

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 research.

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 [1]. 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 [2] 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 weeks 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 [3, 4, 5]. Second, reacting effectively to feedback is the most powerful predictor of learning [6].

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 [7]. Collaborative learning in small groups is reported to promote deep learning [8] and develop communication skills [9]. Cooperative learning tasks in which students help others to learn by explaining topics to each other have been correlated with academic achievement [10]. Girard and colleagues [11] 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 [12] investigated the role of peer feedback in the learning process and suggested that it develops critical

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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 [13, 14]. 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 [11].

Many authors have investigated collaborative learning. Stump and colleagues [15], Kalonji [16], and Dana [17] 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 [18] reported that cooperation promotes higher motor skills performance than individual efforts or competition. Hattie [19] confirmed these findings in his meta-analysis of 800 cases for cooperative learning across the curriculum.

Girard et al [11] 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 [20] and Falchikov and Goldfinch [21] that peer assessment promotes active learning by engaging students.

Slavin [22] 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 [23] 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 [24]. 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 1: Mean confidence ratings by week

Week	Mean	SEM	N
1	77%	1.9%	62
2	79%	2.3%	64
3	78%	2.1%	71
4	78%	1.7%	62
5	82%	3.6%	17
Overall	78%	0.97%	275

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 be 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

Week	Mean	SEM	N
1	74%	2.5%	62
2	74%	2.2%	64
3	73%	2.3%	71
4	76%	1.8%	62
5	78%	4.5%	6
Overall	74%	1.1%	275

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 of usefulness across these weeks.

The mean SOLO ratings for each week are shown in Table 3.

Table 3: Mean SOLO rating by week

Week	Mean	SEM	N
1	74%	1.9%	63
2	73%	2.1%	64
3	72%	1.9%	71
4	69%	1.9%	62
5	73%	2.9%	17
Overall	72%	1.0%	276

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.

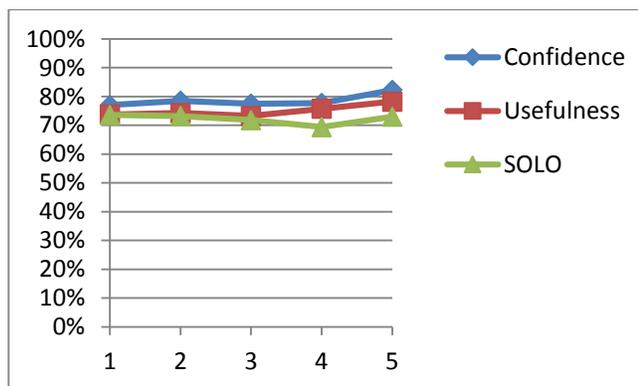


Figure 1: Variation of ratings by week

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.

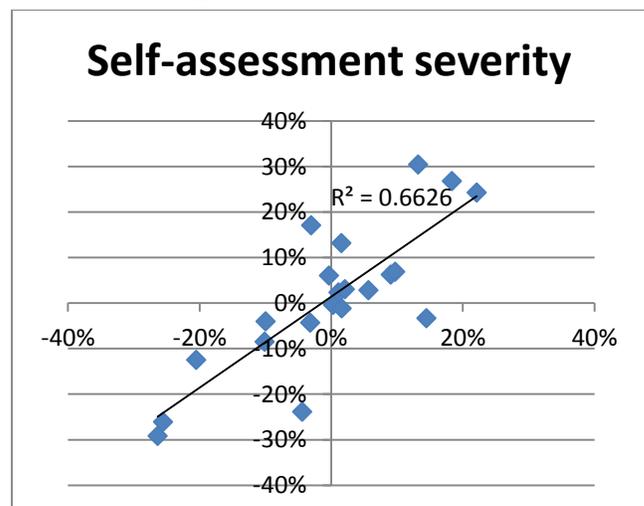


Figure 2: Severity of self-assessment v. peer judgement

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 ($r=.816$, $r^2 =.663$, $p<.001$) 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

Good points	Improvements
Useful.	Fast and short.
McCall's Model Tree	Use bright colour for ppt. Otherwise all good
Good explanation with pretty presentation	Use more examples
Had simple points that were well explained and easy to understand	Lacking in colour/images

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

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

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 of 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 [25, 26, 27] 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 than 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 [28].

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