



Toward the Autonomous Learner: A Design Approach

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ABSTRACT

This paper is a report on part of the case study undertaken with the assistance of students and peers in a medium sized New Zealand Polytechnic. The purpose of the study was to determine whether specifically designed web pages are able to assist a student in their growth from a non-autonomous to an autonomous learner. As part of the process specific attention was taken to the design of a web navigation tool, its design requirements and a tracking system to feed back information on the use of the portal.

The Rational for this topic: The ability to sit at a web based learning tool, whether in an institution or as a distance student requires a level of autonomy in order to be a successful learning experience for the student. If the student's only contact with education has been negative, or the student has received most of their stimulus from television then it is unlikely they will be able to participate fully in this type of education.

In taking a gaming approach, the intention of the case study was to provide another method of browser navigation within an educational site.

The design of a functional portal to aid this navigation was one of the outcomes of the overall case study.

1. INTRODUCTION

The objective of the study was to create a web site that would help students become autonomous learners by using a combination of navigation and levels of learning and that this progress can be measured in some form. The case study was carried out within the School of Computing, Whitireia Community Polytechnic, where the author is a lecturer. The web site was created to provide additional material for a number of existing courses currently running within the School of Computing.

A two-fold approach was taken. First, the material within the subjects alters both in its level of reading difficulty and its depth as the student progresses through the material. Second design of a navigational map to aid subject navigation, similar to navigation maps used in CD-Rom based games. Students were then tracked to determine what pages have been visited in an attempt to determine how students accessed the web pages.



2. METHODOLOGY

The methodology applied consisted of a case study approach of exploratory research involving the following components:

1. Investigation of the cost of particular technologies and their viability to both home and polytechnic environments.
2. The creation of a sample web site with associated task based material to demonstrate those theories that assist second chance learners.
3. A survey of student and staff response to the web pages via an anonymous survey.
4. A review of statistics of student page usage.

This paper concentrates on points 2 and 4.

3. CASE STUDY

In a classroom teachers can quickly rely on a number of visual cues from their students to ensure the delivery of the course. A quick glance will, for example, reveals who is attentively taking notes, pondering a difficult concept, or preparing to make a comment. The student who is frustrated, confused, tired, or bored is equally evident. The attentive teacher consciously and subconsciously receives these cues and adjusts the course delivery to meet the needs of the class during a particular lesson.

By contrast, the progress of a student using web-based instruction has none of these visual clues and therefore must devise other methods of determining how a particular student is progressing.

Within the context of continual technological change the education system is challenged with providing more educational opportunities without increasing an already stretched budget. To contend with this demand many institutions have been investigating the benefits or otherwise of distance and web based education. At its simplest level this may mean courses that are the normal teacher-student relationship augmented with web based material, as with this study, to the other extreme of total teacher-student separation.

The material was offered to students of the polytechnic's school of computing as extra material to existing physically taught classes. The students that were offered the opportunity to trial the web pages come from four distinct groups. The first group are Certificate in Business Computing students who are a mixture of second chance learners and school

leavers. These students are half way through a one-year vocational programme designed to give them entry at the bottom of the IT career ladder. The second group are second year diploma students who are half way through their final year of the Diploma in business Computing. The third group of students are first year undergraduate degree students, studying a three-year Bachelor of Information Technology. The last group are second year undergraduate degree students, studying a three-year Bachelor of information Technology.

In an effort to successfully design for the target group of students, the creation of student profiles was attempted. Each group is made up of three distinct profiles.

Cooper refers to the use of student profiles, or personas, as a powerful tool for development. He states "Personas are not real people, but they represent them throughout the design process. They are hypothetical archetypes of actual users" (Cooper, 1999:124).

The use of profiles to assist in determining, or at least to better determine the actions of a particular individual was used by the author to determine how a particular student may react to any given page. The use of profiles however only works when more than one 'designer' is playing the role of the profile. This avoids capture by any one individual who may presume to know what the profile might do. In this regard the author had assistance from a number of individuals who participated in the role of another designer.

4. COMMUNICATION THEORIES

As stated earlier the intention was to design a system that would help students toward becoming autonomous learners using a combination of navigation and levels of learning.

To achieve this the author researched communication theories in order to understand how students may become autonomous learners.

McCroskey's Communication Apprehension theory is "an individual's level of fear or anxiety associated with either real or anticipated communication with another person or person's". (1987:141). The reasons why this apprehension may occur is a source of much debate. Certainly the problem of apprehension to participate in a web-based mediated discussion group may be to the lack

of functionality of the technology rather than the lack of a will to participate. Apprehension is also heightened by cultural barriers. As many institutes seek to entice overseas students their clientele may also seek not to participate due to a lack of linguistic ability. Beatty et al state "Put simply, after nearly thirty years of research, a coherent explanation for why some people experience anxiety reactions when social interaction is unavoidable remains to be offered" (Beatty, McCroskey and Heisel, 1998:197).

McFadden has investigated alternative delivery systems. His approaches are "based on two pedagogic theories: Cognitive Flexibility Theory and Question Based Navigation. The first simply states that in order to know a body of knowledge in a deep fashion it is necessary to traverse the material a number of times with different issue questions to the forefront of the reader's mind. The second theory states that when reading any material the reader typically has questions raised that need to be answered" (McKinnon, Opfer and McFadden, 1998:495). The author understands McFadden's first theory but questions the second theory on the basis that not all material a reader may be required to read necessarily requires a question to be raised. Much technical material, such as that found in engineering or medicine, is structured in its nature and presents base facts.

Cognitive Flexibility states that the way students are taught has a significant influence on the type of cognitive flexibility students create. This in turn determines to what extent a student will use the knowledge gained. The clearer the instruction, the greater the cognitive flexibility, the more able a student is to apply the knowledge learnt beyond the confines of a single exercise. Web based instruction is well suited to flexible teaching. Although paths of learning can be structured, a student always has the power to click the 'back' button or use the variety of navigational tools within the learning frame to return to an earlier page. This ability, known as 'random access instruction' (Spiro *et al.*, 1992) allows the student to access the knowledge being presented in the order that is "pertinent to his or her needs" (p3).

Although much of the syllabus taught in the School of Computing can be successfully taught in a traditional classroom in a traditional linear fashion, this approach begins to fail once the teacher has been removed from the learning environment. In a self-paced web based learning environment the teacher may no longer be synchronous. What was linear and

structured instruction within the classroom becomes ill-structured in a web based instructional media. Not because the material being taught changes to any great degree but because the web-based instruction, or rather the freedom of this media increases the opportunity for a student to roam beyond the desired set of instruction.

The process of taking a student from a non-autonomous state to an autonomous state of learning requires the student to build onto an existing knowledge base. Spiro *et al.* state that "For learners to develop cognitively flexible processing skills and to acquire contentive knowledge structures which can support flexible cognitive processing, flexible learning environments are required which permit the same items of knowledge to be presented and learned in a variety of different ways for a variety of different purposes" (Spiro *et al.*, 1992:2).

The success of cognitive flexibility theory is limited in success by the degree of sound instructional design. The fact that the media in design is web-based makes the choices for an instructional designer harder, not easier. "There are many ways that hypertext systems (author's note: also read multimedia) can be designed, and there is good reason to believe that a large number of those do not produce successful learning outcomes. What is needed is the discipline of grounding hypertext design in a suitable theory of learning and instruction" (Spiro and Jehng, 1990:170).

'Constructivism' as an umbrella term for a number of theories helps explain the lack of success of many web-based media in transforming the non-autonomous to the autonomous learners. Constructivism relies on the ability of the students "need to construct their own understanding of each scientific concept presented to them" (Brickell, 1998:99). The theories assume that a student has the mental framework in place to construct an understanding. With non-autonomous learners this often requires the attention of a teacher to aid in the construction of a framework. Constructivism places the responsibility for learning with the student alone regardless of what tools, including teachers, are present. A student evaluates the knowledge gained and makes a value decision, an acceptance or rejection of the knowledge being presented.

The decision then becomes part of the student's belief structure. Therefore a poorly designed and supported web page may impart high quality information but in a form that is overpowering to the

student. The intervention of a teacher, by whatever means, may be the difference between the degree of negativity constructed by the student. As a moderating force between the information layout and the information itself the belief structure may be altered to the benefit of the students learning. Therefore the pages attempt to provide information in easy bite sized chunks in order not to overwhelm the student with a huge block of information. The design tries to allow the student to drive the process of gathering information on a manner that minimises the negative impacts.

Romiszwski (1988), states “Only in the last decade or so (author’s note: mid 1970’s) has a more balanced or systems view come to the fore. In education, one of the most influential of recent writers has been Robert Gagne” (p37). Romiszowski points out that Gagne’s approach to instructional design has taken ideas from the behaviourist camp as well as the Gestalt, humanist and cybernetics camps.

Romiszwski (1988) also comments on the process of design. He states “So what is important is not whether you start by defining course objectives (outputs) or course contents (inputs) or the methods to be used (processes), but that you define all three in relation to each other” (p37).

5. DESIGN PRINCIPLES

Knowledge of instructional design is becoming important. Rajasingham and Tiffin (1995) state “Increasingly, however, education involves designing instruction” (p46).

The intention of the design is that the portal and instructional pages should be as simple to use and as quick to load as possible. This resulted in the decision not to use such applications as Flash or other

multimedia applications that have a potential random access memory overhead. The design was accomplished using a divided image and simple hypertext markup language with hyper-links.

Kommers (1996:6) states “The system invites the user to go where his interest is going.” The nature of hyper-linking allows for more information to be offered without forcing the student to view that information they may not require. The choice of whether the hyper-link information is viewed is the choice of the student.

Kommers (1996:6) also states “Orientation and navigation are the costs that emerge from the desire to interconnect information elements and from the ambition to browse freely between semantic elements that you would normally find at different locations in books, different books, different libraries and so forth.”

The attempt in this research project is to produce a navigation tool to provide a control base or portal as a reference point for the student to return to.

Navigation through web-based instruction occurs through navigation links often within the pages themselves. A page traditionally contains a ‘back’ hyperlink to the previous page and a ‘forward’ hyperlink to the next page. The pages created in this research project have dispensed with this type of on-page navigation in favour of a hyperlink on the bottom of the page to the navigation tower.

The issue of copyright on the Internet or in web-based instructional material is in its own right a complex issue and considered beyond the scope of this project.

The design of the navigation tower is subject to copyright and is not to be used without the permission of the author.

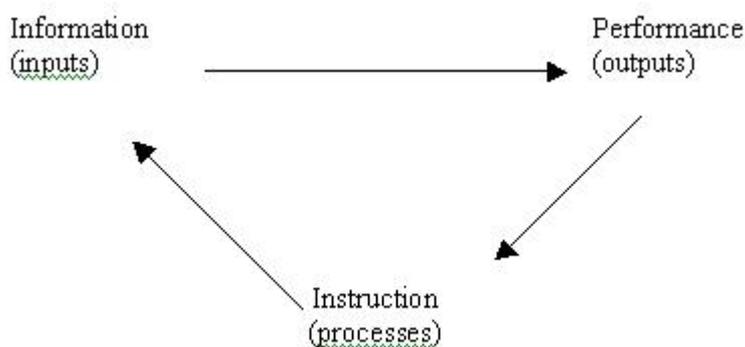


Figure 1. The Design Cycle

6. NAVIGATION TOWER DESIGN

The challenge difficulty was how to design a suitable mechanism for navigation of the web pages. The concept of a building to navigate within was a concept that the author had harboured for some years.

As a society education still takes place within pre-designed or designated rooms. While this is primarily an institutional western view of education, many other cultures identify a house or some other walled structure as a place of learning. In Maori - the meeting house, in Islam - the mosque and in early western civilisation - the monastery.

The use of a tower icon suited well the concept of a series of rooms in which specific information was housed. These rooms may interconnect or be individual in their teaching content. The other issue with the design of a tower was the sense of movement and progression up the tower to the point of completion.

The author decided that in order for the tool to become usable to students it should be functional and easy to use. While the author's experience as a draughtsman enabled the tower to be correctly designed in a sense of proportion and alignment it was felt that a less formal approach should be investigated.

This challenge was brought to a professional cartoonist and graphic artist. The brief was to design a traditional tower that was cut away to reveal a number of rooms to be accessed by a mouse click. As the image was to be divided up for use as a 'mouse over' image on a web page the rooms had to be clearly distinct from each other and still retain its flow. An initial two-dimensional design had six rooms. It was clear early on that six rooms per level was too difficult to achieve without some ability to rotate the image. The decision was made by the author to avoid rotation as this would lead to the complexity of the image and the requirement for a more powerful personal computer to be available to the student. While this was not an issue in regards the equipment available at the author's institution, there was no ability to dictate what the student would have available.

The final design is a three-dimensional tower with five distinct levels containing four rooms on each level. This allows for a total of up to twenty subject rooms can be placed within the tower. Movement through the tower is achieved by dividing the tower up into

twenty separate squares over which the mouse would move to give information to the user about the page that was being viewed and the information contained within that room.

In this research the navigation map, represented by the tower, takes the place of the 'back' button by creating a portal to return to within the framework of the subject being offered. This navigation tower changes as a different subject is selected from the subject selection page always insuring that the correct portal is available.

The reason for both structures is as an attempt to show that the theory of learning is not dependent on the type of material to be taught. The pages concentrate on the flow of learning toward an autonomous learner, therefore the extra features that



Figure 2 - The Navigation Tower 3D

you would normally associate with a complete web-based learning site are not present.

There are a wide variety of software tools now available for institutions to create on-line teaching material. Common throughout the tertiary institutions are Lotus Notes learning space, WebCT and Blackboard. All these tools have the capability of creating a fully working browser-based on-line learning environment with the minimum of instruction for a new Author. The reason for not utilising any of the fore mentioned tools or any of the variety of others is because of the author's intention to attempt another navigation form on the user. Also it was not the intention, at this stage, for the institution to offer the courses as an on-line option.

7. USING THE TOWER

The navigational tower itself is not activated until the student gets beyond the 'Join' page.

Once the student clicks on the 'Join' button, they are sent to the 'Join' page. Here the student is assigned a random generated login ID. Students then click on the "Join" button and are sent to the Subject Selection Page.

Once a student has selected their chosen topic from the Subject Selection page the student will be linked to the Index page of that particular subject. At the same time a pop-up window is also activated and presents the student with a navigation tower relevant to the subject chosen.

The navigation tower will always appear over the page itself. To access the page the student clicks on the page to bring it to the foreground.

As the student moves his or her mouse over the navigation tower, and thus the various rooms within the tower, the information about what information is contained within each room changes. This information is displayed to the top-right of the tower.

Regardless of the subject chosen the navigation tower image remains the same. In this way a consistency is maintained to the student.

8. TRACKING STUDENTS

The footprint tracking system was the next aspect to be designed. This was achieved by changing the HTML pages to Active Server pages. Once the pages are run on an ASP capable server it becomes possible

to track pages by adding an extra piece of code to a link. For example a hypertext link on the navigation tower pointing to the page on Network Topology has the hyperlink text 'Network-Topology.asp?lf=9'. The '?lf=9' code when added onto the end of the hypertext link when combined with active server page code records that the page that is accessed via this link has come from the Navigation Tower - Networking and Networks navigation page.

If the data recorded a result number = 0 then the page was accessed from another source page rather than the navigation tower.

9. COLLECTION OF DATA

There was 532 separate pieces of data recorded in the footprints table showing the location and time of the students as they move around the web pages. On average 8 pages were accessed every time a student entered the web pages. The minimum number of pages accessed at any one time was 2 pages and the maximum was 25 pages.

Times the web pages were accessed also give interesting data. A majority of the web pages (85%) were accessed for less than one minute. The maximum time spent on any one page was 14 minutes.

The fact that the pages were accessed for less than one minute may indicate that students were browsing pages rather than using them as any major source of information. As there was no incentive to seek information, for example no assessment was due, it was likely students were browsing the pages in order to see what the pages contained rather than for any specific reason.

10. CONCLUSIONS

There were a number of problems associated with completing such online research within a limited time frame. However, the research does highlight some interesting characteristics on how students potentially move within web sites.

The pages themselves require more work. Indeed as like any other on-line form they should not remain static and should seek to continue to evolve. Of the two subjects the 'Networks and Networking' subject better expresses the aim of the research to show the differing levels of language and complexity.

The other success of the research has been the development of the research tools. The use of Active Server pages to track the footprints of students has potential for future use. The amount of information that can be obtained from the input of extra code to an HTML coded page opens up a great deal of possibilities.

The hypothesis, that students can become more autonomous by the specific design of web pages, has not been proved or disproved. Simply there is not enough data to give any indication for or against. The mechanisms used are sound and should be explored further. The data collected merely gives a snapshot in time of how students behaved. The author believes however the concept behind the design is sound and, had it continued for the period of a complete course, would have yielded evidence of an increase in a students autonomy.

The success of the tools used to track the way in which students use web pages needs to be explored further. This project suffered from a time restriction and as such it the project should be revisited with a longer tracking period. A suitable time period would be three months minimum or certainly over the duration of an existing 18 week or 36 week course. The overall process of "footprinting" students is in itself a research project.

The completed site can be viewed at <http://www.dutchkiwi.net/research/towerlogon.asp>.

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