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Technology enhanced peer learning with PeerWise: Experiences and perceptions from a developing country

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This paper reports on experiences of using PeerWise - a web-based application that allows students to collaboratively create, answer and develop multiple choice questions. This review covers one year and two cohorts of undergraduate programming students, examining student interaction, contribution and perception of the tool as a learning support mechanism. Evidence from this review suggests that most students were able to contribute to PeerWise and that approximately 25% of students contributed much more than was expected. Overall moderate correlation was observed between students' contributions and final examination scores with students with higher levels of participation scoring high in their final examination. Students likewise reported significant support for the use of the tool to aid teaching and learning. This review also highlights the potential of PeerWise to support collaboration and suggests that this has specific implications for developing countries.

Key words: PeerWise, multiple choice questions, contributing student pedagogy

Introduction

Technological innovations over the last two decades have made it possible to explore various approaches to design, deliver and evaluate teaching and learning. 'Traditional' virtual learning environments, once used to *deliver* content to students, are now being overtaken by more social technologies (Berg, 2001). In particular the new generation of web 2.0 technologies has opened up significant possibilities beyond the delivery of content from lecturers to students by facilitating the creation of rich peer to peer interactions among students and between students and lecturers (Rafaeli, Barak, Dan-Gur & Toch, 2003). The increase in interest and use of these technologies in higher education (Beer, 2008) and their potential to significantly affect teaching and learning has encouraged the development of more innovative and collaborative learning technologies.

Online collaboration and students' contributions of content and ideas to academic discourse through social interactions have been significantly enhanced over the last decade (Collis & Moonen, 2008; Lee & McLoughlin, 2010). Further, the range of new media-rich technologies provides lecturers a number of options for delivering content using pedagogically diverse approaches (Ajjan & Hartshorne, 2008). Modern social networking technologies facilitate collaboration in many

different forms and in diverse environments (Hakulinen & Korhonen, 2010) allowing learners to actively engage in the learning process and to take control of their learning (Ramsden, 2003).

The contribution of students to the learning process is not a new phenomenon. Intrinsic motivation may encourage learners to contribute to the learning process without the direction of teachers and instructional designers (Collis & Moonen, 2006). Further, modern technology has made it easier to configure large-scale learning environments suited to the efficient management of the contributing student. The contributing student pedagogy (CSP) is a pedagogy that encourages students to contribute to the learning process (Hamer et al., 2008) and underscores the active role of students as contributors to the learning process. According to Hamer et al. (2008) two core values are central to CSP: (i) students contribute to the learning process and by extension their colleagues and (ii) students value the contribution of their colleagues. Students can contribute to the learning of others and value their contribution in a course in a variety of ways and, from a long term professional development perspective, one of the arguments for the CSP approach is that it aligns with the drive to develop students for life in the knowledge economy (Collis & Moonen, 2001).

There is emerging evidence of the exploration of technology integration in the teaching and learning spaces of Caribbean educational institutions. Students are demonstrating positive attitudes and inclinations towards technology integration in their learning experience (Gay, Mahon, Devonish, Alleyne & Alleyne, 2006; Singh & Gaffar, 2011; Gaffar, Singh & Thomas, 2011; Kalloo & Mohan, 2011; Singh, 2013). Further, lecturers have also demonstrated similar tendencies (Kistow, 2009; Singh, Gaffar & Thomas, 2012; Thomas, Singh, & Gaffar, 2012). However, Caribbean experiences with technology integration can, at best, be described as minimal and sporadic. Further, none of these studies emphasised a contributing student pedagogy approach to technology integration. Continuous integration, research and experimentation are necessary for us to further understand the true potential of technology integration in our education context.

PeerWise and multiple choice questions

PeerWise was designed using the principles of the contributing student pedagogy. PeerWise emerged from the Computer Science Education research domain at the University of Auckland as tool to support students studying computer programming and is a web-based application that allows students to collaboratively develop a bank of multiple choice questions (MCQs) that becomes available to all students (Denny, Luxton-Reilly & Hamer, 2008). PeerWise affords a number of social interactive tools to engage and motivate learners and allows students to earn badges based on accumulated scores derived from participation metrics. PeerWise also provides a feedback and tagging mechanism to enhance participation.

PeerWise was purposefully developed to exploit students' familiarity with social software and the web 2.0 phenomenon (Denny, 2010) and places the

responsibility of learning into the hands of students in a way is that is consistent with CSP (Purchase, Hamer, Denny & Luxton-Reilly, 2010). Wickersham and McGhee (2008) argue that deeper learning is evidenced when learners don't just regurgitate information but reflect on it to produce knowledge. The use of student-generated MCQs for learning is one example of this approach, and has a wide range of documented benefits (Fellenz, 2004) including the development of a deeper understanding of the subject content learned, with a shift from *acquiring* knowledge to *using* knowledge and developing a sense of ownership of the subject content. Through question construction and response; composition of explanations to contributed questions, and feedback submission to their peers, students engage in the application of higher order cognitive thinking skills (Denny, Luxton-Reilly & Hamer, 2008). This points to a shift from the old paradigm where questions are created by teachers and lecturers then administered to students (Sykes, Denny & Nicolson, 2010).

A number of studies on PeerWise focus on patterns of contribution, and correlations between student contribution and final examination scores. In addition, students' perceptions and the quality of items contributed by students (Sykes, Denny & Nicolson, 2010) are also explored. Denny, Luxton-Reilly and Hamer (2008) found a positive correlation between participation and final examination scores. A similar correlation was reported by Denny, Micou and Simon (2010) and Bates, Galloway and McBride (2011). Denny, Luxton-Reilly and Hamer (2008) reported that students developed high quality questions and were able to determine the quality of questions created by others. Bottomley and Denny (2011) suggested that students were eager participants and contributed a significant quantity of good questions to the question bank. Similarly, Sykes, Denny and Nicolson (2010) and Feeley and Parris (2012) reported that students contributed significantly more than was expected of them. Overall, positive correlations were reported between students' contribution and the grades obtained.

Denny, Luxton-Reilly and Hamer (2008) reported that students believed PeerWise helped them to learn and that they were willing to use the tool again. Bottomley and Denny (2011) stated that students rated PeerWise very highly and found it to be a useful learning tool. PeerWise was similarly rated by students in the studies by Sykes, Denny and Nicolson (2010) and Feeley and Parris (2012).

While evidence points to the significant utility of PeerWise to education, a number of related issues are also highlighted. From the students' perspective, Denny, Luxton-Reilly and Hamer (2008) noted that external motivation is needed to support question generation in PeerWise. Further, issues related to students' dissatisfaction with the moderation of the question bank were reported by Sykes, Denny and Nicolson (2010). The quality of MCQs created by students is also an issue underlined for attention in the literature (Hakulinen, 2010). From the teachers' perspective, Denny, Hanks and Simon (2010) identified three concerns in using PeerWise for their course: the quality of questions in the repository; the evidence of learning benefits, and the issue of students' perceptions of activity value when using PeerWise.

The literature suggests that PeerWise is widely adopted in a range of countries and institutions. However, it is also evident that these studies are predominantly from the developed world. This observation and the lessons learnt are important for adopters from the developing world because the two contexts are very different. Students and lecturers from the developed world are more likely to be technology-engaged than those from the developing world and this could mean the difference between success and failure when integrating technology (Jhurree, 2005).

PeerWise and CSP in a Caribbean education system

The integration of learning technologies to support face-to-face learning environments is a promise and a challenge for educators and students alike. The challenge is greater in environments where students and educators are not familiar with technology integration. However, the relative simplicity of many tools promises to minimise this challenge. PeerWise is one such tool that promises to change the way students contribute to their own learning and that of their peers. The goal of this paper is to provide an exploratory review on the use of this online tool in a developing country context and to compare the outcomes with those of the developed world.

The following questions are addressed:

1. What are the patterns of students' usage of PeerWise and how do these compare with patterns from investigations in developed countries?
2. Is the participation level in PeerWise correlated with final examination scores?
3. What are students' perceptions of PeerWise as a teaching and learning tool?

Methodology

In this study PeerWise was introduced to two cohorts of students registered in the third year of their four year BSc. Computer Science programme at the University of Guyana. This course is titled Introduction to Object Oriented Programming in Java (CSI 312 & CSI 3102) and serves as a comprehensive introduction to object oriented programming. This course lasts for 15 weeks; is the third programming course for the students under study, and follows a typical sequence of study in Computer Science. Teaching for this course is conducted primarily by lectures and by practical laboratory sessions. Assessment for this course is done using in class tests and programming assignments and projects totalling 40% and a final exam worth 60%. Both courses were taught and assessed by the same lecturers across the two years.

The first cohort used PeerWise in 2011 and was made up of 21 students. The second cohort engaged with PeerWise in 2012 and comprised 28 students. Both cohorts were allocated the final eight weeks of their course to use PeerWise to contribute their multiple choice questions. Both cohorts were asked to contribute 3-5 questions; answer as many as they wish, and write critiques and comments on

the questions of others. In the first cohort, 2% of the 40% allocated for coursework was awarded for contributing the minimum amount of questions and for one other contribution. In the second cohort 3% was awarded for making similar contributions. No formal training on the writing of good multiple choice questions was offered. However, students were provided with guidelines as to how to go about writing good questions. There was no training on the general use of the system. The students are experienced users of the internet and therefore training was not deemed necessary for their orientation to the system.

Data from both question banks were collected after the period of assessment and downloaded for analysis. Pearson correlation was used to explore the relationship between contribution of students and their final examination scores. Further, an open-ended online survey made up of six questions was administered, using a free web-based survey tool, Survey Monkey (www.surveymonkey.org), to both cohorts at the end of the respective courses to gather feedback on their perception of PeerWise in supporting their learning. This questionnaire was administered to both cohorts of students using their email addresses. 14 students (82%) from cohort 1 and 20 students (71%) from cohort 2 responded to the surveys. The questions used in the survey are as follows:

1. What are your general impressions of PeerWise?
2. Was PeerWise useful in any way to you during your course? Please expand?
3. Was PeerWise easy to use? Please expand?
4. How has PeerWise impacted on your learning, if it did at all?
5. What motivated you to use the PeerWise, contribute and answer questions? Feel free to be critical.
6. Do you think this tool is useful for students in general? If yes, in what way? All comments are welcome.

Results

What are the patterns of students' usage of PeerWise?

Data from each of the two courses was accessed and downloaded at the end of each course. In this section the overall use of PeerWise by students across the two cohorts along with post evaluation survey results is reported. In the first cohort 17 of the 21 students contributed questions and all of the 21 students answered questions. Table 1 shows a breakdown of the student contributions from cohort 1. In cohort 2 all 28 students asked and answered questions. However, even though more students took this course, the actual total number of contributions is less than that of cohort 1 (Table 2 shows a breakdown of the student contributions for cohort 2).

Table 1. Breakdown of student' contribution – cohort 1 (CSI 312)

Metric	Total	Average per student
MCQs written	132	7.8 (3-5 required)
MCQs answered	906	43.1 (no limitation)
Comments made	342	16.3
MCQs answered correctly	693 (76.5%)	33
MCQs answered incorrectly	213 (23.5%)	10.1

Table 2. Breakdown of students' contribution – cohort 2 (CSI 3102)

Metric	Total	Average per student
MCQs written	121	4.3 (3-5 required)
MCQs answered	667	23.8 (no limitation)
Comments made	61	2.2
MCQs answered correctly	415 (62%)	14.8
MCQs answered incorrectly	252 (38%)	9

Overall, the cohorts contributed an average of 5.3 questions per student which is above the required amount. In addition the cohorts on average answered approximately 34 questions per student - of which approximately 23 were correct. In terms of time spent, an average of 5.3 days was registered. Almost one quarter of the students contributed less than the expected number of questions required and almost one quarter of the students contributed more than the amount required. Table 3 shows the breakdown of the number of questions contributed by students.

Table 3. Distribution of question contribution

No. of questions written	%
< 3	22.4
3-5	55.1
> 5	22.5

Frequency of student interaction with PeerWise

Two very clear patterns of engagement are noticeable. Students in both cohorts contributed most of their questions during the period designated for routine evaluation of their contribution by the course lecturer (mid to late November and early December). This is represented by Figure 1 and Figure 3. Similarly, most of the answers were supplied to questions around the period leading up to final examination (early to mid-December) as demonstrated in Figure 2 and Figure 4.

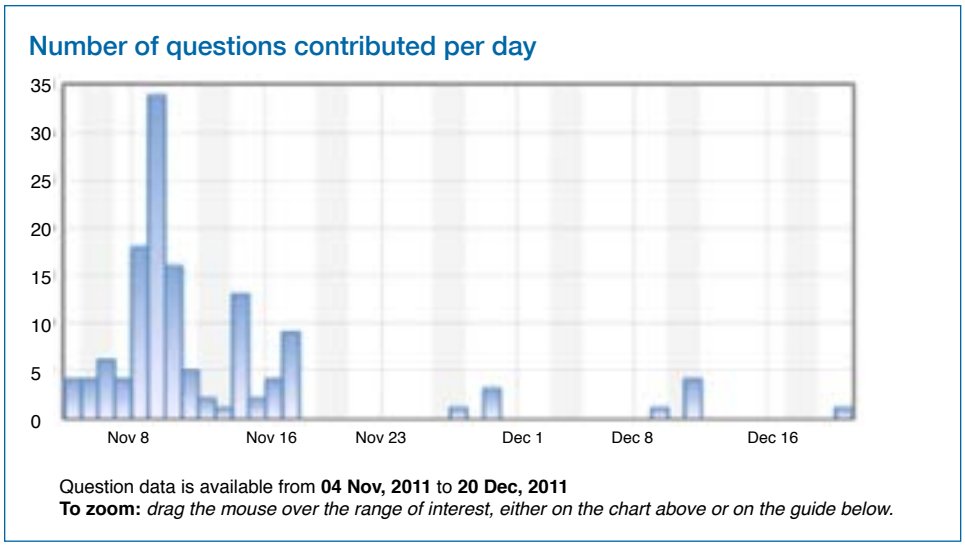

Figure 1. Daily question contribution – cohort 1

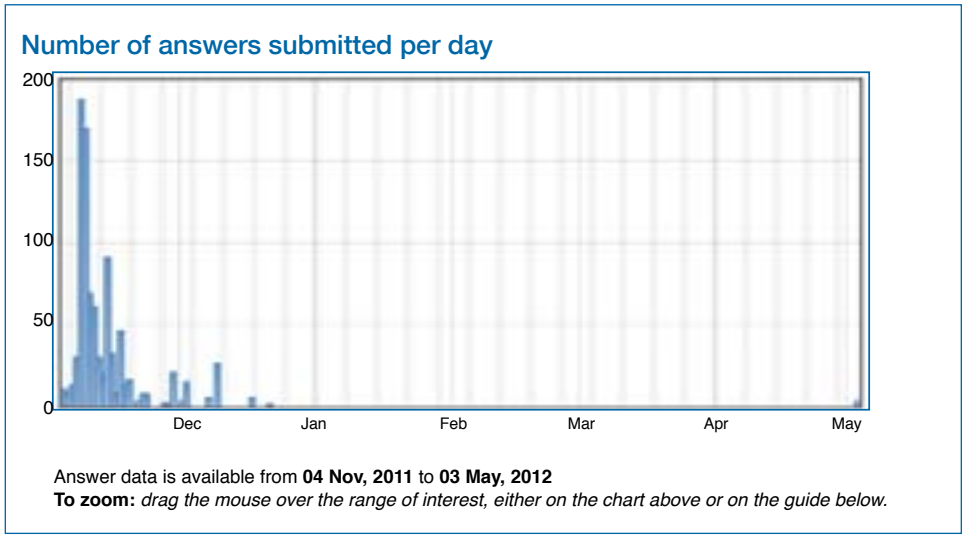

Figure 2. Questions answered per day – cohort 1

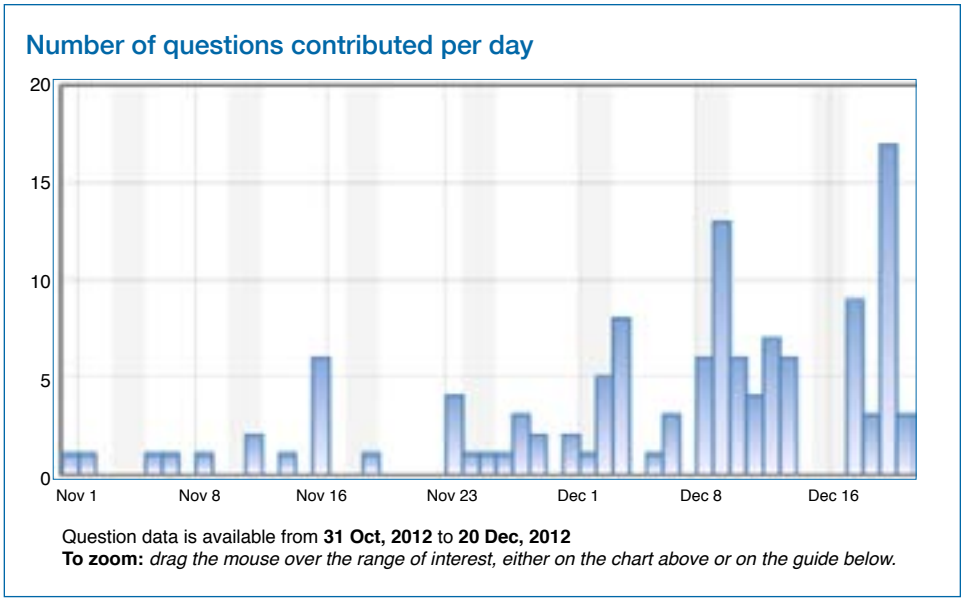

Figure 3. Daily question contribution – cohort 2

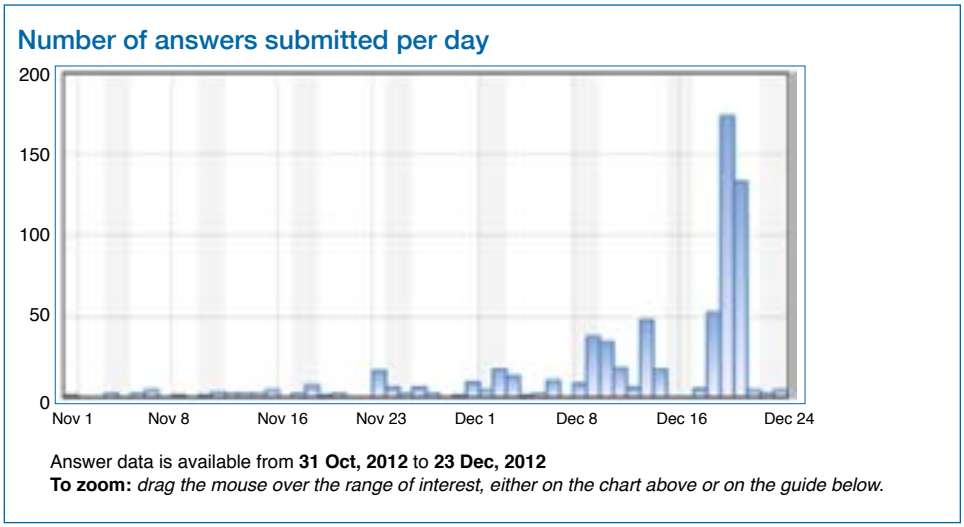

Figure 4. Questions answered per day – cohort 2

Is participation level in PeerWise correlated with exam score?

To examine patterns of contribution that may exist between participation levels and scores obtained in final exams, a number of relationships were explored. In particular, data from the cohorts were combined and then disaggregated by

performance in the final examination. Disaggregation was done using a score of less than 65% (corresponding to a grade C or less) and a score of greater than or equal to 65% (corresponding to a grade B or above). This scheme was used because it was felt to be a straightforward way to identify above average performing students and below average performing students. Table 4 shows the average contribution for the various metrics.

Table 4. Students' contribution and final exam score

Score	Averages					
	Questions written	Questions answered	Questions answered correctly	Number of comments	Length of comments	Days spent interacting with system
< 65% (n=27)	4.5	24.2	15.0	5.8	218.5	4.3
≥ 65% (n=22)	4.3	42.1	31.9	9.8	502.8	6.3

Except for the number of questions asked where students with lower than 65% scored 0.2 more than students with ≥65%, students who scored 65% or more scored higher on all variables. In particular, students with 65% or more achieved approximately twice the number of questions answered and questions answered correctly. Similar patterns are observed for the length of comments made and the amount of time spent interacting with the tool.

Correlation of contribution with examination scores

Pearson coefficient of correlation was calculated to explore possible relationships between students' contribution and their final examination score. Table 5 shows the correlations between question contributions and scores obtained in final examination.

Table 5. Correlation between student contribution and final exam score

Score	Questions written	Questions answered	Questions answered correctly
< 65% (n=27)	-0.06	-0.20615	-0.21244
≥ 65% (n=22)	0.481	0.133132	0.159134

For students with a score of 65% or more, a moderate positive correlation is noted with the number of questions written and final examination scores. However, negligible relationships are observed for the number of questions answered and

the number of questions answered correctly. For students with a score of less than 65%, a negligible relationship is observed between the number of questions written and final examination scores. A weak negative relationship is observed for both the number of questions answered and the number of questions answered correctly and final examination scores.

Student perceptions of PeerWise

Students were asked to describe their experience with PeerWise in relation to its utility; their perception of its value as a tool for teaching and learning; their attitude towards the tool, and their overall motivation for engaging in the process. Three main themes emerged from students' feedback on their experience with the tool: (i) ease of use of the tool; (ii) individual learning experiences, and (iii) pedagogical affordances of the tool.

Table 6 presents a summary of students' responses to questions 2, 3 and 6. A clear majority of the students responded in the affirmative on the measures of usefulness, ease of use and the utility of the tool. Further analysis of excerpts from students' description of their experiences with PeerWise revealed three major themes: (i) ease of use; (ii) positive perceptions of the contributing student pedagogy, and (iii) usefulness and potential of PeerWise.

Table 6. Summary of student responses to survey questions

Question	Cohort 1 (n=14)	Cohort 2 (n=20)
2. Was PeerWise useful in any way to you during your course?	Yes (11), No (3)	Yes (16), No (4)
3. Was PeerWise easy to use?	Yes (14), No (0)	Yes (15), No (5)
6. Do you think this tool is useful for students in general?	Yes (13), No (1)	Yes (18), No (2)

Students' qualitative responses suggested that PeerWise was easy to use and motivated them to continue contributing:

- *Setting up questions was easy enough*
- *It was very easy, no complication at all*
- *PeerWise was an awesome tool once I got acquainted with it (not that it took much time to get acquainted with)*
- *I believe the interface was easy to use and presented a useful way of keeping my interest (the badges and leader board). In fact, once I got started, seeing my position rise on the leader board and getting new badges was addictive*

Overall, students expressed satisfaction with the contributing student pedagogy as it provided a new and engaging way of interacting and learning with other students:

- *…it was useful because it encompasses a new way of learning*
- *…it's a very useful tool for student because it has a new method of learning whereas the student post questions, also provide answer and explanation*
- *The idea of class participation motivated me whereas everyone is involved. Also both contributing and answering question motivated me*
- *I think it should be implemented for other courses especially in Computer Science*

Students described the impact of creating and answering questions; crafting explanations and comments, and explained how this motivated them to become more engaged and thoughtful before posting a contribution:

- *In choosing question content, it caused me to do research on particular areas before I posted a question. I had to be sure about something before I posted it*
- *Answering and reviewing other person's questions also taught me a lot as it was important to research and be certain before presenting suggestions and reviews to questions*
- *…the ability to add explanations and comments for questions was a big help in instances where I may have answered a question incorrectly*

Students also indicated that the tool was used as a revision strategy for examinations:

- *I actually used the tool in preparation for my exams; I wasn't able to get through all of the questions however*
- *I think it can be useful to students as a quick reference and a quick crash study before exams in order to sharpen up*

Students were very supportive in their recommendation of the tool:

- *I definitely think the tool would be useful for students. My only regret is that more students didn't post and critique questions posted*

Students proposed suggestions for technical improvements to PeerWise, and the assessment process, to better support their learning needs. They also indicated that the question bank was used for examination preparation:

- *On the flip side questions that are incorrect need to be fixed so as to ensure students don't end up taking the wrong answers and thinking those are correct*
- *…a contributor should be notified maybe by email when a question that they supplied has comments especially in cases where the comments may be critical of the answer the contributor would have chosen*

Discussion

Patterns of usages of PeerWise

Students in cohort 1 tended to contribute more questions than was expected of them. However students in cohort 2 tended to contribute within the expected range. When combined, 55.1% of the students contributed 3-5 questions (the expected amount) – which is consistent with what was observed by Denny, Luxton-Reilly and Hamer (2008). Significantly, 22.5% of the students contributed more questions than was expected. Both cohorts earned their coursework mark. However, while Paterson, Devon, McCrae and Moffat (2011) suggested that marks may be the strongest influence on student participation, Rhind and Pettigrew (2012) observed that students participated actively in a course where no marks were offered. The awarding of marks as a tool to motivate participation remains an outstanding question. In the context of our study, the numbers are too small to add any new suggestions to this debate.

Question answering and motivation

Both cohorts answered more questions than they contributed. On average students answered approximately five times more questions than they wrote. This is consistent with what is found in the literature (Denny, Luxton-Reilly & Hamer, 2008; Luxton-Reilly, Denny, Plimmer & Bertinshaw, 2011). However, on average, students answered approximately three out of 10 questions incorrectly. Possible explanations for some of the incorrect answers could be that some questions were poorly written or incorrect answers were provided. Indeed a potential indication of this could be inferred from the comment made by a student - that poorly written questions and those with incorrect answers should be corrected to facilitate accurate learning. This is an important point of consideration as incorrect answers could lead to misconceptions about a topic. However, Denny, Luxton-Reilly and Simon (2009) suggest that even poorly written and poorly rated questions can benefit participants and contributors themselves since poorly written questions, if interacted with, provide an opportunity for participants to construct comments, seek out clarifications, and suggest corrections, which then benefit the author and other participants. There is some evidence of attempts by students to suggest corrections for questions that they felt were poorly written and Figure 5 illustrates how participants interacted with authors in such instances:

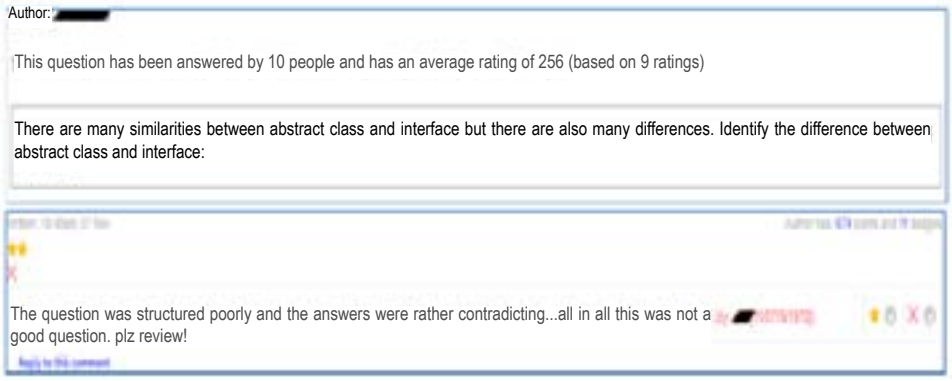

Figure 5. Example of poorly written question and the subsequent student response

This question was poorly written as the second half assumes that there is one difference between an abstract class and interface even though the student suggested many differences. This question was also rated poorly by students, perhaps partially as a result of its poor quality. Further, in cases where incorrect answers were provided, other participants may suggest the correct answer (Denny, Luxton-Reilly & Simon, 2009). Some emerging evidence was found of students attempting to clarify answers that they thought were incorrect. However, the evidence provided on this issue is minimal and therefore a more comprehensive analysis of questions that are poorly written and those with incorrect answers is recommended.

Students reported that they enjoyed answering questions as they felt they were learning more through question answering than though question creation. However, apart from the minimal effort required to select an answer to a question compared to the effort required in creating a question, it is not entirely clear what might explain this preference. One reason could be connected with the type of questions students answered; however, Denny, Micou and Simon (2010) noted that it is unclear whether students choose to answer higher quality questions more frequently than lower quality questions. Another possible explanation for the high level of question answering could be the social gaming element of the tool which provides extrinsic reward elements such as leaderboards, badges, level, and points (Nicholson, 2012). Emerging evidence from PeerWise suggests that students are encouraged by its social gaming elements and Ryan (2013) reported that students were motivated to achieve the highest ratings for a question. To achieve high ratings students reported that they took time to come up with good questions that will achieve high ratings.

Frequency pattern of usage

Two consistent patterns emerge when the data is examined for the actual time and period spent using the system. Students interacted with PeerWise for approximately one to two days when they were being assessed and for a similar number of days leading up to their final examination. This observation is consistent with what was observed by Denny, Luxton-Reilly and Hamer (2008). The usage of the system as final examination approached is an indication of students' perception of PeerWise as a worthy revision tool (Sykes, Denny & Nicolson, 2010). However, to increase usage and engagement at earlier stages, Hakulinen and Korhonen (2010) suggested that multiple deadlines and email notifications may lead students to revisit the system more often. Further, Ryan (2013) suggested that constant feedback is critical for the development of student cognitive processes and to deepen their learning. Results from our survey suggest that emails that inform students when updates are made to the system could possibly influence revisits and usage of the system.

Is participation level in PeerWise correlated with exam scores?

To examine relationships among contribution variables and final examination scores, participants were separated into two groups by grades obtained (grade B or more, and below grade B). On all metrics except number of questions written, students with grade B or above contributed approximately twice as much as other students, and spent more time on the system. This is expected as students who are classified as high performers are likely to engage more with learning experiences (Bates, Galloway & McBride, 2011). This is not necessarily a problem as Ryan (2013) noted that PeerWise provides a space for all students to interact, engage with, and learn from each other. In such an open system, students who are not high performers may benefit from the engagements with their peers.

In terms of correlations, only one metric - the number of questions created, was observed to show a moderate positive correlation with final examination scores. This is consistent with positive but insignificant correlations observed by Denny, Hanks, Simon & Bagley (2011). While other studies reported positive correlation between student activities on PeerWise and examination performance (Denny, Luxton-Reilly & Hamer, 2008; Denny, Micou, & Simon, 2010), it is yet to emerge clearly from the literature which aspects of students contributions, if any, influence performance on final examinations. In some cases, inconsistent and inconclusive results are noted (Bates, Galloway & McBride, 2011). However, notwithstanding these inconsistencies, overall observations are suggestive that PeerWise provides enhanced learning opportunities for students (Feeley & Parris, 2012).

What are students' perceptions of PeerWise?

The usability of learning tools and learners' perception of the value of these tools are critical elements necessary for adoption (Gould, Terrell & Fleming, 2008; Storey, et al., 2002). Students reported favourably on the usability of PeerWise. In particular, they claimed that it was easy to use and that they were able to engage

relatively quickly with process. Learning technologies that are difficult to use may distract users from the main task and hinder participation and engagement (Ardito et al., 2006; Squires & Preece, 1999). According to its author, PeerWise is simple for instructors to use and students require no instructor interaction (Denny, 2010) and this study suggests that usability issues did not affect students' usage of PeerWise. In addition, students suggested that the tool could be improved in some ways to enhance their participation. However, it is important to note that both cohorts of students in this study are computer science majors and are more likely to be tech-savvy than non-majors which could result in under-reporting of technical and usability issues.

Evidence of deep learning and careful engagement with the course material can be inferred from students' feedback on the question writing and answering process. Students noted that they spent time on particular topics from the course outline before writing a multiple choice question. They felt they had to be sure about an idea before posting it to the question bank. Similarly, students noted that careful thought was given to a question before they selected and answer or contributed a comment. These observations are consistent with those reported by Feeley and Parris (2012) and are an indication of the value of active participation and higher order student engagement. The benefit of active student involvement is highlighted by Wilson, Pollock and Hamann (2007) who suggested that activities that stimulate students' engagement will enhance their learning. Huerta (2007) further elaborates this point by suggesting that the key to student learning is active participation and not passive engagement.

Conclusion, limitations and future work

PeerWise provides educators with an easy-to-use tool to support teaching and learning in a socially engaging environment. PeerWise supports student ownership of the teaching and learning process through the creation of learning materials in collaboration with their peers. It affords educators the opportunity to shift focus towards the development of more student-centred, engaging, learning experiences. The findings from this study and previous studies indicate that online tools can support innovative approaches to teaching and learning by allowing students to actively contribute to their learning and that of their peers. This study reports positive experiences for students engaged with CSP in the development of multiple choice questions. On average students contributed more than the minimum expected number of questions and answered more than was expected. In addition, approximately one third of all answers provided were incorrect. An exploration of this subset of answers is recommended for future work. Students also found PeerWise very easy to use and reported positively their opinion of the learning potential of the contributing student pedagogy. These findings perhaps suggest that small rewards may not deter students from making a significant contribution to their learning but there is a need for more investigation in this area.

While the coverage and spread of topics for which questions were contributed have been explored in previous studies, an examination of the cognitive levels of questions created by students remains largely unexplored in the literature. In future studies a more detailed analysis on the cognitive quality of the questions and the comments contributed by students is recommended. Further, an analysis of the questions incorrectly answered compared with cognitive levels could be explored.

This study was set up to investigate the extent to which students who have never participated in a contributing student approach to teaching and learning, engaged with an online tool that supports learning using CSP. This review of PeerWise in a developing country context was also noted to be the first reported study of its kind. The results are very promising and provide motivation for further exploration in the Caribbean and other developing countries.

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