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A Case Study on Peer-Teaching

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Abstract

This paper reports on the feedback of a case study on peer-teaching activity in a third year university mathematics course. The objective of the peer-teaching activity was to motivate learning and raise student commitment. From the questionnaires conducted, students welcomed the peer-teaching activity and their learning motivation was also improved.

Keywords

Engaging Learning, Peer-Assessment, Peer-Teaching

1. Introduction

The third year mathematics course, Complex Analysis and its Applications was undertaken largely by mathematics and physics students at the university. At this point in their degree program, significant demands were often placed on students' time, particular those students undertaking laboratory courses. Student performance in the course of Complex Analysis and its Applications had in part reflected these demands in the past years, accompanied by lowering attendance rates as the semester started. In response, we sought to introduce changes to the course that were intended to improve student engagement and thereby improve student learning. As noted by Brown et al., "if you want to change student learning then change the methods of assessment" [1]—we accordingly decided to change the methods of assessment adopted in the course, in order to motivate students in learning. These changes were first introduced in 2009, the introduction of quizzes, and later peer-teaching in 2011. It was also students' first experience of peer-teaching in an assessed form.

Over the years, a number of other changes also occurred in the delivery of this course, including changes in course content and duration, and course text. While student outcomes appeared to have improved over the rolling out of these changes, it was not really possible to isolate the impact of the changes in assessment (quizzes and peer-teaching) alone, amidst the myriad other factors that may have contributed to the improvement. In order to gain further insight into the impact of quizzes and peer-teaching, as perceived by the student cohort, we conducted surveys in order to find out their perceptions of the new assessment approaches.

This paper only reports the findings regarding the implementation of peer-teaching in the course in 2011, based on pre- and post-course questionnaires which assessed students' attitude toward the peer-teaching activity.

This paper is organized as follows: Section 2 gives a review on some literature concerning peer-teaching; Section 3 describes the peer-teaching activity; Section 4 outlines the methodology of the surveys; Section 5 presents the outcomes of the findings; and finally, the discussion on these outcomes and the conclusion.

This study had the approval of the Research Ethics Committee of the University and students were informed

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of the research purpose.

2. Literature Review

Assessment can be considered an educational tool for evaluating students' performance, with assessment methods chosen to suit students' maturity levels and increase students' involvement and interest in the courses. Dochy and McDowell [2] highlight in their study that "there is no one ideal assessment format for all cases and all assessment formats can have negative effects on teaching and learning". On the other hand, Brown [3] feels that assessment still provides the best indication to both educators and students of their performance.

In addition to monitoring students' performance, assessment has the potential to inspire students to learn. Reference [4] notes that assessment, as a learning activity, has an important effect on how teachers teach and students learn. In our experience, poor student performance was often accompanied by poor attendance, either due to the challenges of managing time between courses throughout the semester, or due to procrastination. Procrastination among students is a common problem at university level, especially for mathematics [5] [6]. This can manifest itself in students' tendency to leave study until too late (e.g. for final examinations), to be slow in seeking help, or to delay preparation for tutorials (sometimes resulting in non-attendance). One approach to addressing this issue—indeed, the approach undertaken here—is to improve students' learning skills and habits through the modification of teaching methods. By creating a challenging yet interesting environment for learning and assessment, and providing opportunities for students to monitor their own progress, we hoped to develop regular class attendance and study patterns, and thereby improve student outcomes. We also sought to create a more stimulating, more engaging, and ultimately more rewarding learning environment for students. A strategy adopted to achieve this end involved the use of peer-teaching.

Peer-teaching provides an atmosphere that promotes the improvement of communication skills, encourages independent learning, and helps to develop self-confidence [7]. Because peer-teaching actively engages students in the learning process, students gain a sense of purpose with regard to the course. In peer-teaching activity, the peer-teachers must understand work well enough to present it to their peers, and the peers must be attentive in order to assess the performances of their peer-teachers [8]. Students also gain a sense of stewardship over their learning by peer-teaching and learning, as they are encouraged to learn from one another as well as from the lecturer, as noted by Vasay [9], "peer-teaching is a technique in helping students perform better in understanding the different concepts, especially their ability to express their ideas." Vasay [9] also finds that students' learning is influenced by how they learn, with many learning best through active, collaborative, small-group work inside and outside the classroom [10]. This certainly contributes towards the development of students' generic skills of team-work, time-management, organizational and presentation skills and communication of mathematics.

Most studies considering the use of peer-teaching to teach mathematics have predominantly targeted school rather than university learning. However, we would expect that the various reflections cited above from these studies, often made in reference to school learners, should be equally applicable to mathematics undergraduates. The purpose of this study was to substantiate such an expectation.

3. Peer-Teaching

Complex Analysis and its Applications was a 13 week semester course and was undertaken largely by third year mathematics and physics students, the class size was usually very small, less than 20 students. In the past years, the overall assessment comprised take-home assignments and a final exam. As mentioned in Section 1, in order to motivate students' learning as well as to improve passing rate, some changes in assessment started to introduce in 2009. An addition assessment peer-teaching was implemented to the course in 2011. There were only 12 students enrolled in the course in 2011. Though the class size was small, it was a convenient sample to experiment a new assessment.

In the past, students received a list of course tutorial questions before each tutorial class, and they came to tutorial class to seek help from lecturer if they had difficulty. For the peer-teaching assessment, students took charge of the tutorial class instead of lecturer. Students were divided into groups of three and each group took charge of a tutorial class. We called the group members as peer-teachers. Tutorial class was run weekly and once a week and two hours. Similarly, each week a list of tutorial questions was given to all students before the tutorial class, so that the peer-teachers who were taking charge of the tutorial class would have time to organize, prepare, discuss or work out tutorial questions together. The peer-teachers were allowed to seek help from the

lecturer before the tutorial class if they had difficulty solving the tutorial questions.

During the tutorial class, the peer-teachers would go around to help their classmates with the tutorial questions. The course lecturer was also available in the class, if the peer-teachers were unable to answer their classmates' questions, the lecturer would provide assistance.

At the end of the tutorial class, the classmates and lecturer were given a mark sheet (**Table 1**) to access the performance of the peer-teachers. The lecturer then collected the mark sheets and compiled the marks. This assessment comprised 10% of the overall assessment of the course; 5% from the classmates and 5% from the lecturer. We used a 4-point Likert scale for assessing peer-teachers, 1 for strongly disagree, 2 for disagree, 3 for agree and 4 for strongly agree.

4. Methodology

In order to seek more information from students, a pre-course questionnaire (**Table 2** is the list of questions) was conducted on the first day of the course, and a post-course questionnaire (**Table 3** is the list of questions) was conducted on the last day of the course. Students were free to decline taking part in the questionnaires. The post-course questionnaire was same as the pre-questionnaire but with an additional question. The questionnaires were mainly to understand students' learning behavior as well as the usefulness and helpfulness of the peer-teaching activity in tutorial class.

We used a 6-point Likert scale for the pre- and post-course questionnaires, 1 for strongly disagree, 2 for disagree, 3 for somewhat disagree, 4 for somewhat agree, 5 for agree and 6 for strongly agree. In addition, there was also an open ended question "Do you have any comments about the way we conducted the tutorial?" in the post-course questionnaire (**Table 6**) to collect feedback about the peer-teaching activity.

5. Results

Table 4 and **Table 5** summarize the feedback of the pre- and post-course questionnaires, respectively. The effectiveness of this activity was in part reflected in the post-course questionnaire. After the activity, 20% of the students felt that they were not independent learner. There were about 70% claimed that they did not do revision after the lecture (67% did not in the pre-course questionnaire and 70% did not in the post-course questionnaire), suggesting that this was indeed enforced learning that might not otherwise have taken place. Question 6 reflected that all students were motivated by the peer-teaching activity; all enjoyed helping classmates in mathematics. Some important changes were reflected in the response to the questions 5 and 7. Question 5 "I enjoy discussing mathematics with classmates." The percentage of students responding in the increased from 83% to 100%, and question 7 "I learn better in mathematics by interacting in class.", the percentage of students responding in the affirmative increased from 58% to 80%. The class was also very positive toward the peer-teaching activity; this reflected in the question 9 of post-questionnaire, 90% agreed that "Having to explain to my peers helped me to understand better."

Table 6 shows the feedback from some students to the open ended question which asked in the post-questionnaire. It is apparent that students appreciated peer teaching and they were more motivated by this learning activity in the tutorial class. Overall, the peer-teaching approach was encouraging and it engaged students in the learning process. From the peer-teaching activity, the peer-teachers also trained themselves to be organized in order to complete their task (the tutorial questions) on schedule in order to help their peers.

6. Discussion and Conclusion

Overall, peer-teaching activity was an encouraging tool in learning. From the questionnaires, most students became motivated learners. This shows that there were needs to revise course assessment to motivate learning. Though about two-thirds showed that they preferred to do mathematics by themselves, the majority enjoyed the peer-teaching in the tutorial classes. Additionally, the majority indicated that they liked to help peers, as helping others to learn motivated their own learning.

It was delighted that 92% of this 2011 cohort of students passed the course. This was higher than the previous year (83%) with the absent of peer-teaching activity. We recognize that various factors influence student outcomes, including the cohort themselves, the teaching staff, their adopted modes of teaching, and their methods of assessment. Though the time frame of this case study and the course may be considered short, and the small

Table 1. Mark sheet for assessing peer-teachers.

	1	2	3	4	
The group was well prepared for the tutorial.					/4
The group understood the work well.					/4
The peer who helped me was patient when I was lost.					/4
The group led the tutorial class well.					/4
I am satisfied with the performance of the group.					/4
From the peer/lecturer (total)					**/20**

1: strongly disagree, 2: disagree, 3: agree and 4: strongly agree.

Table 2. Pre-course questionnaire questions.

Question no.	
Learning	
1	I am an independent learner.
2	I do revision after each mathematics lecture.
3	I am a motivated learner.
4	I prefer to do mathematics by myself.
Tutorial	
5	I enjoy discussing mathematics with classmates.
6	I enjoy helping classmates in mathematics.
7	I learn better in mathematics by interacting in class.
8	I learn better in group work.

Table 3. Post-course questionnaire questions.

Question no.	
Learning	
1	I am an independent learner.
2	I do revision after each mathematics lecture.
3	I am a motivated learner.
4	I prefer to do mathematics by myself.
Tutorial	
5	I enjoy discussing mathematics with classmates.
6	I enjoy helping classmates in mathematics.
7	I learn better in mathematics by interacting in class.
8	I learn better in group work.
9	Having to explain to my peers helped me to understand better.

Table 4. Summary of pre-questionnaire (12 students took part).

Question no.	1	2	3	4	5	6	Disagree (sum of 1, 2 and 3)	Agree (sum of 4, 5 and 6)
Learning								
1	0	0	0	1	6	5	0%	100%
2	0	3	5	4	0	0	67%	33%
3	0	0	2	1	6	3	17%	83%
4	0	1	2	2	4	3	25%	75%
Tutorial								
5	0	0	2	6	1	3	17%	83%
6	0	0	1	2	6	3	8%	92%
7	0	1	4	2	3	2	42%	58%
8	1	1	3	1	5	1	42%	58%

1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: somewhat agree, 5: agree and 6: strongly agree.

Table 5. Summary of post-questionnaire (10 students took part).

Question no.	1	2	3	4	5	6	Disagree (sum of 1, 2 and 3)	Agree (sum of 4, 5 and 6)
Learning								
1	0	1	1	1	6	1	20%	80%
2	0	4	3	1	2	0	70%	30%
3	0	1	0	4	3	2	10%	90%
4	0	2	1	3	1	3	30%	70%
Tutorial								
5	0	0	0	0	8	2	0%	100%
6	0	0	1	2	4	3	0%	100%
7	0	1	1	3	3	2	20%	80%
8	0	0	0	4	6	0	40%	60%
9	0	0	4	1	2	3	10%	90%

1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: somewhat agree, 5: agree and 6: strongly agree.

Table 6. Answers to the open ended question in post-course questionnaire.

Do you have any comments about the way we conducted the tutorial?
1) Tutorial helped in fine tuning techniques, this was good.
2) It was a nice idea. But I felt that in our group there were only a few who did well and these people helped the others who could not solve the exercise by their own.
3) I do not know if everybody tried to solve the questions, but the group who did it could always answer our questions and that was a good thing.
4) Good idea to make students learn from peers.
5) Tutorials were done well, especially with the worked answers given out afterwards.
6) Tutorials were good, especially photocopied solutions were handed out afterwards.
7) Groups were well prepared and helpful.
8) Well conducted; good for ground collaboration.
9) Running the tutorial this way (by the students) encouraged participation and helped re-enforce our knowledge.
10) It was very good and the explanations of the students were very helpful.

cohort size also made statistical inference challenging, it was an encouraging outcome that our findings showed that students found peer-teaching a motivating additional element in the classroom. This was particularly reflected in the response to the question, "I learn better in mathematics by interacting in class." However, care must be taken with the implementation, encouraging their participation while balancing the effort that students facing competing demands on their time are able to invest.

In conclusion, the overall activity was a positive one, with improved pass rate and generally positive feedback from students. This positive feedback certainly leads teaching staff to extend the approach to other mathematics and science courses, where analogous problems arise.

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