DOES CLASS SIZE IMPACT THE EFFECTIVENESS OF PEER LEARNING USING PERSONAL RESPONSE SYSTEMS IN LARGE QUANTITATIVE UNITS?

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Abstract

In this paper, we investigate whether the success of changes implemented to encourage peer collaboration in a large postgraduate statistics unit with heterogeneous student cohorts is affected by class size. Upon enrolment, students demonstrate varying levels of statistical literacy and numeracy, with many lacking understanding of basic concepts. These factors are thought to contribute to low levels of peer interaction in tutorials. We also argue that the provision of multiple tutorials in a traditional setting, with 25 students and one facilitator, diminishes the consistency of delivery and application of key statistical concepts. We investigate an approach to combining tutorial group work and “super tutorials” that promote an effective and interactive learning environment for a large quantitative unit. In an attempt to diminish disparities and improve consistency in the delivery and application of key statistical concepts co-teaching and “super-tutorials” were introduced within which students were allocated into small groups. Furthermore, a personal response system (PRS) that allows for both individual and team-based responses to questions was utilised. The use of the PRS within tutorials that cater for group work allows facilitators to effectively engage with students and obtain real-time feedback. This style of question delivery, referred to as team-based learning modules, were used in both traditional-sized tutorials (25 students with one facilitator) and larger “super-tutorials” (50 students with two facilitators). Team-based learning modules were introduced based on the constructivist perspective which advocates that groups of learners collaboratively construct and share basic knowledge as a learning community. In both types of tutorials, it was found that PRS can enhance peer collaboration. The focus of the current work is to investigate whether the size of the tutorial class also impacts on this success. In this paper, we compare data obtained from both large and small tutorials from team-based modules and surveys. We compared the improvement in responses from individual students and groups both tutorial sizes. In general, students performed better in groups compared to individually. We also analysed student perceptions of the effectiveness of team-based modules. Overall, our research suggests that use of the PRS can enhance peer collaboration and their learning experience. Additionally the combination of a PRS within a team-based learning module encourages collaborative learning in both small and large classes. Moreover, we found that “super-tutorials” have been more effective in promoting peer collaboration in comparison to traditional-sized tutorials.

Keywords: Peer collaboration; personal response system, team-based modules; co-teaching; class size.

1 INTRODUCTION

An introductory Statistics unit is essential in most business degrees [1]. In fact it is generally agreed that numerical and analytical skills are sought after by most employers. However, globalization and massification of education has brought about new challenges in the teaching and learning of quantitative units. Teaching quantitative units in large classes is always challenging because of the heterogeneous nature of students who may have different aspirations, values and expectations about the learning process in the classroom. As argued by [2], “teaching statistical courses is challenging because they serve students with varying backgrounds and abilities”.

In our large quantitative unit, we identify a number of challenges that drive this study. First is the varying levels of students’ understanding on statistical literacy/numeracy and basic concepts. Second is the low levels of interaction in lectures due to large enrolments which we try to address by providing tutorials after lectures. Third, the provision of multiple tutorials in a traditional setting (up to 25 students and one facilitator) has issues in the consistency of delivery and application of key statistical concepts. In fact, there has also been a lack of support provided for the professional development of less experienced tutors.
We argue that the practice of teaching and learning in a quantitative unit such as Statistics needs to be set up in a way that resembles the workplace. It should ideally involve teamwork and collaboration. Collaboration should, not only be the objective of teaching statistics but also used as a strategy in facilitating effective student learning [3].

It is also noted that new technology is increasingly used in the teaching of statistics in many reputable universities [4]. The PRS involves equipping students with a handset allowing them to submit responses to questions delivered by facilitators.

In order to enhance peer collaboration, active learning and professional support, we implemented team-based assessment and created several “super tutorials”. These innovations were combined with a suite of changes that included group work, co-teaching and a polling system which provides real-time feedback to both students and teachers.

The model that we have for this unit comprises of two set-ups: large-class “super-tutorials” with 50 students and 2 facilitators and, small traditional tutorials with up to 25 students and one facilitator. All tutorial questions were designed to facilitate group work among students as well as collaboration among facilitators. Individual and group work is then then assessed via team-based modules. These modules are administered using the PRS.

In large units with multiple facilitators such as the one discussed in this paper, collaborative teaching can benefit less experienced facilitators by providing support for their professional development. With this in mind, the introduction of “super-tutorials” in this unit was specifically aimed at encouraging the practice of co-teaching. Co-teaching is a practice prevalent in secondary education and undergraduate level, but limited in its practice in postgraduate units. It has been evidenced in a number of studies that co-teaching is not only beneficial in improving student outcomes but also facilitating professional development among facilitators ([5]; [6]; [3]).

The arrangement of small and large tutorials as well as in-class activities are informed by the constructivist perspective that encourages teachers to provide a “constructivist learning environment” [7], within which groups of learners (in the classroom setting) collaboratively construct and share basic knowledge as a learning community.

Co-teaching in large tutorials also supports the collaboration between students as well as facilitators. Co-teaching can be understood as a practice of teaching by multiple facilitators who simultaneously work together in one classroom with groups of students and share their work in planning, organizing, delivering, and assessing the instruction ([6]; [8]). It is one example of a model of effective professional development for in co-teaching, facilitators work together to examine student work and determine ways to improve teaching and learning practices [9].

In facilitating the engagement of facilitators and students, we implemented the use of a personal response system (PRS) within all tutorials, large and small. Our findings indicate that the use of a team-based module within a PRS can enhance student collaboration and facilitator interaction.

The use of the PRS also allows for real-time feedback. This approach was inspired by the idea that students’ diverse needs and various acquisitions of basic statistic and computer skills can be addressed if there is “strong synergy between content, pedagogy, and technology” [2]. The PRS allows students to give responses to questions given by facilitators, individually and in groups. The feedback can then be reviewed in real-time and facilitators can engage in further discussions [10].

This paper looks at the effect of class size on the effectiveness of peer learning through the use of a PRS. We compared the improvement in responses from individual students and groups both tutorial sizes. In general, students performed better in groups compared to individually. Moreover, we found that “super-tutorials” have been more effective in promoting peer collaboration in comparison to traditional-sized tutorials.

The plan of this paper is as follows. Section two outlines how data was collected, and explains data collection techniques, section three is a review of the results and the final section provides concluding remarks.

2 DATA COLLECTION

For the purpose of this study, data was collected in semester two of 2016. In week 0, students were sent a link to an online quantitative survey. The survey was administered through the Learning Management System. The survey was open for one week and reminders were sent to all students.
Using a five-point Likert scale, the survey assessed their background, learning experience regarding the use of Microsoft Excel, online learning and group work.

Toward the end of the semester, another survey was conducted to assess their feedback regarding group work and the effectiveness of the audience response system in their learning. The PRS consisted of team-based modules which allowed students to submit responses individually and as a team.

In week 6 students were asked three questions, and in week 12 they were asked 5 questions. Students were allocated alphabetically to groups of five and stayed in their assigned groups all semester. In the first round, students provided their individual answers to questions using the PRS. Then students were given time to discuss their answers with their group and then submit a group answer. Using the raw data from the PRS, we were able to determine if the student changed their answer, and whether or not the changed answer improved their score. In week 6 the possible score changes could range from -3 to +3, and in week 12 they could range from -5 to +5.

3 RESULTS

We present an extract from the Week 0 survey for semester two, 2016, providing further separate results for small tutorials as well as “super tutorials”. This is presented in Table 1 below:

<table>
<thead>
<tr>
<th>Question</th>
<th>International student</th>
<th>Domestic student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you an international/Domestic student?</td>
<td>96.01%</td>
<td>3.99%</td>
</tr>
<tr>
<td>Have you studied basic statistics before?</td>
<td>55.62%</td>
<td>44.38%</td>
</tr>
<tr>
<td>Have you ever used Microsoft Excel before?</td>
<td>89.86%</td>
<td>10.14%</td>
</tr>
</tbody>
</table>

There were a total of 552 students who participated in the survey. Preliminary findings suggest that 97 percent of students are international students and half of them have studied statistics before. Although ninety percent of them possess prior knowledge on Microsoft Excel, a majority are only familiar with basic functions in Microsoft Excel.

The results from the survey also show that although eighty percent have had experience submitting online assessments/quizzes, only fifty percent have ever been involved in online polls and less than forty percent have been involved in flipped learning.

Table 2 provides an extract of the results of the survey conducted toward the end of the semester for both large (“super-tutorials”) and small tutorials.

<table>
<thead>
<tr>
<th>Question</th>
<th>Class Size</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group work during tutorials helps me understand the material better</td>
<td>Large</td>
<td>31.2%</td>
<td>49.7%</td>
<td>17.3%</td>
<td>1.7%</td>
<td>0.0%</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>28.8%</td>
<td>40.4%</td>
<td>25.0%</td>
<td>1.9%</td>
<td>3.8%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>30.7%</td>
<td>47.6%</td>
<td>19.1%</td>
<td>1.8%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Learning Catalytics in tutorials helps me understand the material better</td>
<td>Large</td>
<td>27.7%</td>
<td>57.2%</td>
<td>12.1%</td>
<td>2.3%</td>
<td>0.6%</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>15.4%</td>
<td>55.8%</td>
<td>23.1%</td>
<td>5.8%</td>
<td>0.0%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>24.9%</td>
<td>56.9%</td>
<td>14.7%</td>
<td>3.1%</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

Overall, the results confirm that group experiences have been shown to contribute to student learning for both large and small class settings. The results also suggest there is strong evidence to support
the use of Learning Catalytics as a real-time feedback tool. We received a very positive result where almost all of students (above eighty percent overall) consider this tool as having helped them understand the material better. The main advantage of using this tool is that it enhances interactivity in class and encourages students to be involved in the learning process. Here we received stronger results in large classes as opposed to small tutorials.

We then compared the change in student scores between large and small classes based on the results obtained from the use of the PRS. We analysed scores from weeks 6 and 12. In week 6, there were 194 students in large classes, and 66 students in small classes. In week 12, we had 174 responses from students in large classes, and 60 from students in small classes. The charts below summarise our findings.

Fig. 1 and Fig. 2 show the change in raw scores for week 6 and week 12 respectively.

Both charts show that in general, most students improve their score after collaboration. More students in large classes tend not to change their answer. However, students in small classes tend to improve their marks more than those in the larger classes, with the difference being larger in week 12. Furthermore, of the students who get a worse mark after collaboration, more tend to come from the larger classes.

![Figure 1. Score changes in week 6 by class size.](image)

![Figure 1. Score changes in week 12 by class size.](image)
There were three questions posted for the team-based module presented in week 6. The average score improvement in week 6 for small classes was 0.59 marks compared to 0.44 marks in large classes. Further analysis using a t-test found that there was no statistical difference in improvement between the class sizes (p-value = 0.269).

In week 12, there were five questions posted for the team-based module. The average score improvement was 1.02 marks for the small classes and only 0.53 marks in the large classes (5 questions were asked in week 12). In this case, a t-test found that there was a statistical difference in improvement between the class sizes (p-value = 0.019). Nevertheless, the result seems to suggest that students in small classes get more benefit from collaboration than those in larger classes.

In order to analyse where the improvement was, scores were categorised into better, no change and worse. We conducted a Chi-square test of association for the responses in week 12. It is found that class size is associated with the level of improvement (p-value = 0.009). The results indicate that smaller classes do better than is expected after collaboration, while students in the large classes do worse than expected.

4 CONCLUSION

In this paper, we explore challenges facilitators encounter when teaching a large heterogeneous cohort in a postgraduate statistics unit. In an aim to enhance peer collaboration, we implemented team-based assessment modules using a PRS. Based on the results, we found that the use of small groups with the aid of a PRS encourages collaborative learning. This approach is well received by students in both small and large tutorials.

However, when we compare individual and team-based scores in tutorials, students in small classes tend to improve their marks more than those in the larger classes, with the difference being larger at the end of the semester. This result is interesting. It seems to suggest that students in small classes benefit more from collaboration in comparison to their peers in large classes. It may also be due to the complexity and number of questions delivered in the modules analysed. We note that in week 6, there were fewer questions delivered in the module. Therefore the variation in answers was smaller. These questions required no calculations whilst those in week 12 required some calculations.

Our results also suggest that room size and design plays a role in collaboration. Although learning is socially constructed with and through others, little is known about the inter-relationship of the design of the space, technology and pedagogy and how these elements come together to enable students to act and engage in learning processes and pathways. More specifically little is known about how the physical design and attributes of a collaborative learning space influence student and teacher participation in collaborative activities. This is planned for future semesters.

REFERENCES


