREAS OF IMPROVEMENT
Over the course of the internship, my role has been to identify business practices of HH&A and also identify areas of improvement for the company.

The CakePHP ERP system that I am working on currently is a major upgrade for our invoicing and customer/job database that will result in a more usable, faster, and upgradable system. We also have a POS (Point of Sale) system for in-shop sales but it does not require upgrading at this stage.

Another area of improvement that I have identified is a lack of cross-training on specialised jobs. In other words, if a specialised job is required and the specialist is away on holiday, the customer normally has to wait for them to get back. I am attempting to get training on as many specialised jobs as possible so that I can cover for them if need be, which also allows us to do more jobs.

The final area that I have identified for improvement is that for our business to grow we need more customers. The problem is that with the current downturn younger clients tend to be strapped for cash, and since we are not in a prominent position in the shopping centre of Havelock North, we rely on traditional forms of advertisement. We are growing slowly and in specialised areas.

4. FINDINGS AND CONCLUSION
My role in HH&A is to cover the shop as needed, help grow the company, train to be a better employee, and improve the systems to be more user-friendly. The experience I gain from upgrading our ERP system will also go towards me doing more work for Justin (our programmer) doing CakePHP for major clients.

The internship is a way for EIT to gain feedback on the initial experience of BCS graduates in the workplace as well as a way for interns to solidify their learning and gain industry experience. I have been very lucky to get a job in a business that deals with a wide variety of IT issues, and I think this has been a very good internship for any EIT final year BCS student to do.

From the perspective of HH&A they will get an improved ERP system and other employees will also be able to take on more work, while having more time for their families.

5. REFERENCES

This poster paper appeared at the 4th annual conference of Computing and Information Technology Research and Education New Zealand (CITRENZ 2013) incorporating the 26th Annual Conference of the National Advisory Committee on Computing Qualifications, Hamilton, New Zealand, October 6-9, 2013. Mike Lopez and Michael Verhaart, (Eds).
ABSTRACT
The cloud represents for computing an area of extraordinary growth, both in terms of uptake from organisations wishing to offload some of their computing services and in terms of the expansion in the range of services available. As a result, it is important that students encounter the technologies and environments associated with the Cloud. This poster outlines a basic approach for offering a practical course in cloud services, specifically the intersection of public and private cloud environments and how these can be best managed with available tools and strategies.

Categories and Subject Descriptors
K.3 [Computers and Education]: Computer and Information Science Education - computer science education, curriculum, information systems education.

General Terms

Keywords
Cloud computing, teaching resources, private cloud, public cloud.

1. INTRODUCTION
The Department of Computing at the Christchurch Polytechnic Institute of Technology (CPIT) will offer a new course on cloud computing in the first semester of 2014 called "Cloud Services". This is a response to the rapid proliferation and expansion of cloud-based offerings and graduates needing to be informed of this vital area of computing. The challenge for teaching staff is how best to introduce students to the topic and provide them with a meaningful experience of these technologies. The course covers two main cloud options: the private cloud and the public cloud [1]. Each of these cloud options provides a different perspective on how organisations might utilise cloud computing, both now and in the future.

While offering students choices allows them to take greater responsibility for their learning, teaching staff must also ensure the choices offered will ultimately lead to a favourable outcome. To this end it has been decided to only allow choice from a selected range. If students decide that they wanted to pursue an option outside the offered range, teaching staff would have to carefully consider that option in a one-off basis.

2. CLOUD COMPUTING AT OTHER INSTITUTIONS IN NZ
A number of New Zealand universities currently offer courses that contain elements of cloud computing, but these focus on security. For instance Waikato University offers a 2014 course titled "COMP427/527 Cloud Computing Technologies and Security" [2]. Other institutions may teach some cloud computing but again it is done in relation to security, for instance Canterbury University offers "COSC 421: Special Topic: Advanced Topics in Security" [3] and University of Otago offers "INF0393 - Computer Security" [4]. There is more to the cloud than security and while this is critically important, it is ultimately just one aspect of this form of computing. Outside of the universities there are a number of vendor driven cloud computing courses delivered by institutes of technology and polytechnics [5] and private training establishments [6].

3. REQUIREMENTS
The Cloud Services course focuses on the major constraints related to virtualisation, networking, and storage. The choice of private cloud platform is limited to some extent by the hardware available. The teaching network at the Department of Computing at CPIT called TechLabs makes desktop-based virtualisation available to students, and this demands powerful hardware. One of the computer suites has machines with 32 GB of RAM and quad core Xeon CPUs. They run Windows 7 as their operating system and VMware Workstation 9 for the virtualisation software.

In addition to the hardware virtualisation requirements, shared networking and storage is also important. The network infrastructure, with its support for virtual LANs, enables students to work in groups and share their environments. TechLabs
switching equipment can be configured to accommodate the cloud computing course.

Along with the sharing of their machines, the sharing of their data allows students to be separated from the actual workstations and allow their virtual machines to be more easily shared between workstations. It is expected that new computers will be purchased in 2014 and machines of equal or more powerful configuration will be available. Any choice of platform for the private cloud will have to work within the constraints of the environment.

As for the public cloud choice, the main consideration is cost. As an academic institution, teaching staff have to be mindful of cost as public cloud offerings can be expensive if its use is not properly monitored.

4. POSSIBLE CLOUD CHOICES

Within the limitations outlined in section 3, the choices of platform for students in 2014 will be:

4.1 Private cloud computing
VMware Workstation allows guests to run their own hypervisor due to the feature. This feature allows VMware Workstation to host the following hypervisors: VMware’s ESXi, Microsoft’s Hyper-V, Citrix’s XenServer, and open source project KVM. The ability of VMware Workstation to host these hypervisors allows a number of private cloud solutions to be supported within the TechLabs environment.

The private cloud solutions that would be offered to students are VMware’s vCloud Director (which uses the ESXi hypervisor), Microsoft’s Private Cloud (which uses the Hyper-V hypervisor), and OpenStack (which can use all the hypervisors supported by VMware Workstation).

4.2 Public cloud computing
Students will be given the choice of three major public cloud computing providers: Microsoft’s Azure platform, HP Public Cloud and the Amazon Web Services (AWS)). While other platforms exist, Azure, HP Public Cloud, and AWS are attractive options because each offer academic programmes and/or free trials, allowing tertiary education access to free (but limited) use of resources [7] [8] [9]. Google also have a comprehensive offering but at present there is no academic pricing plan.

5. POSSIBLE PROJECT CHOICES

The project work on private cloud integral to the course will require students to explore the use of cloud technologies and automate the management of traditional infrastructure services such as file and print, identity, network administration, database and hosted applications. It will also focus on provisioning environments for testing and development by teams internal to the organisation.

The project work on the public cloud will focus on the types of deployments that organisations typically perform, from hybrid infrastructure to hosting elastic public facing services. The course will also involve transitioning from an in-house application to the cloud and that it involves.

6. CONCLUSIONS

There is little doubt that present and future graduates will encounter and interact with cloud computing in some form or other. The course provides students with an experience of different platforms and the range of possibilities of how this paradigm shift will affect their working lives. This involves the current interplay between public and private clouds and their actual and potential role in business. Moreover, as a level 7 course it contains an element of critical evaluation and comparison, not just in terms of functionality but also in terms of flexibility, scalability and cost.

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ABSTRACT
This paper reports on a project carried out at CPIT in Christchurch to investigate the set of processes involved in converting an idea or concept into a solid object. After the initial thought, an appropriate file for interpretation by 3D printer is created, followed by inputting that file to a suitable printer which then fabricates the required solid, three-dimensional object. The poster shows a schematic that documents an ordered approach to tackle practical issues found while recording the procedures. Those that have been noted either appear to impede progress or affect the quality of the required, expected outcome. In the next phase, suggestions for improving the smooth transition and improving quality will be made.

Keywords 3D Printing, Process Documentation, Quality.

1. INTRODUCTION
This poster describes a process improvement project being conducted by a third-year Bachelor of Information and Communications Technology (BICT) student in the Department of Computing at CPIT. 3D printing has its roots in Stereolithography (SLA), a process patented in 1988. Typically it now refers to the direct fabrication of physical products from a drawing made using Computer Aided Design (CAD) software. Specialised software effectively slices the model into thin layers that are interpreted by the printer to create the finished object one layer at a time.

Three-D printing is as diverse as the human imagination. Printer capability is rapidly increasing while costs are reducing as economies of scale become evident. Using high fidelity prototyping, the traditionally expensive and impractical production of optical elements, for example, is also now more affordable [6]. Surgeons can order human body replacements for surgical implants; architects can easily show their 2D plans as solid buildings, interior designers can print fittings and furniture, (see Fig 2), cabinet-makers can trial special handles and light industry can develop parts either to use without modification or else for subsequent mass-manufacturing. [3] 3D printing can also make ecological sense - the additive process involved results in significantly less material wastage than traditional manufacturing techniques. [1]

Since the manufacturing process is “additive”, often extruding a thermoplastic material through a nozzle, it builds the required object upward, in slices, from a flat surface. Conventional manufacturing methods contrast with this since the process typically works the other way around; a regular block of material with cuboid dimensions is the starting point and material is removed until the required shape remains. Machining processes are severely limited by physical access to the block, so if complex shapes are required they are often made in pieces that are subsequently fixed together. The many advantages are not without
a new set of problems, however. One problem is that as the hot
substrate cools, it shrinks and distorts in often unpredictable and
undesirable ways, see for example [2, 4]. When printing, some
objects need to be printed using some means of dimensional
compensated due to this shrinkage. See Willis et al [5].

2. THE PROJECT
Like many large learning institutions, CPIT aims to prepare
graduates for the future as well as current needs of industry. The
early adoption of new technologies that offer unprecedented
opportunities for local industry to speed and refine the
development process is a requirement to maintain a position of
leadership in the IT community.

3D printing has been tried for over 3 years within CPIT in one
form or another - one of the intentions has been to offer a service
to any local light industry keen to investigate the possibilities this
relatively new technology affords. Some small-scale "desktop"-sized machines have recently been augmented by two more
modern and more capable machines. With new technological
capability comes a learning curve and problems of all kinds.

In 2012, CPIT purchased a large powder-based printer and
together with the provision of a smaller wire-fed printer has
provided extended capabilities and allows for finer or more cost-
effective work to be carried out. A number of problems have
occurred with the machines and this project is an attempt to help
solve them, once they have been comprehensively documented.

The challenge addressed here is making this technology more
accessible to a wider audience by identifying and removing
existing barriers.

Currently, many issues are bound in the details; between novel
idea and solid object, there are a number of potential problems,
including:

- Choice of authoring language to generate required file
  format required
- Handling errors thrown up in the production process such as
  objects sticking to the platform, support material removal
- Material costs and time to manufacture; learning curve
  regarding process optimisation
- Quality of finished item - e.g., from mechanical suitability
  and fitness-for-purpose to surface finish and aesthetics
- Management of the printer and ancillary preparation and
  finishing machines

Initially it was decided to engage the people with some experience
in order to discover and record as much of the process as possible
in text and diagrammatic form. An error log was started; so many
errors were entering the system that adequate tracking, let alone
their resolution, was becoming unmanageable. It was hoped that a
methodical, process-focused approach might reveal some
improvements that could be made.

3. DISCUSSION
The research project is still in its infancy but already has shown
that improvements could be made by adopting modified
procedures. One improvement might be obtained from
disseminating up-to-date, comprehensive, working documentation
written in plain English accessible by any potential users of the
process.

So far, the authors have learned a lot about this emerging industry
technology and have begun to develop some understanding of the
issues faced when attempting to deploy them to good effect while
meeting defined needs.

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An Holistic Approach To Skill Development

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ABSTRACT
This poster is the result of the author’s doctoral research which examined the use of project-based learning in IT degrees. It identifies a holistic approach to IT education, starting from secondary school level, which the author believes would lead to better graduate outcomes for the IT sector.

Categories and Subject Descriptors
K.3.1 [Computers and Education]

General Terms
Human Factors, Theory.

Keywords
Capstone projects, project-based learning, professionalism

1. INTRODUCTION
The author’s doctoral research set out to answer two questions. Question One asked whether there was a demonstration of IT skills exhibited by students during a capstone project, and Question Two attempted to determine how a project-based learning approach contributes to the initial development of IT professional skills. This poster paper presents the answers to these questions and proposes a holistic approach to IT education and professional development.

2. RESULTS
The research for Question One identified that the students who undertook the project gained from the learning experience, increased their confidence and developed their technical and non-technical skills. Question Two showed that project-based learning, as undertaken in a capstone projects, could not directly be linked with the development of IT professional skills and values. The capstone projects, however, did provide students with a sound basis to commence work within the profession. Their completion of portfolios of work provided each with an advantage when seeking employment. There was no evidence to suggest students develop a better understanding of professional ethics, values and practices through their capstone projects. This is not to say this cannot be achieved, nor that there may have been no ‘latent’ learning that may emerge later in their careers. The poster is a diagrammatic view of how IT skills could be enhanced with the participation of all stakeholders.

3. CONCLUSIONS
The challenge for the IT sector is the creation of the professional society. There are many working in the sector at present who have no professional qualifications and do not see the need to belong to a professional body. That horse has bolted. There is an opportunity however to develop a framework through education that reinforces the benefits of a professional approach underpinned by a professional body. A holistic approach to the structure of IT education and professional career development is required if New Zealand is to develop as a competitive contributor to the global knowledge economy. In an effort to address this goal the following steps are proposed.

All IT programs should be accredited by the IITP using the ACS framework. This could include registering all project-based courses. As discussed in the previous chapter, this process is already under way with initial discussions and development being held between IITP and the ACS. The adoption of this certification will initially be in addition to the program certification and review undertaken by the NZQA. It is a necessary step for the IT sector, through the IITP, to gain ownership of the development of future IT sector employees. The proposed process is no different to that undertaken by the nursing profession in New Zealand, where the
Nursing Council is actively involved with curricula validation and the registration of graduates. Once the initial group of institutes have their curricula validated and accredited by the IITP it will be difficult for others to remain outside of this regime as accreditation is an important factor in course promotions.

All students enrolled in an IT program should be registered with the IITP as student members. Such a membership currently exists, but is optional. Coupled with the previous suggestion of curricula accreditation, this would encourage continued membership prior to the beginning of students’ professional careers. This would also result in students becoming exposed to the purposes and values, and learning its code of conduct of the IITP much earlier.

All TEOs with accredited IT programs should be required to develop pathways of study with their local secondary schools. This IITP has been actively involved in the review of the secondary teaching units with a focus on a career in IT. These teaching units have been introduced into the Year 11 curriculum in 2011, Year 12 curriculum in 2012 and are to be introduced to the Year 13 curriculum in 2013. This provides an opportunity for all TEOs to develop a pathway of IT education from secondary students into tertiary study.
ABSTRACT
In this paper, we describe a student project from 2012 where physical interfaces were developed to aid communication with a group of severely physically challenged children.

Categories and Subject Descriptor
K.3.1 [Computers and Education]: Computer Uses in Education –computer-assisted instruction (CAI).

General Terms
Performance, Design, Human Factors.

Keywords
Interaction

1. INTRODUCTION
The Southern Institute of Technology was approached by a local teacher to develop computer devices to improve the communication experiences of a small group of severely physically challenged children. The children, aged between 11 and 18, had limited motor movement, were confined to assistant propelled wheelchairs, and had little or no means of verbal communication. The main interaction to date had been using buttons mounted on a mouse, and on toys. There was little knowledge of the extent of the world-view of the children.

The children had been in a relatively isolated environment and there were concerns over their acceptance of a small group of strangers intruding in their environment, let alone intruding in their personal space. Ethical approval was given by SIT, all interaction was sanctioned by the children's parents/guardians and was closely supervised by their teacher. The project had the risk that it was quite possible to spend the eight months with no positive outcomes.

The project follows a growing movement to use sensors and computer controlled devices to assist children with special needs. Alper, Hourcade, and Gilutz [1] discuss using HCI techniques and specifically mentions projects helping children with hearing problems and projects assisting children with autism.

Our project was a capstone project for final year students in the Bachelor of Information Technology at the Southern Institute of Technology. The students had just started a Human Computer Interaction paper where they investigated ways to physically interact with computers using more than the traditional methods such as keyboards and screens. The main technologies used were the Phidget Kits from a Canadian company - Phidgets Inc (http://www.phidgets.com). Phidgets were used for digital input and output, a variety of analog sensors such as touch, light, heat, force, and potentiometer based turn angles, RFID readers, accelerometers and servo motors. Saul Greenberg and Michael Boyle pioneered these devices and have published a number of papers showing their applications [2]. Since then they have been used in a variety of both educational and industrial applications. Deligiannidis [3] describes how a virtual reality gaming environment using Phidgets was used with children with cerebral palsy to help boost self-esteem through social interaction.

For our project the students also investigated basic operations using the Microsoft Kinect for recognition of body movement and ultimately this became the most productive part of the project.

2. RESULTS AND FINDINGS
Initially the group simply extended the switch based devices in order to learn more about the children and the limitations on their capabilities. Small programs were developed to stimulate them visually, and involved picture recognition. One design point that quickly became apparent was the need for all software to have minimal decorative features and plain coloured backgrounds in order to avoid distracting the children. The next stage of development was to create simple stick figure applications that the students could control using the Microsoft Kinect device. The Kinect uses a series of cameras to body detect movement. This was highly advantageous to our children as it meant they could communicate with the computers without having to attach sensors to their heads and limbs – a situation that would have been intrusive. Because of the limited and mobility of the children and their lack of control over their movement, any detected motion had to have a wide tolerance range.
The group first extended the picture recognition games to use the Kinect for input and then worked on a simple music program where the children controlled, via the Kinect, a virtual drum set with cymbals.

3. FUTURE DEVELOPMENT
There are a rapidly increasing number of HCI devices coming on the consumer market which may help improve life experience for people with severe challenges such as our children had. The group researched eye-tracking technology initially but found the technology was not appropriate for this project both cost-wise and time-wise; however it should be revisited in the future. Some work has been done on the Leap Motion sensor as an alternative to the Kinect; however the features of the Leap Motion are higher accuracy of movement detection, a very narrow depth range for movement and detection of hands, not the entire body. While the Leap Motion is an exciting development, the limitations that the children have with movement make the Kinect a more useful communication device at this stage. Another device we have looked at but which is not yet available is the MYO armband from Thalmic Labs (http://www.thalmic.com). Until we have such a device we cannot compare its suitability but movement detection without cameras promises to offer potential.

4. CONCLUSION
While this project has only touched the surface of what can be done, it has been satisfying and successful in that we have shown that it is possible to increase the level of interaction with these children. While the projects were quite simple the project has shown that there are new possibilities available for such children not simply in education but in their general lives where computer control can be extended to controlling their environment with less reliance on caregivers.

The project was appreciated by the teacher, and this year another group of final year students have been invited to continue where the original project left off.

REFERENCES