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PeerWise: Students' perceptions of creating questions for their peers

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Abstract

PeerWise (https://peerwise.cs.auckland.ac.nz/) is a system which allows students to create multiple-choice questions for other students, answer questions posed by their peers and then provide feedback (Denny et al, 2008). There is evidence in the literature to show this method of assessment has a positive impact (e.g., Guilding et al. 2021; Fergus et al. 2021; Feeley and Parris 2012), particularly on students' attainment and engagement. In a funded project, we introduced PeerWise into the assessment for a module at Sheffield Hallam University (U.K.) and another at La Trobe University (Australia). In this case study, we give an overview of PeerWise and the activities within the platform, results from our evaluation of the activity, and advice for implementation collected within the project from other practitioners around the world who have experience using PeerWise. Cohesive themes arising from our evaluation and the advice collected are summarised to form recommendations for improved student experience and outcomes, for future implementation of the PeerWise platform by practitioners.

Keywords: PeerWise, student-generated questions, problem posing, peer feedback, assessment.

1. Introduction and background

PeerWise (Denny et al, 2008) is a website (https://peerwise.cs.auckland.ac.nz/) where students can post multiple-choice questions for their peers within a closed course site. When setting questions, students present up to five answers, indicate which answer is correct and provide an explanation. Explanations may include worked solutions to a problem, reasoning for why a particular answer is correct, or reference to module materials. When answering questions written by their peers, students get to see the explanation once they have answered, provide feedback comments, and give two ratings: one for overall quality, as well as a difficulty score. Feedback provided can be of a general nature, or include suggestions for improved clarity of the question or explanation, or suggested corrections. Following feedback, students are able to edit their questions if desired. Students can see all the questions posted on the course site, the difficulty ratings and the feedback. All the activity, including summary pages, can be seen by the instructor accounts connected with the course site.

PeerWise is used in many different disciplines, including Computer Science, Psychology and Physics. Benefits include better exam performance, as reported in the study within Medicine by Guilding et al. (2021). Fergus et al. (2021) saw high student engagement in both formative and summative Chemistry assessment. Overall, as presented by Feeley and Parris (2012) in a Political Science example, more learning can result from the use of PeerWise. In particular, they found that there was a statistically significant association between the number of PeerWise questions answered and a student's change in rank in student performance, from midterm to final exam rank.

Within this case study, we present two examples of assessment that required students to use PeerWise.

1.1.U.K. University – first year module

The assignment at Sheffield Hallam University (SHU) in the first year of BSc Mathematics was a one-off assignment at the end of the module around number and algebra that had two deadlines: one for creating questions (part 1), and another for answering questions and providing feedback (part 2). Within part 1, the students were required to create one question on set theory and the other on binary operations. They had to highlight the correct answer and write an explanation. In part 2, the students answered at least two questions on each of the two topics that their peers had written, and leave feedback. The work was worth 5% of the module mark.

When marking the work after all parts of the assessment had been completed, there were a number of considerations which the students knew about before they undertook the assessment. If a question writer had made an error (e.g., they had marked the wrong answer as correct), this was picked up in the marking stage and the students who answered that particular question were given the credit for what they had done correctly, even if their answer was marked as incorrect on the system. When determining grades, the difficulty of the questions answered were taken into account. When marking the assignment overall (including questions, answers, explanations and feedback), factors such as communication, knowledge and understanding, demonstration of skills, whether the work was beyond expectation of the level, and correctness of answers determined the overall grades.

1.2. Australian University – third year module

Unlike the assignment at SHU, the assessment at La Trobe University (LTU) was ongoing throughout the semester in a third-year statistics capstone module. It contributed 10% towards the final module mark and was structured as follows:

1. 5% for writing one question per week (10 out of 12 weeks)
2. 2.5% for answering at least 25 questions correctly
3. 2.5% for the 'reputation score', which is based on question authoring, answering, and rating.

The reputation score is calculated within the PeerWise platform via an algorithm that encourages students to participate early rather than last-minute, and encourages quality and fair contributions. For example, students do not accumulate points simply for providing ratings. Rather, a student will gain a point when another student gives a particular question the same rating as they did. This encourages students to participate early, and also fairly, since unreasonable ratings are less likely to be agreed with by other students. In a similar manner, points are scored on the 'answering' component when a student correctly answers a question and another student then selects the same answer. For question authoring, points are scored by the author when other students rate a question either "good", "very good", or "excellent". The reputation score is calculated as a combination of the question authoring, answering, and rating components, and higher scores are awarded to students participating in all three components rather than just one or two areas.

The marking was mainly automated by using the various scores from the PeerWise website. As students are able to provide feedback on their peers' questions, many errors are corrected without the need for intervention by the lecturer. However, questions were checked to make sure they related to the weekly content. Also, since the reputation score depends on the number of students in the class, this was taken into consideration when using the reputation scores from the website.

2. Methodology

We aimed to evaluate the experiences of students in their use of PeerWise in Mathematics and Statistics in the modules. We were particularly interested in the experience of each stage of the process and any reactions to the visibility of their work. A questionnaire was conducted in classes at both SHU and LTU after the assessment involving PeerWise was carried out. In the modules under consideration (one from each university), all students were invited to take part.

Within the questionnaire, we checked which activities of the assessment they carried out. We asked 4-point scale questions regarding how they found creating questions and providing feedback. These were followed by open questions about anything they gained from each of the stages. They were asked closed questions about the most and least beneficial parts', and open questions about why.

The students were asked about the effect of each of the stages whether they thought their confidence, understanding and ability had increased, decreased or stayed the same. Students were not prompted to interpret confidence, understanding and ability in a specific context; rather, these questions were intended to gain insight into a student's perceived confidence, understanding and ability in the subject material overall. We asked whether it concerned them whether their question would be seen by other students, with the options of 'yes' and 'no'. They were asked whether their questions would have been better, worse or the same quality if they knew they would not have been available to other students and why. The evaluation is presented in Section 3.

Following the assessment and its evaluation, the authors noticed the variety in the strength of questions. In particular, some students stayed close to the taught material, e.g., by asking for definitions. In contrast, some students were able to demonstrate a deep level of understanding by creating entirely new questions where they had taken misconceptions into account. We also noticed the differences in how the two assessments had been done, and some issues (e.g., the amount of time to mark in the approach at SHU).

Student researchers used the list of PeerWise publications (https://peerwise.cs.auckland.ac.nz/docs/publications/) to identify academics who had used PeerWise, and subsequently conducted a short questionnaire which mainly contained open questions asking for advice on using PeerWise for assessment, how to encourage students to write high quality questions and general advice. The information gathered is presented in Section 4. In Section 5, common themes arising from the advice gathered and our own evaluation are summarised, leading to recommendations offered for future implementation in Section 6.

3. Evaluation

Students had the opportunity to fill in questionnaires in both modules. There were 9 and 3 responses from cohorts of 24 and 8 students at SHU and LTU respectively. Figure 1 shows that students generally found PeerWise easy to use, but there was more of a mixed response regarding the difficulty of creating questions.
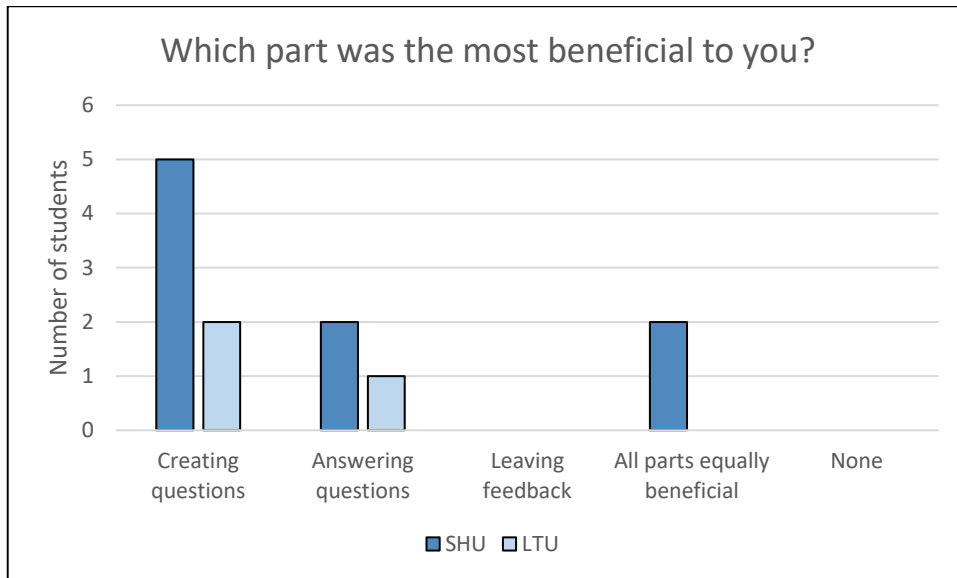
Figure 1. How students generally felt about parts of PeerWise (both SHU and LTU).

When asked what the most beneficial part of the assessment was, the most common response was creating questions. Some students selected answering questions or all parts (Figure 2). No students reported that leaving feedback was the most beneficial part, and no students reported "none". When asked what part was the least beneficial, leaving feedback featured in the answers (Figure 3). Some students found that all parts were equally beneficial, with one SHU student providing the following comment:

"All parts worked well in different ways." **(SHU student)**
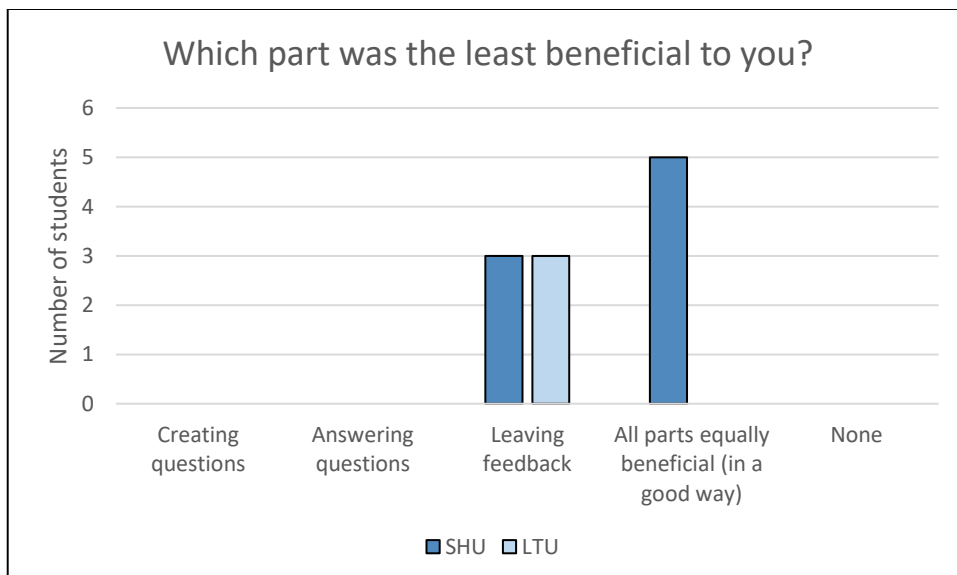

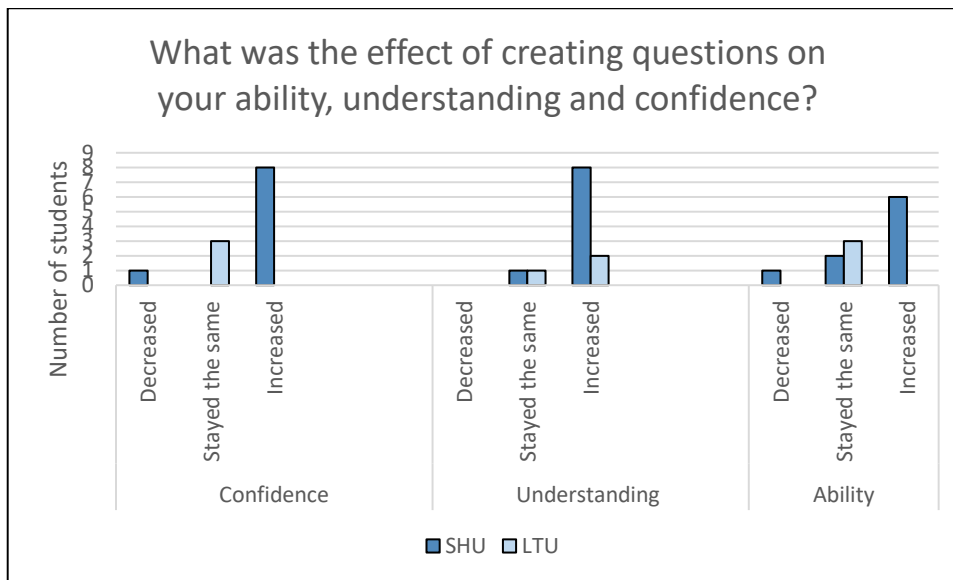Figure 2. Student views on which parts were the most beneficial (both SHU and LTU).

Figure 3. Student views on which parts were the least beneficial (both SHU and LTU).

Creating questions, answering questions and leaving feedback will now be explored in more depth.

3.1. Creating questions

When asked what they gained from creating questions, the most common responses were around engagement with module content (five SHU students). This is perhaps due to topics being selected at SHU that had not been taught for a while. It appeared to be a useful revision exercise. There were some comments about the activity helping with understanding of the module content (three SHU students). Three students (two from LTU and one from SHU) also said they learnt about designing questions in the exercise.

Amongst the students who thought that creating questions was the most beneficial part of the assessment, a couple indicated it was because of the understanding that this brought:

"Creating questions meant I had to develop a better understanding of the content to be able to put it into a question and explain the answer." **(SHU student)**

"Mainly it was coming up with a question answer combo that was unambiguous. That meant that I had to make sure that I understood the concepts surrounding the question I chose." **(LTU student)**

Another LTU student thought creating questions was the most beneficial part due to the revision being required:

"Was a chance to review previous learning and choose the most applicable knowledge to anwser [sic] the question" **(LTU student)**

As reflected in the student comments, Figure 4 shows that creating questions in PeerWise helped increase students' perceived understanding. Some of the SHU students reported that they thought it increased their ability and confidence, but none of the LTU students reported this. It is interesting that one SHU student indicated that creating questions had decreased their ability and confidence.
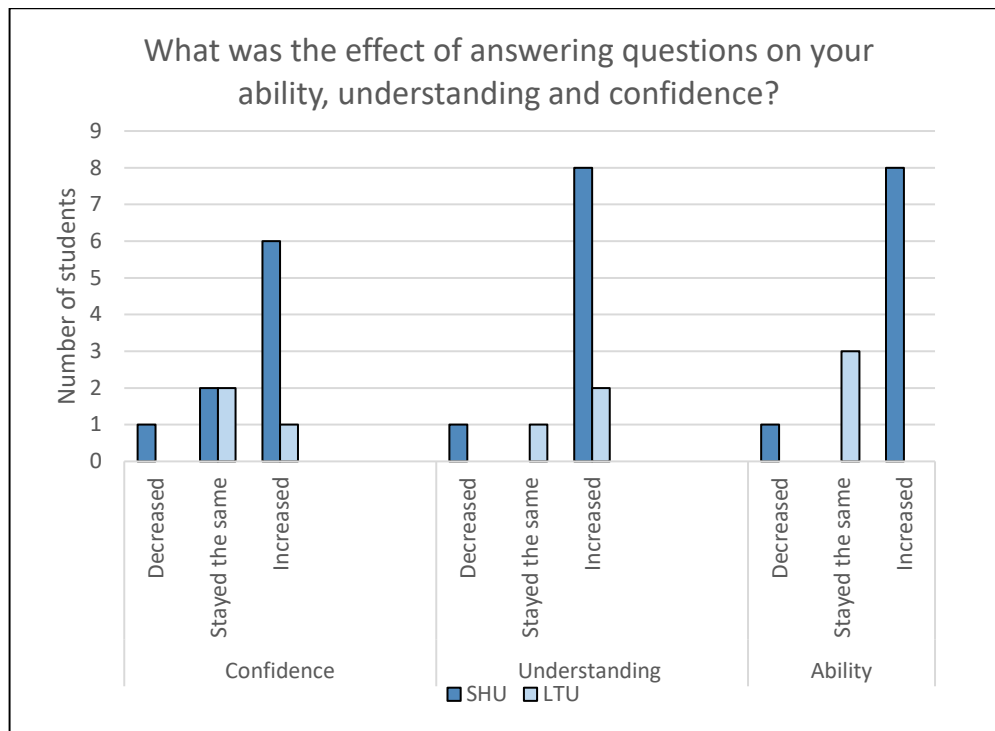
Figure 4. Students' views on the effect of creating PeerWise questions on ability, understanding and confidence (both SHU and LTU).

3.2. Answering questions

When asked whether they had gained anything from answering questions, one SHU student and one LTU student did not provide an answer. The rest of the SHU students said this part was useful for learning and/or revision (eight students) as it tested their understanding. The following student thought this part was the most beneficial part:

"It was the part that revised the subject the most as it asked questions I may not have thought of." **(SHU student)**

The following student highlighted how the mixture of questions was useful:

"Getting a variety of different questions from each student with different levels of difficulty" **(SHU student)**

One of the students also found it reassuring that they were not alone in finding content challenging:

"I saw what I assumed other people considered challenging topics, and felt at ease with myself for finding some of them quite difficult myself." **(SHU student)**

Both LTU students said that answering questions was beneficial for designing questions. The difference in the responses in Figure 5 from the SHU and LTU students can be explained by the way the LTU students regularly created questions following on from recent topics, whereas the SHU students only did this once on topics they had not encountered for a while.

Some students thought that answering question in PeerWise increased their ability, understanding and/or confidence (Figure 5). In the same way as creating questions, students most commonly

reported increases in understanding as a result of answering questions. It is again interesting that one SHU student thought that all three factors had decreased because of answering questions.
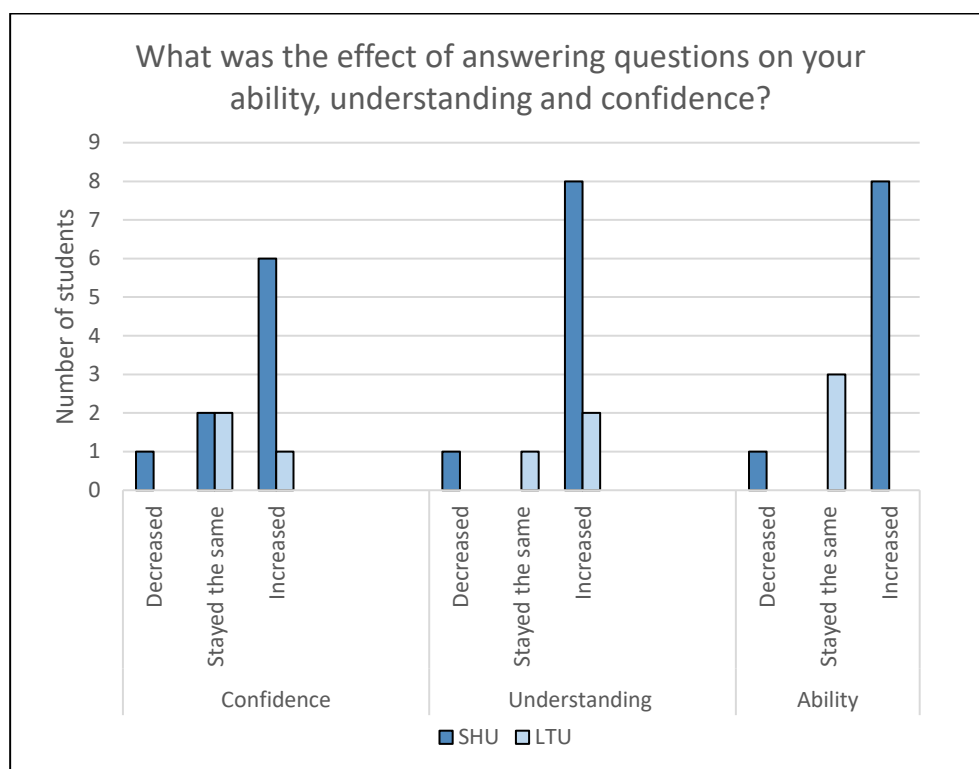

Figure 5. Students' views on the effect of answering PeerWise questions on ability, understanding and confidence (both SHU and LTU).

3.3. Giving feedback

Two SHU students and one LTU student did not provide a comment regarding whether they gained anything from giving feedback. Five SHU students pointed towards being able to reflect on question writing and two referred to learning. On the other hand, the LTU students focussed on the learning community advantages. The comments about what they gained from giving feedback were:

"The feedbacks were mainly for the lol's and the memes. I feel it brought me closer to my fellow students [sic] *though, as it built a sense of camaraderie."* **(LTU student)**

"How much banter people like." **(LTU student)**

The difference between the LTU and SHU responses here could also be partly due to the difference in assessment strategies, particularly surrounding the ongoing (LTU) versus one-off nature (SHU).

When indicating which parts of the assessment they thought were the least beneficial, a couple of students indicated that they thought leaving feedback for others was not helpful for them academically (one SHU student and one LTU student). However, one of these students thought it could have been helpful for others:

 "I believe the feedback may have been more useful to the students I was providing it to." **(SHU student)**

The other student thought that leaving feedback was beneficial for enhancing the learning community:

"In an academic sense they were the least beneficial, but they were the most fun and they definitely gave us something to talk about and bond over" **(LTU student)**

The LTU students thought their ability, understanding and confidence stayed the same as the result of giving feedback (Figure 6). Although this was a common response amongst the SHU students, some of them thought that their ability, understanding, and/or confidence increased because of providing feedback.
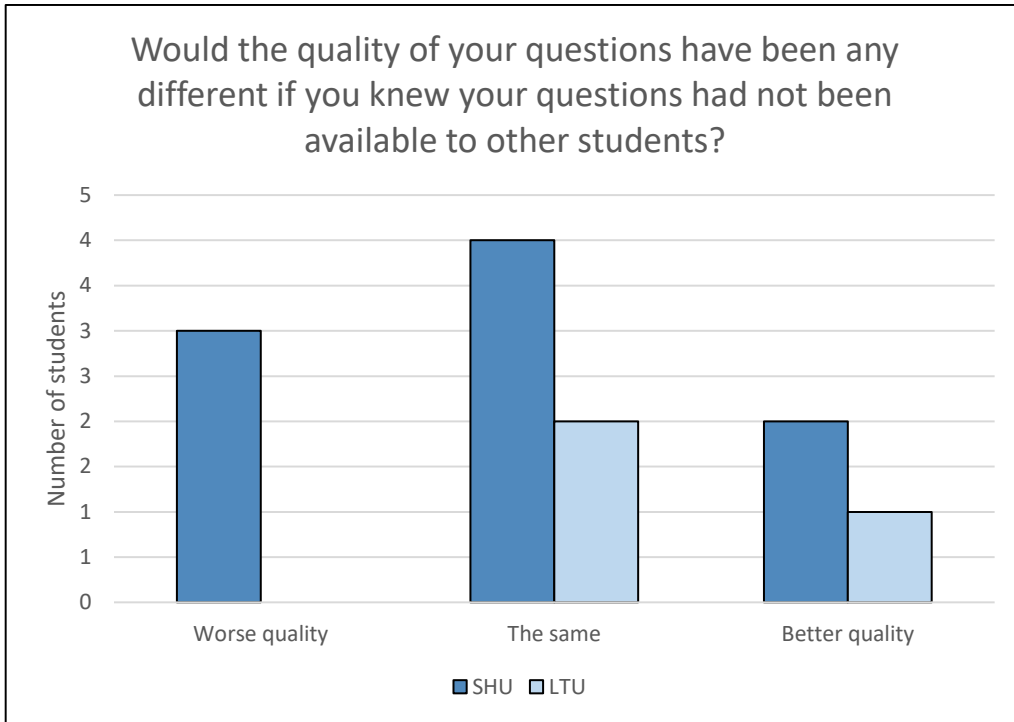

Figure 6. Students' views on the effect of providing feedback on PeerWise questions on ability, understanding and confidence (both SHU and LTU).
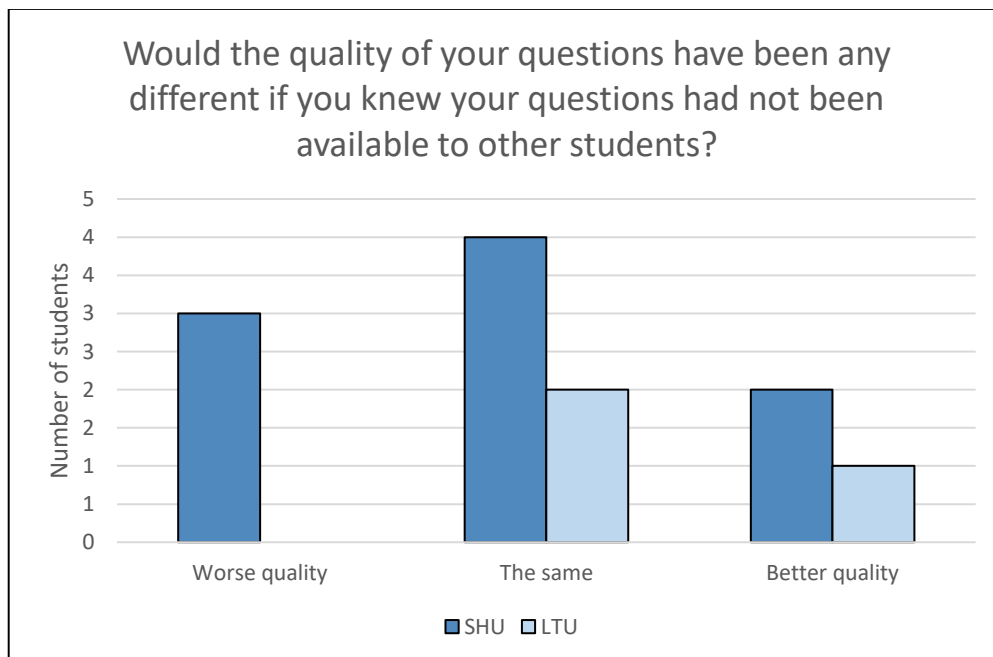

Figure 7. Student views on whether the quality of their questions would have been different if their questions had not been available to other students (both SHU and LTU).

3.4. Visibility and quality of questions

At SHU, two out of nine students were concerned that their questions would have been seen by other students, whereas seven were not. At LTU, none of the students were concerned about this.

When asked whether the quality of their questions would have been different if their questions had not been visible to other students, the most common answer was that they would have been the same (Figure 7). One SHU student, who provided this response, indicated that their focus was mostly on the marks:

"My grade is the most important thing so my work should not change based on who sees it because it should be consistent" **(SHU student)**

Amongst students who said their questions were either better or worse, there were reactions to the pressure of knowing their questions would be visible to other students. The following student had a positive response to pressure and said that their question would have been of a worse quality if their questions had not been seen by others:

"There comes a pressure not to look silly when presenting work to others especially people you know, friends, teachers, classmates." **(SHU student)**

There were a couple of students who had negative responses to the pressure, which meant they thought their question would have been better had it not been visible to other students. This is due to worries about other students and the fear of visibly making mistakes.

"Less stress to write questions, probably would have put a bit more effort or made them harder so others wouldn't worry too much about them." **(LTU student)**

"The idea of someone answering a difficult question I wrote (that might've been wrong) was potentially embarrassing." **(SHU student)**

4. Advice

Following our own experience of using PeerWise for assessment, we gathered advice from practitioners across the world regarding using PeerWise.

4.1. Encouraging students to write high quality questions

We collected examples on how students can be encouraged to write high quality questions. One indicator of a 'high quality question' is that it encourages higher-order thinking (Bloom, 1956), as discussed by Scully (2017) in relation to the creation of multiple-choice questions (MCQs). As compared with knowledge recall, for example, questions that encourage higher order thinking require a greater depth of understanding from both the question writer and the question answerer, thus fostering greater learning. High quality MCQs also avoid flaws such as grammatical clues, vague terms, implausible distractors, and the presence of less than or more than one correct answer (Tarrang and Ware, 2008).

As we learnt from other educators, approaches to encourage the creation of high quality questions included running workshops to help students with creating and critiquing questions (**Delyse Leadbeatter, Dentistry, The University of Sydney**), providing writing guides (**Adam Persky, Pharmacy, University of North Carolina at Chapel Hill**), giving exemplars of different quality questions, explanations and feedback (**Suzanne Fergus, Chemistry Education, Learning &**

Teaching, University of Hertfordshire), and providing advice on question writing (**Philip Smith, Medicine, Cardiff University**). We were also told about the following approaches:

"During in-class polling, I often highlight the type of question and why I am using it…We provide links to two websites with advice on question design."
Susan Howitt, Biology, Australian National University

"Encourage students to actively review/critique each other's questions and give them opportunity to edit their questions prior to teacher harvest the questions for marking."
Ky-Anh Nguyen, Oral Microbiology, University of Sydney

4.2. The use of PeerWise for assessment

Regarding the use of PeerWise for assessment, a couple of educators recommended working with the students when introducing a PeerWise assessment:

"Co-design a quality assessment tool with students"
Delyse Leadbeatter, Dentistry, The University of Sydney

"The mark scheme was shared and discussed with students in the PeerWise workshop that took place to introduce the tool."
Suzanne Fergus, Chemistry Education, Learning & Teaching, University of Hertfordshire

Other advice included providing clear instructions (**Denis Duret, Veterinary Science, University of Liverpool**), possibly having a PeerWise activity *"with open book in a set time slot"* (**Anonymous, Educational and Developmental Psychology, Monash University**) and using PeerWise for formative assessment with large groups (**Suzanne Fergus, Chemistry Education, Learning & Teaching, University of Hertfordshire**).

4.3. General advice

General advice about PeerWise also featured comments about student involvement. Suggestions included the following:

"Important to fully discuss/negotiate with students before commencing! Ownership with each class."
Anonymous, Educational and Developmental Psychology, Monash University

"We now get students to conduct the introduction to PeerWise as this gives the whole thing more credibility. Also students enjoy being course administrators and looking in on student questions to leave comments and help."
Philip Smith, Medicine, Cardiff University

Other advice included spending time helping students in areas such as giving feedback (**Delyse Leadbeatter, Dentistry, The University of Sydney**) and the following:

"Students felt overwhelmed if there are too many questions to be reviewed for a given period of time"
Ky-Anh Nguyen, Oral Microbiology, University of Sydney

"Provide some questions initially to get the ball rolling"
Denis Duret, Veterinary Science, University of Liverpool

We will use this advice when using PeerWise in the future.

5. Discussion

It is noted that the number of responses to the student survey gives a limited picture of the student experience. However, the responses still gave an insight, especially into the differences in results between the SHU and LTU modules. The evaluation within this case study indicates that overall PeerWise generally had a positive impact on the learning experience of students in both modules. For example, several students thought that their understanding had improved because they used PeerWise, and some thought their ability and/or confidence increased.

The most prominent theme arising from SHU students' qualitative comments was related to PeerWise being a useful tool for re-visiting material. This highlights one of the advantages of the assessment approach adopted at SHU where, as a one-off assessment, students were asked to write and answer questions on topics that had not been taught for a while. For SHU students, the activity appeared to be a useful revision exercise. By contrast, the most prominent themes arising amongst LTU students were related to the positive impact on their ability to write clear questions, which in turn helped increase their understanding, and the learning community that the activity helped to foster. This highlights one of the advantages of the ongoing nature of the assessment approach which was adopted at LTU.

Also of interest was the diversity of student reactions towards the fact that their questions would be visible to other students. While some students reported that the quality of their questions was not impacted, some other students reported either a positive or negative impact. This finding indicates that future work to further explore student perceptions as they relate to visibility of questions would be of interest.

Much of the advice presented in Section 4 was consistent with the student feedback and our own implementation and perceptions of the activity. For instance, several students commented that through engaging with the activity, they gained skills related to designing questions, indicating that this was a new skill for them. This supports the advice from practitioners that teaching students how to write high quality questions in the initial stages would provide useful scaffolding for this activity. Providing clear instructions was also highlighted in the practitioners' advice. In our own experience, we found this to be a useful practice also, so that students knew what was expected of them and were able to gain as much as possible from the activity.

From our experience, how to use PeerWise for assessment is a question that requires careful consideration. Two methods were presented in this case study, both of which had advantages and disadvantages as discussed. Furthermore, while one method involved manual marking and thus facilitated a more rigorous marking scheme with a higher focus on question quality, the other involved automated marking but with less capacity for detailed evaluation of question quality. While manual marking may be considered a preferred option in terms of quality of the assessment, the feasibility of doing so at large scale may come into question. One practitioner offered an alternative solution for large cohorts, which was to use PeerWise for formative assessment only and as such, the benefits of learning would still be available to students without the need for formal marking to occur.

It was also observed that, in general, the student perception was that providing feedback was the least beneficial part of the activity. However, some studies have shown that providing quality peer feedback to other students can have a positive impact on one's own academic performance (e.g., Li and Steckleberg, 2010). It would therefore be useful to help students understand the benefits of providing feedback to others, particularly in terms of the benefits to their own learning. This sentiment was echoed in the gathered advice, and the suggested methods could be used to help with this, such as workshops to critique feedback, providing exemplar comments and creating guides.

6. Recommendations for future implementation

The common themes arising from the evaluation within this case study and the practitioners' advice provide some useful conclusions. These can be offered as recommendations for future implementation in order to improve the student experience while using PeerWise, as well as student outcomes. First, it is recommended that at the initial stages of implementing PeerWise in a module, support is provided to students on how to write high quality questions. Second, it is recommended that the benefits of providing feedback to others, particularly for one's own learning, is communicated. Suggested methods for implementation of these recommendations include workshops, exemplar questions and comments, and creating guides. Third, it is recommended that clear instructions be provided to students to facilitate a positive and beneficial student experience. Fourth, it is recommended that careful thought be given to the assessment strategy. While there are a number of options in this regard, including manual, automated, or no marking (formative only), consideration may be given to the class size, weight of the assessment, and desired outcomes.

7. Funding

8. Acknowledgements

9. References

Bloom, B.S., 1956. Taxonomy of educational objectives. Handbook 1: Cognitive domain. New York: McKay.

Denny, P., Luxton-Reilly, A. and Hamer, J., 2008. The PeerWise system of student contributed assessment questions. In *Proceedings of the tenth conference on Australasian computing education - Volume 78* (ACE '08), pp.69-74. https://doi.org/10.1145/1384271.1384293

Feeley, M. and Parris, J. 2012. An Assessment of the PeerWise Student-Contributed Question System's Impact on Learning Outcomes: Evidence from a Large Enrollment Political Science Course. *SSRN*, pp.1-30. https://doi.org/10.2139/ssrn.2144375

Fergus, S., Hirani, E., Parkar, N. and Kirton, K. 2021. Strategic Engagement: Exploring Student Buy-in across a Formative and Summative Online Assessment. *All Ireland Journal of Higher Education*, 13(1), pp.1-24. Available at: https://ojs.aishe.org/index.php/aishe-j/article/view/441 [Accessed 14 October 2021].

Guilding, C., Pye, R.E, Butler, S., Atkinson, M. and Field, E. 2021. Answering questions in a co-created formative exam question bank improves summative exam performance, while students perceive benefits from answering, authoring, and peer discussion: A mixed methods analysis of PeerWise. *Pharmacology Research & Perspectives*, 9(4), pp.1-12. https://doi.org/10.1002/prp2.833

Li, L., Liu, X. and Steckelberg, A.L., 2010. Assessor or assessee: How student learning improves by giving and receiving peer feedback. *British Journal of Educational Technology*, 41(3), pp.525-536. https://doi.org/10.1111/j.1467-8535.2009.00968.x

Scully, D., 2017. Constructing multiple-choice items to measure higher-order thinking. *Practical Assessment, Research, and Evaluation*, 22(1), p.4. https://doi.org/10.7275/swgt-rj52

Tarrant, M. and Ware, J., 2008. Impact of item-writing flaws in multiple-choice questions on student achievement in high-stakes nursing assessments. *Medical education*, *42*(2), pp.198-206. https://doi.org/10.1111/j.1365-2923.2007.02957.x