

A Pilot Study of e-Quiz and e-Review Programs in the Online Blended Learning of First-Year Engineering Mechanics

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BACKGROUND

In traditional teaching philosophy, large-class units such as First-Year Engineering Mechanics have experienced significant challenges with respect to a lack of close lecturer-student interaction, prompt performance feedback, and students' engagement and self-motivation in the unit study. Online blended learning and self-assessment approaches have become useful tools to reinforce traditional teaching and assessment modes of 'attending the real lectures' or to 'physically sit for the quiz tests'. Their advantage lies in study flexibility and unconstrained self-development of students in the designated unit activities. A pilot study of e-quiz and e-review programs was undertaken in a First-Year Engineering Mechanics unit to evaluate their usefulness in students' blended learning.

PURPOSE

How to enhance individual students' unit feedback, minimise the physical constraints of quiz access, and remove the barrier of limited topic-review opportunities is expected to be tackled in this study.

DESIGN/METHOD

The Pearson Mastering Engineering online platform was utilised in the e-quiz practices. This contains interactive self-learning and self-assessment modalities with sufficient hands-on feedback to guide students through an entire set of quiz problems after completing the assessment. The e-review was implemented through Elluminate *Live* to allow students to participate in weekly online review sessions conducted by the unit lecturer using a graphics tablet. Statistical data were analysed for the user-friendliness of online educational tools, enhanced level of effective learning and the students' feedback and view of the learning experience.

RESULTS

A small number of high-achiever participants tended to best utilise e-quiz program to advance their academic performance when compared to formal assessment components including the in-class quizzes and final examination. Underperforming students (as the majority) presented less interest in the e-quiz primarily due to their 'assessment-oriented' mindset. Better understanding of mechanics topics/contents and more engagement and self-motivation were found through the e-quiz surveys. The e-review study suggested that students preferred viewing the recorded e-review sessions to personally participating in the peer-to-peer live consultation. Student participants praised the user-friendly Elluminate *Live* features in terms of 'interactive learning', 'collaborative learning' and 'a sense of learning community'. The usefulness of recorded e-review sessions and comprehensive review materials were also highly commended.

CONCLUSIONS

The e-quiz pilot study offers great potential to enhance the first-year students' understanding of complex mechanics concepts and impact positively on their flexible self-evaluation. It particularly facilitates more able students to further advance their achievement levels. The e-review was clearly recognised by students as a supplementary academic support to gain more direct individual interactions with lecturers. The higher utility of e-review materials, especially for viewing recorded e-review sessions, was shown to be beneficial to effective learning. The student disengagement and low participation/survey response numbers are of particular concern, which is anticipated to be altered when both programs are introduced as additional assessment components in the future study.

KEYWORDS

Online blended learning, virtual classroom, distance e-learning

Background

Engineering Mechanics 100 (EM100) is a first-year core unit in the Engineering Foundation Year (EFY) program at Curtin University with a large number of students on two campuses (over 300 at Bentley campus in WA, Australia and 180 at the Miri campus in East Malaysia). It covers a wide range of mechanics topics from Statics, Dynamics to Fluid Mechanics in 12 teaching weeks. Three major unit assessment components of laboratory practical tests (30% weighting), in-class quizzes (20% weighting) and a final examination (50% weighting) are used to assess the ultimate learning outcomes. However, effective teaching and learning for this unit are inhibited by current challenges encountered, comprising large-class lectures, high student-to-staff ratio and very limited opportunities for individual interactions and feedback from lecturers. The designed structure of in-class quizzes conducted in weekly tutorials for 10 minutes (with small groups of typically 25 students) has not allowed enough time for students to complete all the quiz questions. On the other hand, the time constraints due to the extensive range of mechanics topics covered make it difficult for students to obtain an appropriate review of the lecture materials and topic revisions with the aid of lecturers. The other critical problem worth noting is that self-evaluation of students' study progress can be potentially weakened. This phenomenon might be caused by late attendance of students due to class swaps at different campus venues or class absence arising from medical and family issues. As a result, mark allowances are sometimes granted for legitimate absences in the overall assessment mark.

The aforementioned learning barriers have encouraged educators to introduce online and blended learning approaches as an alternative delivery mode in tertiary education owing to the current advances in Information Technology (IT) area. The use of e-learning platforms appears to be essential as functional education tools to directly link up between students and lecturers. The e-quiz approach has been developed in recent years as a regular online assessment tool in different disciplinary units especially those with large student numbers (Metz, 2008; Kibble, 2007). Metz (2008) found that upper-division students were more likely to use weekly online quizzes as a more helpful tool for their learning as opposed to the lower-division students. Souza and Bingham (2005-2006) showed that the robust Blackboard e-quiz feature worked very well when directed at important issues or areas of confusion for undergraduate courses on human evolution and history. On the other hand, Garcia et al. (2007) outlined the existing commercial educational platforms for synchronous distance e-learning and found Elluminate *Live* is a very powerful and popular package in multi-media, many-to-many, collaborative online education. Murphy and Ciszewka-Carr (2007) highlighted the need to enhance student-student interactions by using two-way audio and direct messaging in Elluminate *Live*. Barron et al. (2005) compared teaching strategies with the use of Elluminate *live* and HorizonLive, demonstrating that students felt more closely connected with other students and instructors with agreement levels of 83.3% and 75%, respectively. In particular, instructors had very good experience with technology-based teaching as reflected by 'very satisfied' rate of 60% and 'satisfied' rate of 40%. Croft et al. (2007) provided general guidelines on implementing Elluminate *Live* and tablet PC to deliver a hybrid course in the Extended Campus Engineering Program. Their results suggested that Elluminate *Live* was regarded as an extremely effective online resource mainly used as a complementary aid to lectures, but not to completely replace the traditional dynamics of lectures. Fuller (2009) concentrated on student engagement in large classes using Elluminate *Live* for the provision of real-time interaction, collaboration and group meetings. It was found that Elluminate *Live* was a more flexible means of accessing academic support (90% student agreement), an overall satisfactory teaching tool (96% student agreement) and 'more than expected' to improve student learning in the studied subject (80% student agreement).

This paper presents a combined evaluation of using e-quiz and e-review programs to investigate the impacts of online interactive self-assessment and self-learning approaches on the students' learning experience and flexibility, study feedback and effectiveness in achievement of learning outcomes.

Project Development and Methodology

Program design

Only the four-week Dynamics module was used for the topics covered in the e-quiz and e-review programs. The program development was structured as a 'pilot study' or 'trial-run', which means that students' participation was completely voluntary, and thus no unit assessment marks were attracted due to their program engagement.

In the e-quiz program, online quiz questions were initially set up based on sets of questions extracted from the question bank integrated into the Pearson Mastering Engineering platform. 100 student volunteers were selected after their expression of interest (EoI) via email communications. Afterwards, student access points were arranged with the help of a Pearson educational consultant, having the student's university email addresses (only student ID format was presented) as the login names with corresponding customised passwords. The students then started to participate in online weekly e-quizzes which were open for one week starting from Sunday to enable their participation at their preferred time and venue. Each e-quiz was set to be completed within 30 minutes and the e-quiz marks and solutions were automatically released and became accessible on the Mastering Engineering platform in the following week. Students could revisit past quiz questions for revision and re-practice purpose but their re-attempts at them would not be marked.

In the early stage of e-review program, e-review PowerPoint slides, simple quiz questions and worked examples associated with their detailed solutions were developed systematically. The e-review timetable was thereafter scheduled in such a manner that students' common free time was utilised from 12:30-1:30 pm on Wednesdays. Meanwhile, hyperlinks of e-review sessions were established from a drop-down Elluminate *Live* tab on Blackboard. Such information was released as a unit announcement on Blackboard and was simultaneously sent to students' university email addresses for notification. The actual conduct of the e-review program by the Dynamics lecturer was scheduled on a weekly basis in his office with the following detailed teaching and learning activities taking place in the sequence:

- The e-review of previous week's Dynamics topics using PowerPoint slides, which comprise fundamental Dynamics concepts, theory and important formulae or equations.
- Polling activities with a set of simple quizzes in either 'Yes-No' or multi-choice format to facilitate self-monitoring of students on their understanding.
- Live demonstration of weekly fully worked examples (not solved in large-lecture classes in the teaching weeks) and past-semester examination questions (conducted during study weeks) with the aid of a graphics tablet on Elluminate *Live*.
- Flexible interactions with individual students to allow them to raise questions and post live queries on Elluminate *Live* during/after e-review and example work-out time in order to obtain the immediate clarifications and advice from the lecturer.
- Student viewing of playback videos of recorded e-review sessions.

Finally the online survey questionnaires were completed by students to provide first-hand feedback on the usefulness of these two programs in the context of their learning experience.

Participants

100 EoI students from both Bentley and Miri campuses at semester 1 2011 were invited to participate in the e-quiz program. All students with a number of 431 in semester 1 2011 and 516 in semester 2 2011 at both campuses were invited to take part in the e-review program. Ethical approval to conduct the studies and research surveys was granted by the Curtin University Human Research Ethics Committee for the 2011 academic year so that participants had a clear idea about the purpose of the study, their right to voluntary participation and anonymity of all survey responses.

Description of educational tools

The Pearson Mastering Engineering platform (www.masteringengineering.com) used in the e-quiz program is one of most technologically advanced online tutorial and homework systems to enable students' learning and assessment activities with feedback to specific errors. Optional hints are sometimes also provided to break down complex problems into small and simple steps to solve. Its interface consists of 'assignments' to access quizzes and homework, 'roster' with student information, 'gradebook' for mark records and analyses as well as the 'item library' including a set of quiz/tutorial questions for selection. Lecturers can easily monitor students' study progress from automatically marked items, their work-out steps and attempt history.

Illuminate *Live* (Croft et al., 2007; Fuller, 2009) implemented in the e-review program serves to transfer face-to-face teaching sessions from a physical environment to an online virtual educational environment for relatively small study groups. Only basic settings are required which include an internet connection and computer speakers (for receivers) from the students' side. This platform enables the lecturer as a session moderator to use electronic peripherals such as a webcam, a microphone and a graphics tablet for the e-review program. Four built-in window features consist of 'participant window', 'chat window', 'audio window' and 'white board' within Illuminate *Live* interface. Their respective functions are detailed elsewhere (Illuminate *Live* V 10 Moderator's Accessibility Guide, 2010). The other important features worth mentioning here are the webcam function between the lecturer and students to establish the video-supported interactions during the initial introduction and question time, and application sharing in a pre-loaded MS Word document to display worked example contents. Furthermore, index recording and playback functions were concurrently employed to facilitate non-attending students to view recorded live sessions afterwards as many times as they wished.

A WACOM graphics tablet DTF-720 with a 17 inch LCD interactive pen display screen was used as a hand-writing recognition tool. With the help of a cordless and battery-free stylus pen, lecturers can make annotations, draw diagrams and figures and demonstrate worked-out steps on the Whiteboard and in shared MS Word documents, respectively.

Evaluation method and data analysis

After completing the e-quiz and e-review programs, students enrolled in Engineering Mechanics 100 were invited via Blackboard announcements with direct access hyperlinks to participate in online survey questionnaires on SurveyMonkey (www.surveymonkey.com). The questionnaires were designed to comprise about 20 different types of 'single/multi-choice', 'level-ranking' and 'directly answered' questions with a wide range of focuses on interface user-friendliness, impacts of specific interface features on effective learning aspects, as well as students' experience of and feedback on e-quiz and e-review programs. Students were given less than 10 minutes to complete the anonymous surveys and got the chance to be entered into prize draws of Apple iPod Shuttle 2 GB and an iTunes \$50 card for survey participations, respectively. Statistical results were automatically generated in SurveyMonkey and replotted using MS Excel prior to their analysis.

Results and Discussion

Student participation

From 100 Eol originally received for e-quiz participations, student interest rate declined significantly with 45 login-in students to Mastering Engineering, as evidenced in Figure 1. Thereafter only 31 students took part in Quiz 1 and then the participation number dropped to only 9 taking Dynamics quiz 4. This trend implies that the original Eol students had a lack of on-going commitment to continuous e-learning and e-assessment owing to its non-contribution to the unit's assessment by way of obtained marks.

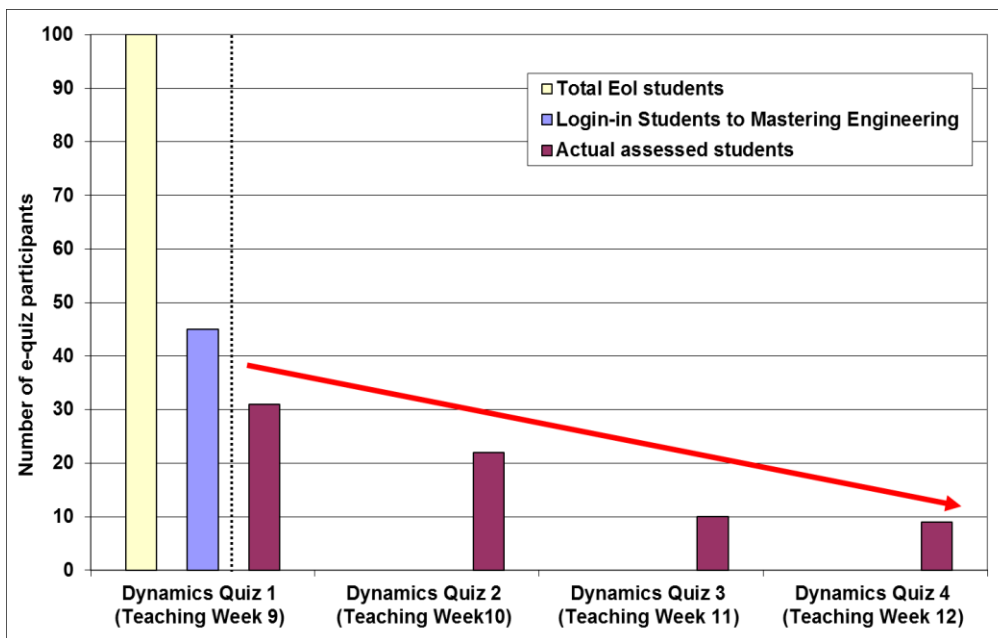


Figure 1: e-quiz participation data at semester 1 2011.

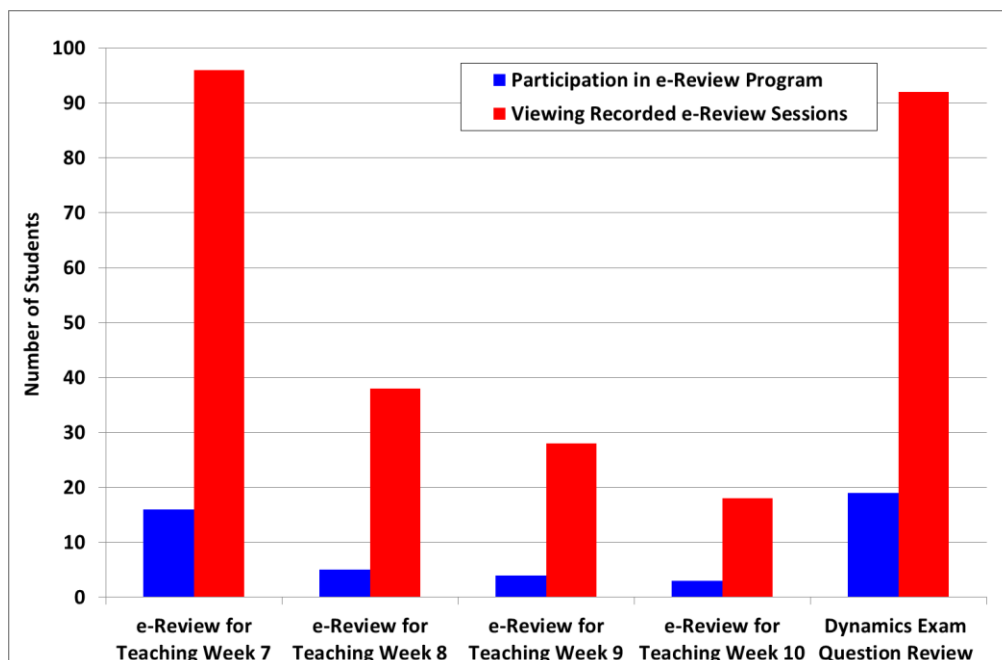


Figure 2: Participation and view numbers in e-review program

Similarly, the overall e-review participation was also low being less than 5 students for teaching weeks 8-10, as seen in Figure 2. Nevertheless, relatively high numbers of about 16 and 19 were found respectively in the first e-review session for teaching week 7 and Dynamics examination-question review at the end of semesters. These trends can be explained by students' initial interest and curiosity to try Elluminate *Live* as a new and flexible online learning system and then later their examination-focused mindset to gain the lecturer-oriented guidance for their unit revision and examination preparation towards the end of semesters. It is evident that students' steady learning habits were not evidenced despite their initial enthusiasm and motivation. The disengagement of students tends to undermine the effective implementation of both e-quiz and e-review programs at least in the live-learning mode. As an equally important factor, the view number for recorded e-review sessions is also demonstrated in Figure 2, which reflects indirect participation in the e-review program, especially for those who were unavailable in the live consultation sessions during the designated time. The more significant view number as opposed to participation number

indicates that students tended to view play-back e-review sessions, which is revealed by 96 and 92 in view numbers for the first e-review session and Dynamics examination-question review, respectively. In addition, the total view number decreased for both semesters in a monotonic manner from 38 to 18 from the second to the fourth e-review sessions. Clearly view number resembles the live-participation trend. Consequently, viewing the e-review sessions (similar to the use of iLecture system by way of playing back recorded lectures) has been found to impact more positively on students' learning by means of greater study-interest attraction as compared to the live sessions.

Performance comparison between e-quiz and unit assessment

A comparison between e-quiz results and assessment marks comprising in-class quizzes and final examination is depicted in Figure 3. There are no distinct linear correlations between overall in-class quiz marks or examination marks and e-quiz marks. Some high achievers in the assessment mark range of over 30 obtained relatively good e-quiz marks of 14-30 and 20-30, as seen in Figures 3(a) and 3(b), respectively. This implies that only a small portion of more able students have made better use of e-quiz program to further advance their achievement levels irrespective of the real mark involvement, which is in good accordance with results found by Metz (2008). However, the majority of participants have no interest or become less active in the e-quiz program as evidenced by its mark ranges of 0 and 1-9 (represented by a large cloud of scattered data). This finding suggests that most of them have only focused on assessment based activities while ignoring positive study-aid items that could potentially improve their final learning outcome. Furthermore, the seriousness level of actual assessment appears to be more significant relative to developed e-quizzes since nearly all the data are shown above the equal mark lines.

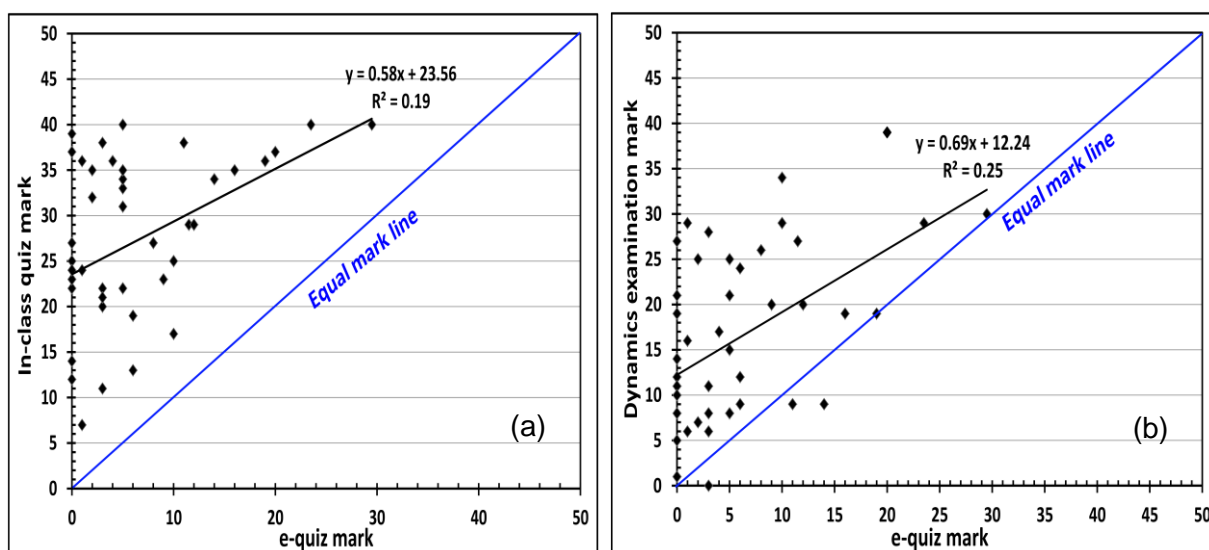


Figure 3: Correlation between e-quiz results and performance in formal Dynamics assessments: (a) weekly in-class quizzes and (b) end-of-semester 1 2011 examination

Online survey results

Student learning experiences in e-quiz and e-review programs are reported explicitly in Figure 4. Given that the scale threshold of 2.5 (dashlines in Figure 4) between agreement and disagreement levels for positive learning impacts, the relevance of e-quiz to the Dynamics topics/contents as well as more engagement and self-motivation in e-quiz compared to in-class quizzes were ranked as the top two most useful experiences from students' viewpoints. In contrast, the opportunity to view the recorded e-review session, enhanced e-review learning materials and usefulness of both previous weeks' lecture materials and past examination questions are the most noteworthy aspects of e-review program participation.

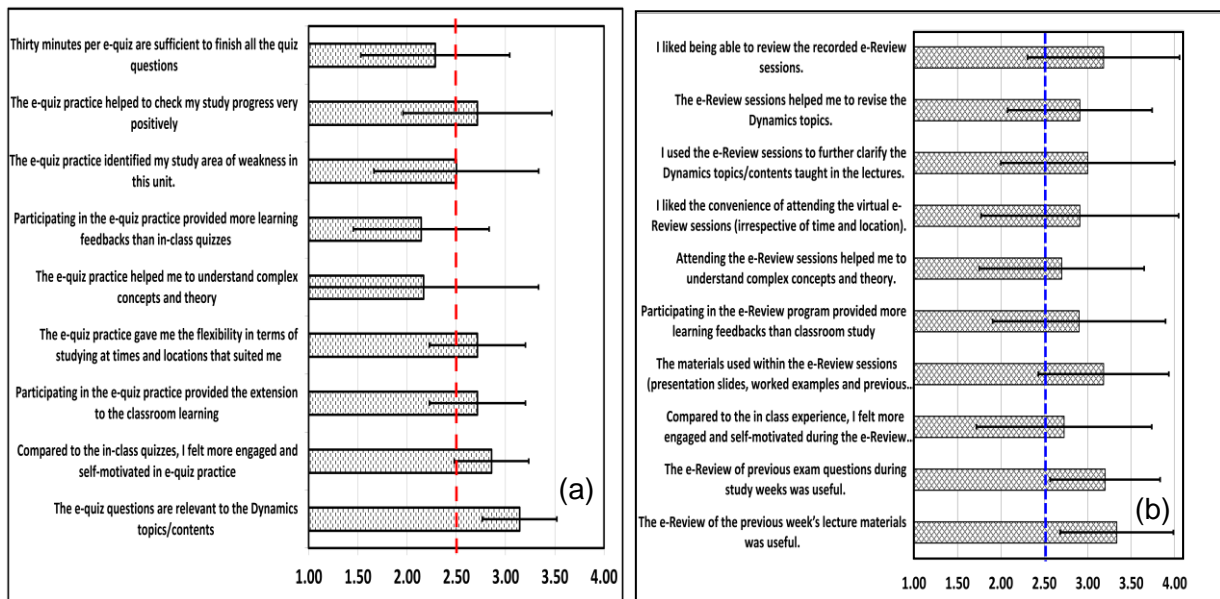


Figure 4: Average agreement levels of student learning experience in (a) e-quiz program and (b) e-review program (total e-quiz response number n=7 at semester 1 2011 and total e-review response number n=12 for both semesters 1 and 2 2011. 1=strongly disagree, 2=disagree, 3=Agree and 4=Strongly agree)

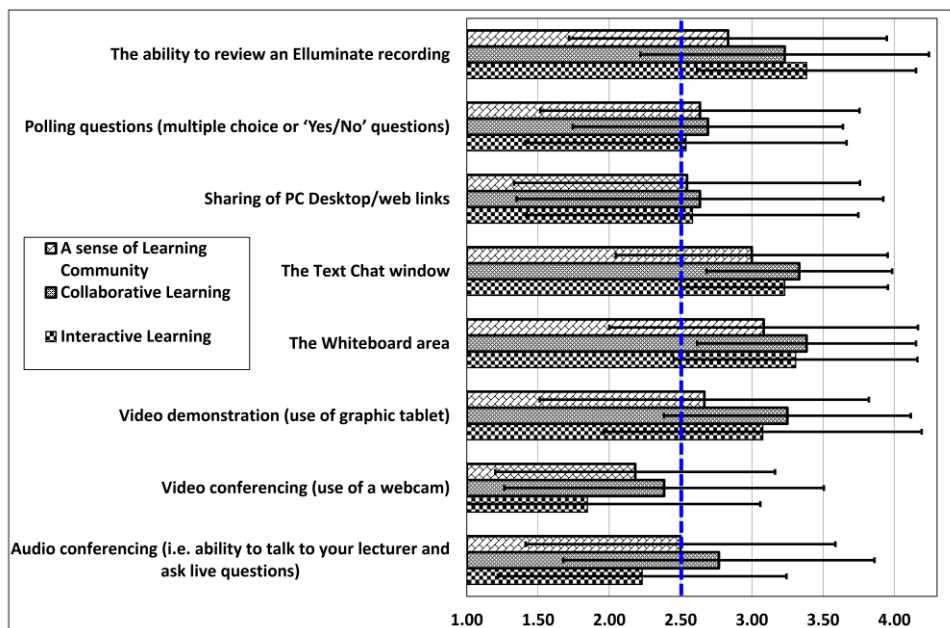


Figure 5: Average agreement levels of interactive learning, collaborative learning and a sense of learning community using Elluminate *Live* features in e-review program (total response number n=13 for interactive learning and collaborative learning and n=12 for a sense of learning community in both semesters 1 and 2 2011. 1=Low to 4=High for the agreement level)

With respect to the effectiveness of Elluminate *Live* features associated with three enhanced learning aspects of ‘interactive learning’, ‘collaborative learning’ and ‘a sense of learning community’, ‘the ability to review an Elluminate recording’, ‘text chat window’, ‘white board area’ and ‘video demonstration (use of graphics tablet)’ were ranked as the four favourite features according to the e-review survey results with the same dashline threshold level of 2.5, shown in Figure 5. In particular, ‘video demonstration (use of graphics tablet)’ has also

been found to be a potentially effective visual aid to facilitate both interactive and collaborative learning.

As for both Figures 4 and 5, experimental error bars with high standard deviations suggest that little consensus (or a wide variation of 'taste' on these online educational tools and learning experience) has been reached, especially for the use of Elluminate Live features in e-review program. It has to be noted that this trend might be altered when survey response rate is highly improved as this pilot study is limited to both low participant number and survey response number.

Student comments

Typical student perceptions of these two programs as pedagogical tools are presented in the following based on gathered information extracted from Curtin eVALUate (the student online learning feedback system) reports and online survey questionnaires:

Program Usefulness

"e-quiz, e-review and lab are excellent."

"The Dynamics trial quizzes this semester were helpful especially in understanding the topics of Dynamics."

"Another good resource to help learn the topics."

"The live e-review sessions were really helpful. Great way to sum up certain concepts and apply them to questions."

"e-review was extremely helpful and the delivery pace was far better than in the lectures."

Program Expansion

"I found the e-review aspect extremely helpful. I think it should be done in Statics and Fluid Mechanics as well."

"The most helpful part so far was the Dynamics module only. The questions done during the lectures and the Elluminate are very helpful. Would really be useful for Statics as well."

"If at all possible, please introduce the e-review sessions for Statics and Fluids!"

"Please extend it to the whole unit-there may not be time to review Fluid Mechanics but the option to review Statics would have been very helpful."

These comments were categorised with respect to 'program usefulness' and 'program expansion'. For the former, implementations of Mastering Engineering and Elluminate Live used in e-quiz and e-review programs were endorsed as helpful online-assistive educational tool to self-assess their study progress effectively or recap fundamental Dynamics concepts and apply them to the real worked examples in practice. In the latter, it was suggested that the e-review program be expanded to include both Statics and Fluid Mechanics components in this unit, thus revealing its potential as a supplementary study activity to benefit all the taught components of the unit.

Conclusions

The e-quiz pilot study has shown great potential for enhancing first-year students' understanding of complex mechanics concepts and impacted positively on their flexible self-evaluation, most particularly reflected from the further advances of academic achievements of more able students. The e-review was clearly recognised by students as a supplementary academic support to gain more direct individual interactions with lecturers which was

impractical in a real large-class lecture. The higher utility of e-review materials, especially the set-up of subsequent viewing of recorded e-review sessions, proved to be beneficial to effective learning. However, the disengagement of students as shown by low participation numbers in e-quiz and e-review is of some concern due to the assessment-oriented mindset that it reveals. This issue might diminish if both programs were implemented as formal assessment components in addition to the existing laboratory practical tests and final examination. A higher usage rate and survey response rate from future studies would be expected to confirm the applicability of e-quiz and e-review programs under modified assessment conditions.

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