PeerWise - The Marmite of Veterinary Student Learning

Amanda Sykes[1], Paul Denny[2] and Lesley Nicolson[3]
[1]Student Learning Service, The University of Glasgow, Glasgow, UK
[2]Department of Computer Science, The University of Auckland, Auckland, New Zealand
[3]School of Veterinary Medicine, The University of Glasgow, Glasgow, UK
amanda.sykes@glasgow.ac.uk
paul@cs.auckland.ac.nz
lesley.nicolson@glasgow.ac.uk

Abstract: PeerWise is a free online student-centred collaborative learning tool with which students anonymously author, answer, and evaluate multiple choice questions (MCQs). Features such as commenting on questions, rating questions and comments, and appearing on leaderboards, can encourage healthy competition, engage students in reflection and debate, and enhance their communication skills. PeerWise has been used in diverse subject areas but never previously in Veterinary Medicine. The Veterinary undergraduates at the University of Glasgow are a distinct cohort; academically gifted and often highly strategic in their learning due to time pressures and volume of course material. In 2010-11 we introduced PeerWise into 1st year Veterinary Biomolecular Sciences in the Glasgow Bachelor of Veterinary Medicine and Surgery programme. To scaffold PeerWise use, a short interactive session introduced students to the tool and to the basic principles of good MCQ authorship. Students were asked to author four and answer forty MCQs throughout the academic year. Participation was encouraged by an allocation of up to 5% of the final year mark and inclusion of student-authored questions in the first summative examination. Our analysis focuses on engagement of the class with the tool and their perceptions of its use. All 141 students in the class engaged with PeerWise and the majority contributed beyond that which was stipulated. Student engagement with PeerWise prior to a summative exam was positively correlated to exam score, yielding a relationship that was highly significant ($p<0.001$). Student perceptions of PeerWise were predominantly positive with explicit recognition of its value as a learning and revision tool, and more than two thirds of the class in agreement that question authoring and answering reinforced their learning. There was clear polarisation of views, however, and those students who did not like PeerWise were vociferous in their dislike, the biggest criticism being lack of moderation by staff.

Keywords: PeerWise, veterinary, MCQ, student-centred, peer feedback, reflection, student engagement

1. Background

In traditional educational settings, students are much more familiar with answering questions set by their course instructor than they are with authoring questions of their own. This latter task offers a number of potential benefits which are well documented (Nicol, 2007), and a growing body of empirical evidence supports the inclusion of student authored questions in the learning process (Barak and Rafaeli, 2004, Rosenshine, Meister, and Chapman, 1996, and Yu and Hung, 2006). To create a clearly worded, relevant question and to explain the answer to that question in their own words, a student must be actively engaged in processing and organising course material.

The use of technology makes it possible for students to efficiently share their authored questions with one another. Unlike composing a question, which may initially be a novel task for many students, sharing content with their peers is an activity to which students today are already highly accustomed. Social media and social networking tools, such as YouTube and Facebook, are extremely popular with students, and examples of systems in which all of the content is user-generated and shared publically (or at least within a social group). In this paper we report on the use of a freely-available web-based tool, called PeerWise, to support students authoring and sharing multiple-choice questions (MCQs). One of the advantages of the MCQ format in this context is that students are challenged to consider misconceptions when designing a set of alternative answers. While PeerWise is the most widely used tool of its type, a range of similar tools exist supporting several question types including multiple-choice questions (AGQ (Chang, Huang, Tung and Chan, 2005), QPPA (Yu, Liu and Chan, 2005), QSIA (Rafaeli, Barak, Dan-Gur and Toch, 2004), Questionbank (Draaijer and Boter, 2005)), open-response questions (Luxton-Reilly, Plimmer and Sheehan, 2010), and programming questions (Denny, Luxton-Reilly, Tempero and Hendrickx, 2011). The familiarity of students with other social networking tools, and PeerWise's intuitive interface, facilitates ease of use by students with a range of computing experience.

An overview of the PeerWise tool has previously been given (Denny, Luxton-Reilly and Hamer, 2008a), so we include just a short summary here. PeerWise use requires minimal staff input: the course instructor typically begins the process by setting up a repository on PeerWise and granting their students access to the resource, and from this point the workload is student-centred. The main menu of PeerWise, shown for a typical student in the course that is the subject of this study, is shown in Figure 1. This menu is divided into three sections; questions that are authored, answered and remain unanswered by the student.

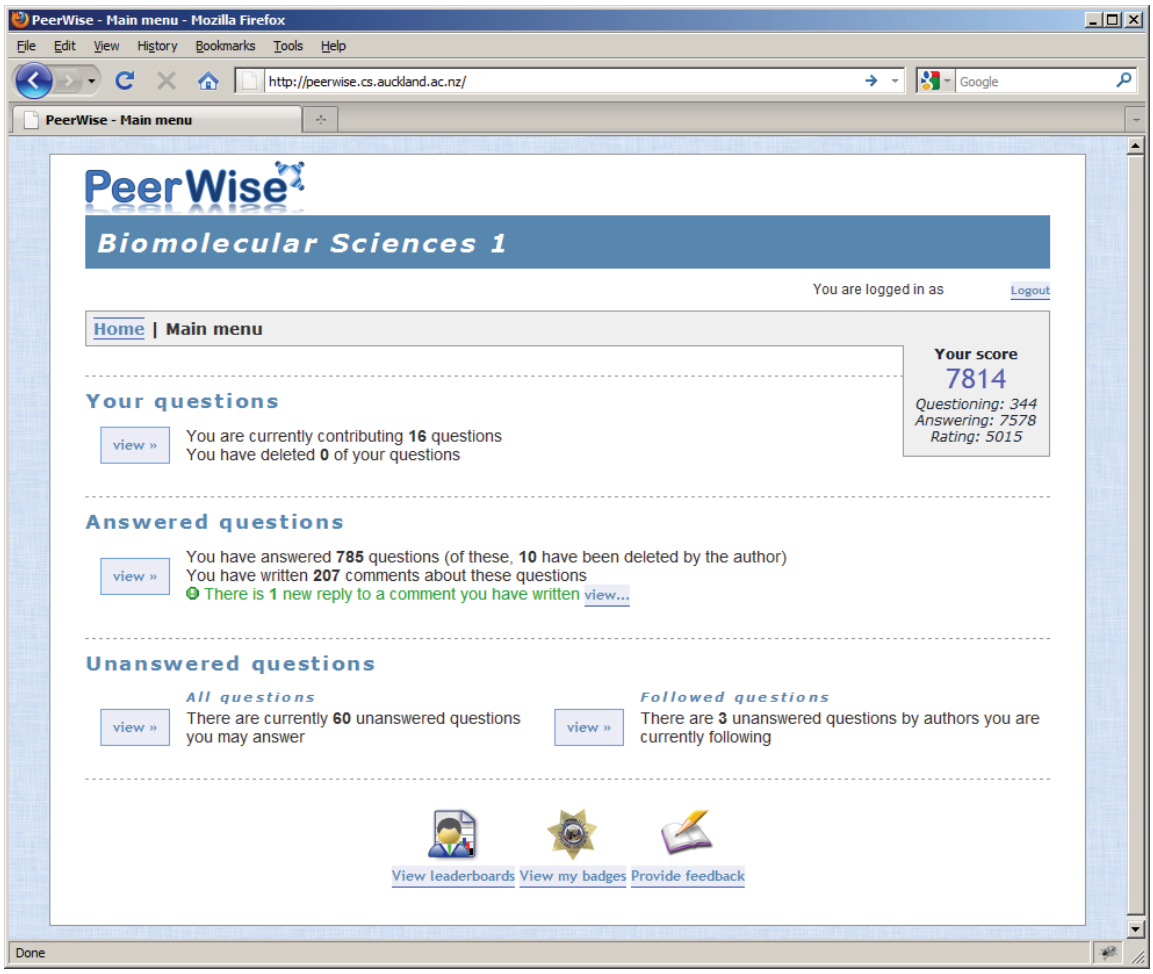

Figure 1: A student's view of the main menu of PeerWise

Students can create questions at any time, and are guided through this process by the PeerWise interface. They are also encouraged to help organise the bank of questions by associating relevant topics, or tags, with each question they contribute. Students can answer, evaluate and discuss any of the questions created by their classmates at any time. When using PeerWise to practise answering questions, students can filter questions by difficulty and by topics of interest and can use the ratings assigned to questions by their peers to find good quality questions to answer. PeerWise employs several basic game mechanics to encourage participation, for example, students are rewarded with points when the contributions they make are endorsed by other students.

Although this feature was not enabled for the course in this study, students can also earn badges for completing certain tasks within PeerWise. The idea of using badges, or achievements, for engaging and motivating users is becoming standard practice in online gaming and social systems. In 2002, Microsoft pioneered the first large-scale implementation of an achievement system with their XBox Live platform. Other successful examples of these types of systems include Wikipedia's barnstars (Kriplean, Beschastnikh and McDonald, 2008) where contributors are rewarded by other users for hard work and diligence, the badges rewarded for constructive participation to StackOverflow's question and answer site (StackOverflow, 2011), and the use of badges to encourage "check-ins" on popular location-based services such as Foursquare (Foursquare, 2011). Antin and Churchill (2011)

recently outlined five social psychological functions for badges as used in social systems. The use of badges in PeerWise aligns with these functions, which include "Goal Setting", known to be an effective motivator, as well as “Instruction” and “Reputation”.

Previous studies of the use of PeerWise at the tertiary level have focused on student perceptions, repository quality and learning gains. This research has shown that students perceive PeerWise to be a useful and enjoyable activity (Denny, Luxton-Reilly and Hamer, 2008b), that they are capable of creating high quality, relevant repositories (Purchase, Hamer, Denny and Luxton-Reilly, 2010), and that there are measurable benefits to student learning (Denny, Hanks and Simon, 2010). Although PeerWise has been used in a range of disciplines, this is the first report of the use of PeerWise with students of Veterinary Medicine.

The University of Glasgow Veterinary undergraduate cohort is diverse, with a high number of graduate students and overseas students, 31% and 40% respectively in 2010-11, with a range of educational backgrounds. The high qualification tariff for entry, along with expectations of achievement in areas other than academia including the acquisition of many hours of animal experience, results in selection of academically gifted and highly motivated individuals. In addition, the veterinary undergraduate curriculum is extremely intensive in terms of scheduling of classes and volume of course material. These combined factors result in a cohort of highly strategic learners. We elected to trial PeerWise with all 141 1st year veterinary students in Veterinary Biomolecular Sciences as their enthusiasm levels are generally high, the workload is lighter than that in later years, and a familiarity with and appreciation of the benefits of new technologies could be harnessed in later years of their undergraduate degree.

2. Methodology

The Veterinary Biomolecular Sciences course is taught over the first and second years of the Glasgow Bachelor of Veterinary Medicine and Surgery programme. Teaching is conducted primarily by lectures supplemented with small group tutorials, laboratory and computer-based classes and a student-directed learning assignment. The first year course comprises 11 topics delivered in two terms from September until March. Assessments comprise 1 class exam at the end of term 1 which contributes 10% to the year mark, and a professional exam in May, contributing 85%, both of which include MCQs and short answer questions. As an incentive to participate in the PeerWise task, the final 5% of the professional mark was assigned to this task and in addition students were informed that some of their questions might be used in the class exam. In order to obtain these marks students were required to meet 8 deadlines as indicated in Table 1. The total requirement per student was therefore to author 4 questions and to answer 40. These were minimum participation requirements, and students were free to contribute to a greater extent if they wished.

Table 1: PeerWise deadlines in Veterinary Biomolecular Sciences course

Deadline	Task	Date
1	Submit 1 MCQ on topics: cell biology, proteins and enzymes, molecular biology	Mon 25th October 1700hr
2	Answer 10 MCQ	Mon 8th Nov 1700hr
3	Submit 1 MCQ on topics: metabolism, biostatisics, genetics	Mon 22nd Nov 1700hr
4	Answer 10 MCQ	Mon 6th Dec 1700hr
5	Submit 1 MCQ on topics lipids and nitrogen	Mon 24th Jan 1700hr
6	Answer 10 Term 2 MCQ	Mon 7th Feb 1700hr
7	Submit 1 MCQ on topics nutrition, blood and signalling	Mon 28th Feb 1700hr
8	Answer 10 Term 2 MCQ	Mon 7th Mar 1700hr

Peerwise use was scaffolded by an introductory interactive session lasting an hour. Following a brief overview of the session, students participated in an 8 question quiz (Nora Mogey, personal communication allowing use of questions, originally sourced from Race and Lewis), highlighting the limitations of poorly written MCQs. Context-based MCQs were then presented illustrating poorly and well formed biomolecular sciences MCQs, the latter including simple and more complex examples. Good and bad aspects of MCQs were reiterated before moving on to an introduction to the PeerWise interface with screen-shots of each of the main screens. We emphasised the benefits to students of engaging with the task, showing exam performance improvement data from published studies (Denny, Hamer, Luxton-Reilly and Purchase, 2008) and informing them of the 5% they would gain for their

final year mark if they met all deadlines and submission criteria. The session was closed with practical information on how to log in to PeerWise and the specifics of the assessed task.

Data was collected via the administration menu in PeerWise in the form of student activity profiles and database content, for the period 20th September through to the final deadline, 7th March. Student opinions on the PeerWise tool were gathered through standard course quality assessment questionnaires and through a specific survey, conducted on SurveyMonkey, including Likert-based and open-response questions (Table 2 and Table 3). Comments made in response to the open-response questions were coded, as driven by comment content. Some individuals made comments relevant to more than one of the assigned codes, in which case all relevant codes were attributed. The coded data was then allocated into categories from which overarching themes were identified (Denscombe, 2010, p286-295). Finally, student performance in a summative exam (the class exam originally scheduled for December but postponed until January due to bad weather) was assessed relative to student engagement, on an individual basis, with PeerWise. For the purposes of this paper, results presented focus on student engagement with PeerWise, student perception of the tool and correlation between engagement and class exam grade.

Table 2: Likert questions from the SurveyMonkey survey

Q1	Developing an original question on a particular topic reinforced what I knew about that topic and improved my understanding of the material
Q2	Answering questions written by other students helped reinforce what I knew about the subject and improved my understanding of the material
Q3	Reading other students' comments about my questions helped me to learn
Q4	I liked to see how other students rated my questions
Q5	I thought that PeerWise was innovative
Q6	This year I found the process of developing original questions and answering other students' questions to be useful and I would like to use PeerWise again in the future

Table 3: Open-response questions from the SurveyMonkey survey

Q7	What do you believe is the biggest benefit of using PeerWise?
Q8	What aspects of using PeerWise did you find most useful, interesting or enjoyable?
Q9	What do you believe is the biggest problem with PeerWise?
Q10	Can you recommend something that would make PeerWise more valuable or effective for learning in Veterinary Medicine?

3. Results

3.1 PeerWise data

PeerWise was available to students throughout the Biomolecular Sciences course from the 20th September, 2010 until the end of the academic year. Of the 141 students enrolled in the course, all participated in PeerWise and all but 15 met the minimum requirements. From 20th September until the final deadline, 7th March, a total of 795 questions were authored. Of the 17859 answers submitted to these questions, 11725 (66%) matched the correct answer indicated by the question author.

With respect to question authoring, individual contributions ranged from 3-16 and the mean number of questions authored per student was 5.6 (median = 5). The mean number of questions answered was 126.4 (median = 78) with a range of 32-785. So, students on this course answered many more questions than required, although the number of questions they authored was similar to requirements.

Figure 2 shows the total number of questions authored and Figure 3 the total number of answers submitted each day from the start of term until the final PeerWise deadline. The four spikes in activity with respect to questions authored correspond to the four question authoring deadlines. Students'

activity became increasingly focused with each deadline, with practically no new questions authored by students in the weeks between deadlines two and three, and three and four. Activity spikes are also evident around deadlines three and four for answer submission, but are less obvious for the first two. Of interest is the large spike of activity on the 13th January, the day before the class exam. As no course credit was on offer during this time, this activity corresponds to voluntary use of the tool as a resource for revision.

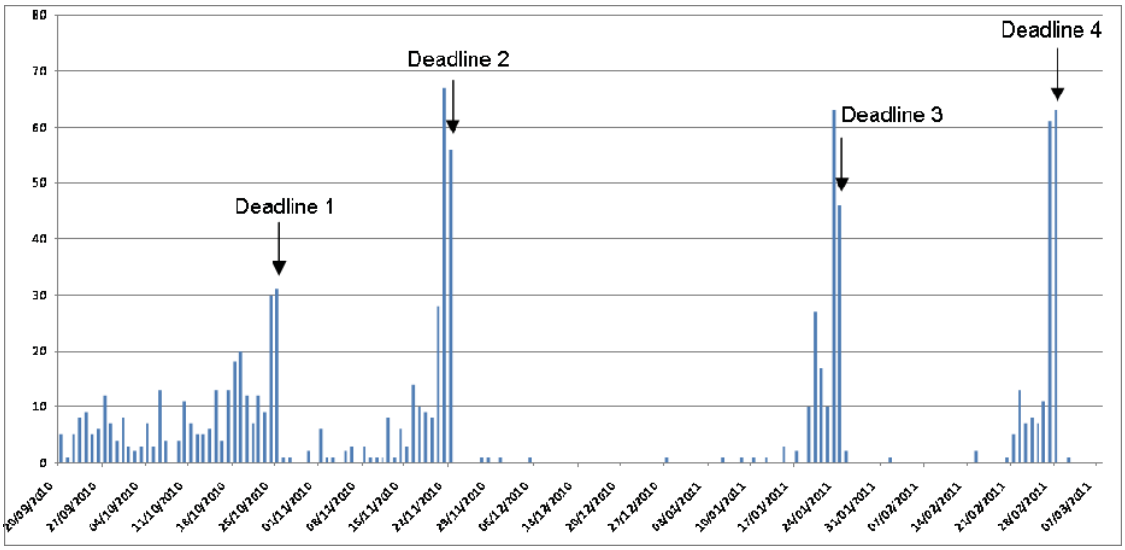

Figure 2: Number of questions authored per day

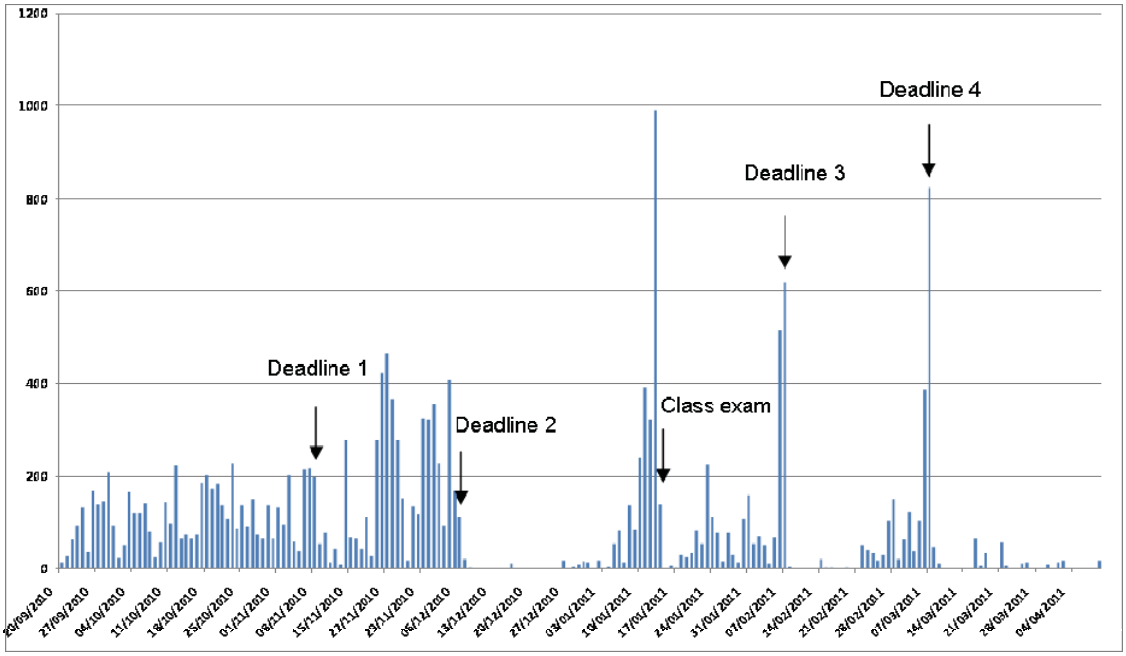

Figure 3: Number of answers submitted per day

3.2 Exam grade data

A scatter plot of the total number of answers submitted by each student in the course when using PeerWise, against their class exam grade revealed heavy skewing of data due to a small number of students answering a very large number of questions. The data was log-transformed to correct for this and the resulting scatter plot is shown in Figure 4. The relationship between class exam grade and the log of the number of questions answered is not very strong, which is to be expected given the many factors involved in determining exam performance. However, a medium-strength (de Vaus,

2001) positive correlation exists (r = 0.34), and this relationship is highly statistically significant (p << 0.001) (Wessa, 2011).

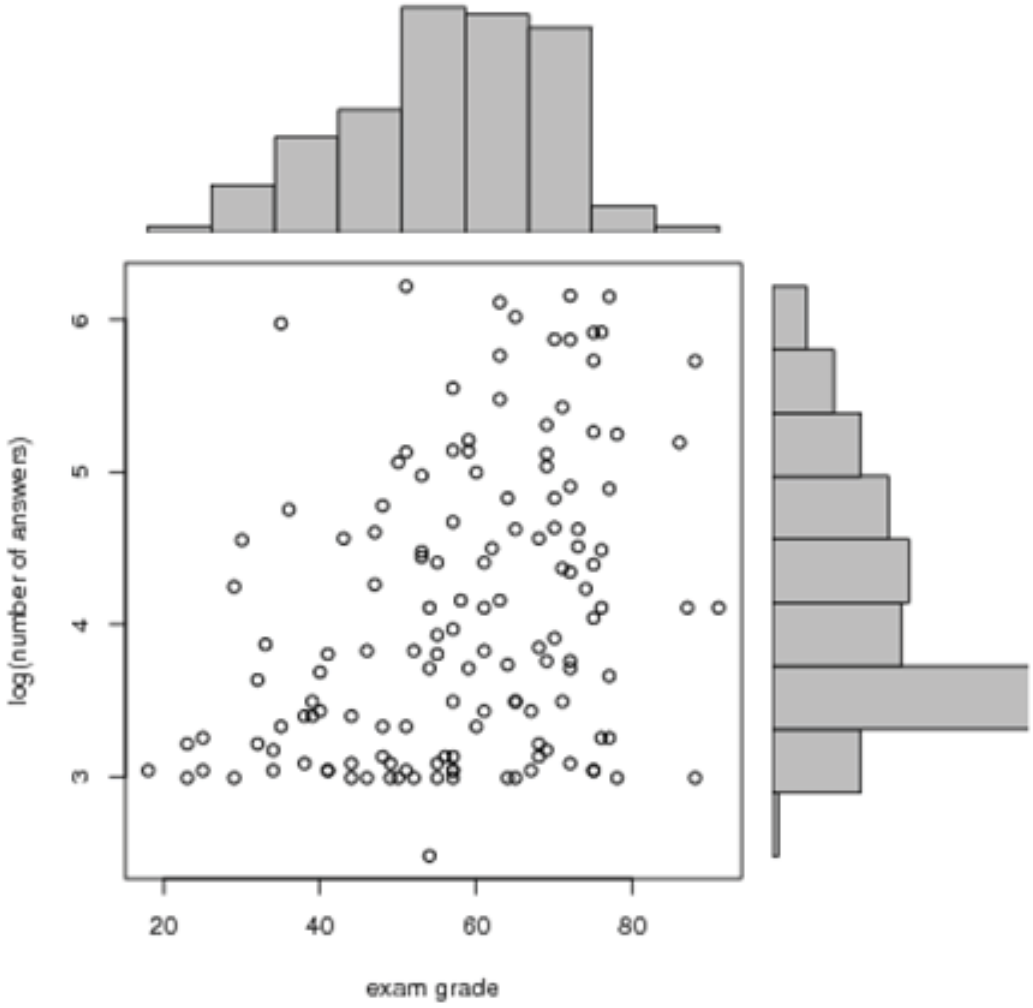

Figure 4: Exam grade plotted against log (number of answers submitted)

Similar to the number of answers submitted, the number of distinct days that a student was active with PeerWise is also skewed. Figure 5 plots the log of the number of days of activity against the class exam mark. Once again, a medium-strength positive correlation exists (r = 0.33), and this relationship is highly statistically significant (p << 0.001).

3.3 Survey data

The standard course-associated quality assurance questionnaire sent to students at the end of term 1 prompted students to score the value of each lecture, laboratory practical, computer session and the PeerWise exercise. PeerWise received the highest score of any activity, with an average of 4.01/5. In response to the opportunity to comment openly on PeerWise, 19 students made comments, with the majority focused on its benefit as a learning and revision tool or on issues regarding poor moderation by students.

A total of 68 students responded (48% response rate) to the SurveyMonkey survey (the survey questions appear in Table 2 and Table 3). A summary of the student responses to the Likert questions on the class survey is given in Figure 6. Each bar is centred on “neutral” and shows the relative proportion of “strongly disagree”, “disagree”, “neutral”, “agree” and “strongly agree” responses. Responses to Q1 and Q2, regarding student attitudes to the value of authoring questions and answering questions authored by their peers, were mostly positive, with more than 75% of

students either “agreeing” or “strongly agreeing”. Q3 and Q4 drew the least favourable responses; some students did not find the comments or ratings provided by their peers about their own questions very valuable to their learning. As shown by the response to Q5 and Q6, the majority of the class found PeerWise innovative and would wish to use it in the future.

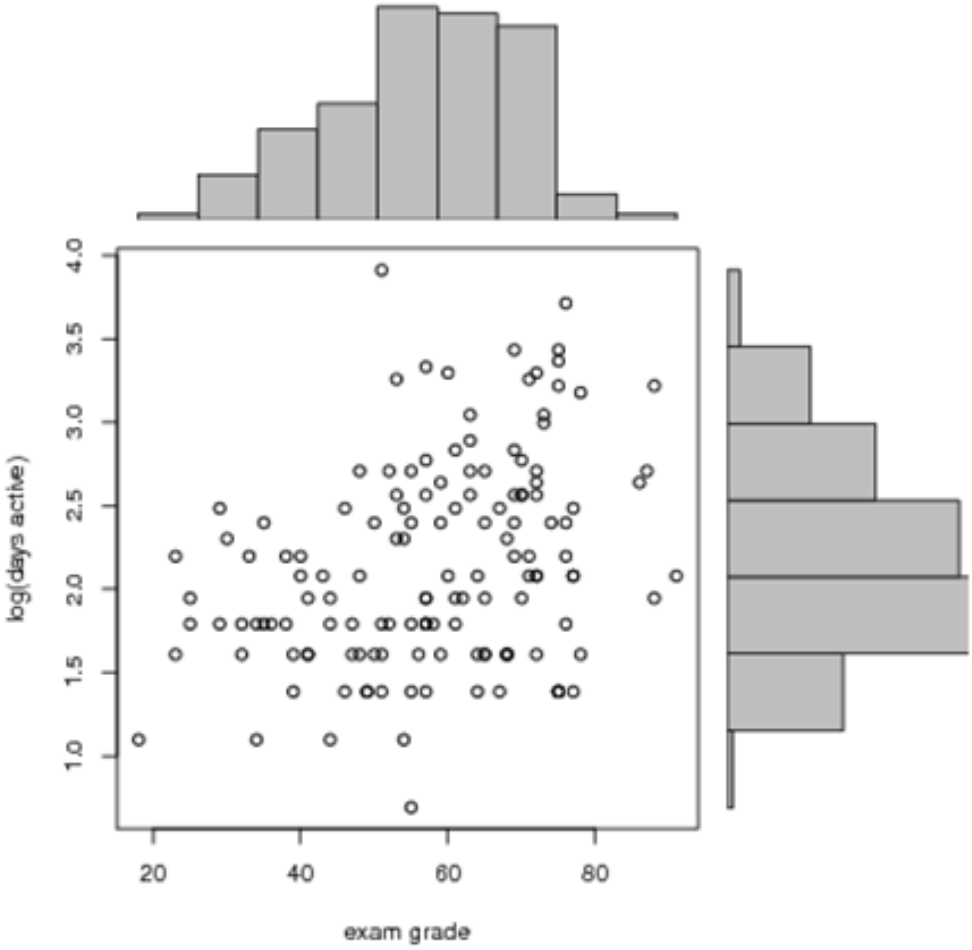

Figure 5: Exam grade plotted against log (number of days of activity)

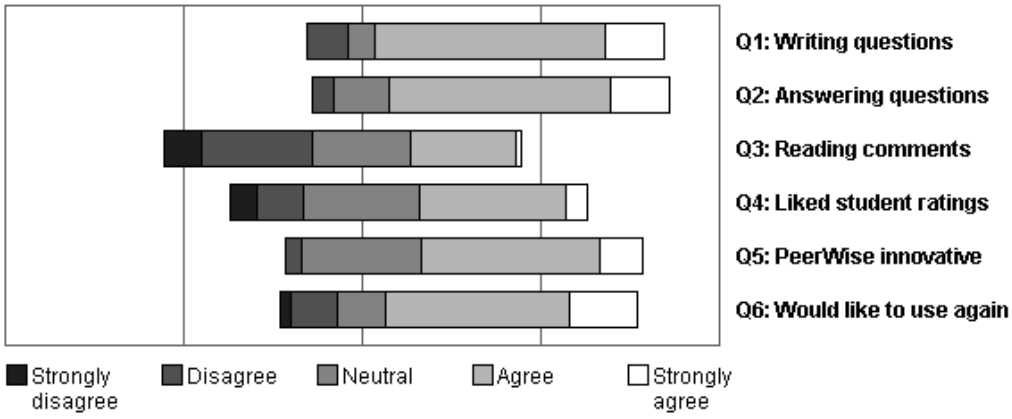

Figure 6: Responses to Likert questions from the SurveyMonkey survey

The feedback we received to the open-response questions was interesting. The students described PeerWise as beneficial for revision, learning and receiving feedback (Q7: What do you believe is the biggest benefit of using PeerWise? Figure 7) and these aspects were also reflected in their response

to Q8; What aspects of using PeerWise did you find most useful, interesting or enjoyable? (Figure 8). Consistent with the result for Q4 (Figure 6), a number of students felt that the comments written by their peers were problematic (Q9: What do you believe is the biggest problem with PeerWise? Figure 9). Students also commented on poorly written and unrepresentative questions, and many suggested that moderation by staff would solve these problems. The issue of moderation was raised again in response to Q10: Can you recommend something that would make PeerWise more valuable for learning in Veterinary Medicine? (Figure 10). Students also expressed a desire for PeerWise use to be extended to other courses in the Veterinary curriculum.

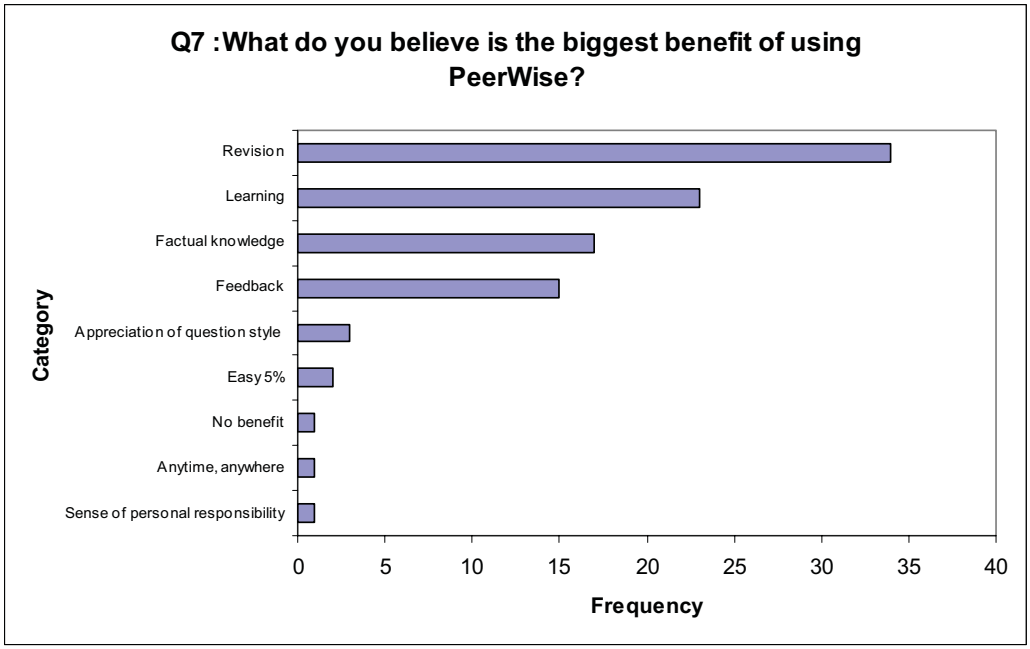

Figure 7: Responses to question 7 from the SurveyMonkey survey

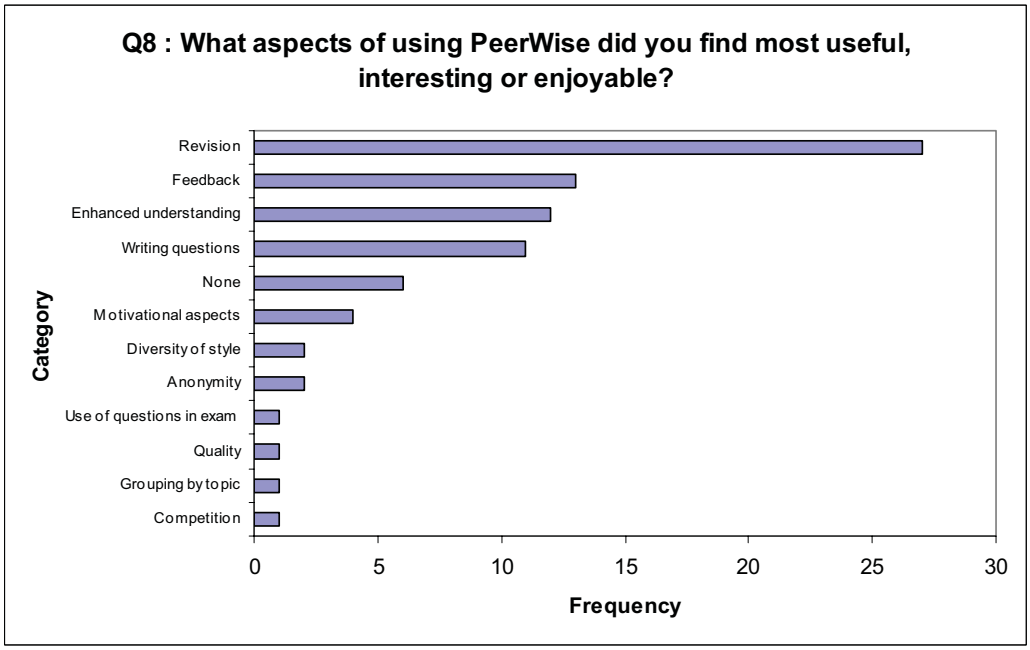

Figure 8: Responses to question 8 from the SurveyMonkey survey

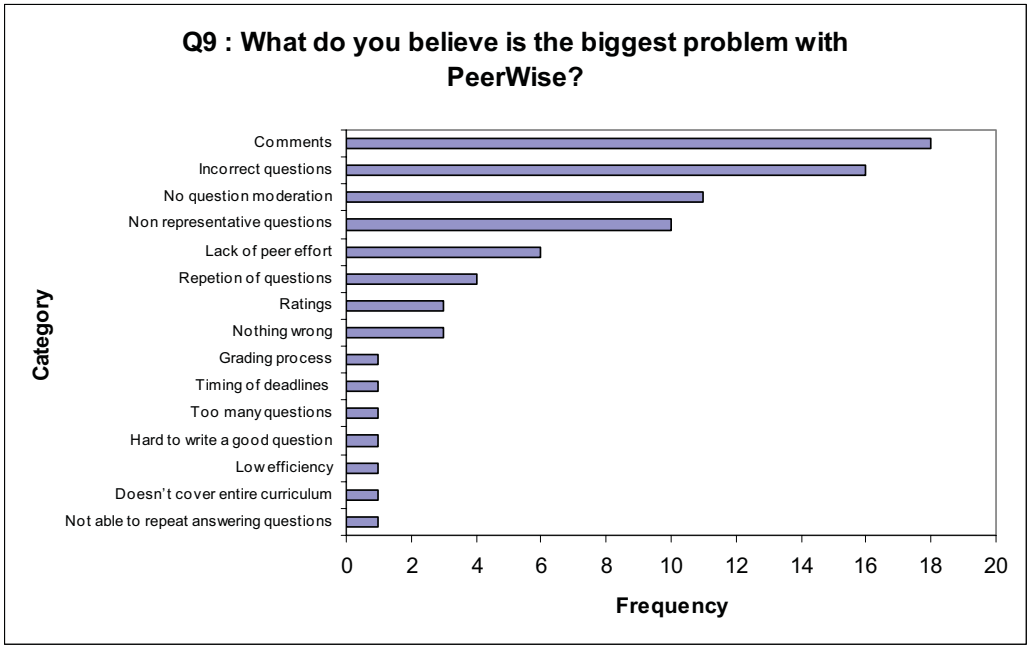

Figure 9: Responses to question 9 from the SurveyMonkey survey

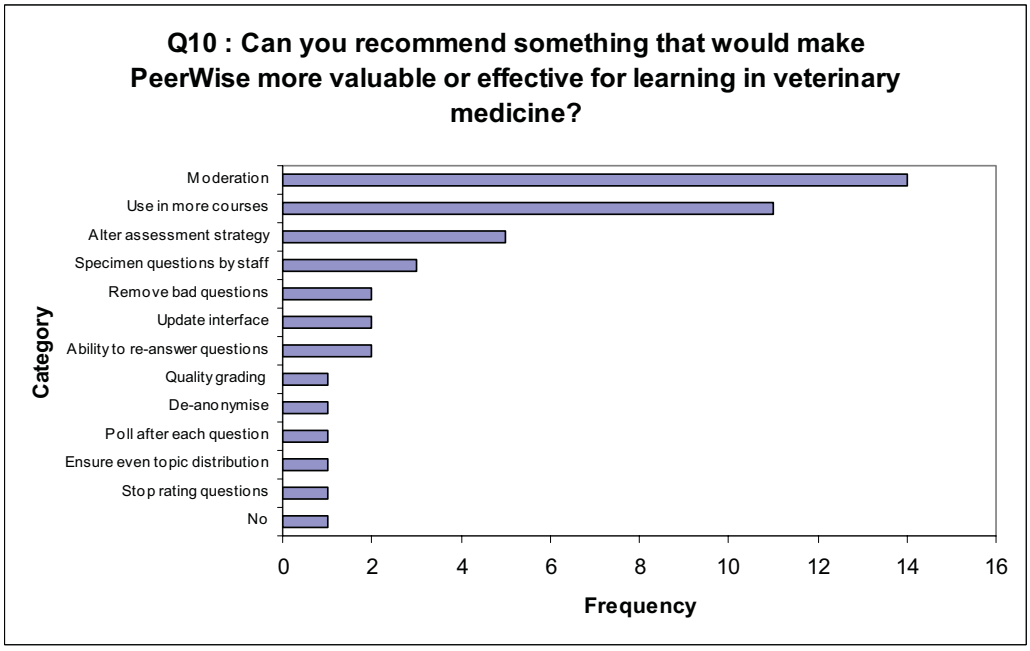

Figure 10: Responses to question 10 from the SurveyMonkey survey

4. Discussion

This first report of PeerWise use with students of Veterinary Medicine manifested many positive outcomes:

- Student compliance with the deadlines required to be met for the continual assessment mark was high with 100% of students meeting a minimum of five deadlines and 90% meeting all eight, despite only 5% being allocated to their final professional exam mark.
- Student engagement with PeerWise was high: over half the class authored more questions than the minimum although most did not author significantly more than required (consistent with

studies in other disciplines). Nearly two thirds of the class answered more questions than required.

- Elevated engagement by 30% of students in the two week periods prior to the original and rescheduled class exam dates, indicated a recognition of the worth of the tool for exam revision.
- Student feedback was predominantly affirmative, with the majority of positive comments focusing on the deeper learning aspects of the tool and its value for feedback and exam revision purposes.
- Positive correlation was evidenced between PeerWise engagement and the class exam grade: the data shows a positive relationship between number of questions answered and final exam grade, and between the days of activity with PeerWise and final exam grade. In both cases, although the relationships are only moderately strong, they are highly statistically significant ($p << 0.001$).

Although some of the potential limitations of MCQs as an assessment tool remain in the context of use of PeerWise questions for revision, in particular the failure to evoke higher levels of Bloom's taxonomy (Nicol, 2007), the process provided students with an opportunity to generate hundreds of practice MCQs covering the entire BMS1 course. In this study many students clearly engaged with the repository as a revision bank of questions as evidenced by both the SurveyMonkey responses and the PeerWise activity data, and as a general rule those who engaged to a greater extent tended to gain a higher grade in the class exam. Although these relationships do not imply causation, we believe they are positive results that warrant further investigation. Additional data is forthcoming from the end of year professional exam and we intend to investigate the correlation between PeerWise engagement and final year mark.

The most positive responses to the Likert questions were in terms of the benefit of writing and answering questions to the student learning process. In the open-response questions, comments reiterated the benefits and appeal of PeerWise and focused on its facilitation of learning and understanding and its use as a revision tool. The major negative issues commented on were the poor quality of many comments and questions, with much repetition, perceived poor effort by peers, incorrect or badly formed questions and disagreement between students regarding correct answers.

Anecdotal evidence from meetings with individual students and comments from the SurveyMonkey survey revealed polarisation of opinion about PeerWise as a learning tool. Whilst the Likert data shows some neutrality towards PeerWise, the majority of responses were either positive or negative. This, combined with the course questionnaire comments, indicates an overall 'love it or hate it' response to PeerWise in this cohort of students, mirroring the marketing slogan of Marmite, the well-known savoury spread.

The high compliance rate (90%) of Veterinary students with all specified deadlines contrasts with that of first year Biology students at the same institution offered an identical incentive (5% of final summative grade) where only ~25% of the cohort attained all deadlines (Tierney & Sykes, 2011). Whilst we make no claim as to the pedagogical merits of using PeerWise with Veterinary students relative to students of other disciplines, our results indicate that a strategic and highly motivated cohort will engage enthusiastically with PeerWise for relatively little summative reward.

In a wider context, National Student Survey results highlighted formative assessment and feedback as areas for improvement. Our overall experience is that PeerWise facilitates enhanced engagement with assessment and feedback. Furthermore, encouraging students to use PeerWise can enhance Graduate Attributes desirable within Veterinary graduates, including reflection, communication skills and critical evaluation (Laidlaw, Guild and Struthers, 2009) as well as day one competences (RCVS, 2010). Finally, although we have no proof of causation, the positive correlation between PeerWise engagement and exam performance is worthy of further examination. This result, the positive student feedback and the simplicity of adopting the tool are compelling reasons why other educators should seriously consider implementing PeerWise.

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