A study of student participation and nonparticipation in prelecture electronic surveys

Vincent C. H. Tong and Danny S. L. Chow

Vincent C. H. Tong is senior lecturer in Geophysics at UCL-Birkbeck Research School of Earth Sciences. His research interests also include technology-enhanced learning (TEL) and the research-teaching nexus. As TEL Champion at Birkbeck, he is responsible for developing institutional strategies and representing Birkbeck regarding TEL matters on external bodies. Danny S. L. Chow is lecturer in Accounting at Durham University. Address for correspondence: Dr Vincent C. H. Tong, Department of Earth and Planetary Sciences, Birkbeck, University of London, Malet Street, London WC1E 7HX, UK. Email: vincent.tong@ucl.ac.uk

Abstract

Student nonparticipation in electronic surveys represents a challenge to educators as it may impact significantly on the implementation or evaluation of the associated teaching activities. We here study the student evaluation of a pedagogical project consisting of prelecture online polling followed by linked revision lectures. This investigation involves studying the responses from 43 undergraduate students following a course in accounting at a British university. With regard to the students' views on the use of prelecture polling, our study shows that there are no statistically significant differences between those who did not participate in the online polling and those who did. Both groups of students were generally positive about the use of (1) polling results in structuring the revision lecture, (2) online survey in helping them prepare for the examination and (3) online polling as a teaching platform in other courses. Our findings therefore suggest that prelecture electronic surveys can help engage students with follow-up lectures, including those who did not participate in the prelecture survey.

Introduction

Electronic surveys provide an effective way to collect feedback from students (eg, Das, Ester & Kaczmirek, 2011; Klaas, 2003; Klaas & Baggaley, 2003). Apart from their function as a feedback-gathering platform, the use of electronic surveys in teaching has become more widespread with the increasing availability of required technology and equipment. The most common forms of electronic surveys include the use of clickers in lecture theatres (eg, Draper & Brown, 2004; Easton, 2009; Fies & Marshall, 2006) and the adoption of Internet-based platforms such as online polling (eg, Kay & LeSage, 2009; Stahl, 2005). Depending on whether polling and its related teaching activities are conducted simultaneously, electronic surveys can be categorized as synchronous or asynchronous. Synchronous electronic surveys take place at the same time as teaching, whereas asynchronous electronic surveys (AES) are administered before or after the pedagogical activities (eg, Wang, 2003).

AES are traditionally used as a postlecture feedback collection tool (eg, Moss & Hendry, 2002). As it does not serve primarily as a teaching device, the pedagogical function of AES is not well established. Moreover, these surveys are unlikely to make a significant impact on the learning experience of the students who provided the feedback in the first place if the polling is carried out only after all the teaching is completed. Despite these limitations, the application of AES can be expanded beyond its feedback collection capabilities and can form an integrated part of learning

Practitioner Notes

What is already known about this topic

- Asynchronous electronic surveys (AES) have traditionally been used as a postteaching feedback tool.
- AES have recently been implemented prior to in-class revision (IR) to act as a novel pedagogical and lecture-planning tool in an undergraduate science module with a relatively small class size.
- AESIR (combined use of AES and IR) have been found to help students' examination preparation by (1) prompting them to study the course materials and (2) providing a more engaging learning experience during the post-AES lecture.

What this paper adds

- AESIR have been successfully adapted for teaching in a different academic discipline (accounting) with a larger student cohort.
- Of the students who attended the revision lecture, there were no statistically significant differences in the evaluations of the AES between groups of students who had participated in the prelecture polling and those who had not.
- The evaluation shows that both groups of students had a generally positive learning experience with the use of AES in the revision lecture.

Implications for practice and/or policy

- The design of polling questions and the subsequent uses of students' responses in structuring the follow-up lecture may be more important than the absolute participation rate in the AES.
- AESIR are scalable: it can be adapted according to the pedagogical needs of a given discipline and class size.
- Students' responses in the AES can serve as a useful criterion for selecting or prioritizing topics to be covered in the revision lecture.

and teaching. For instance, it is possible to combine assessment and feedback collection. Prelecture online quizzes, usually in the form of multiple-choice questions (eg, Baggaley, Kane & Wade, 2002; Ko & Rossen, 2010), can be somewhat similar to AES even though the primary function of quizzes is to provide assessments on students' learning. Given that quiz questions usually have well-defined answers, these online assessments are different from AES, which are used to collect opinions and feedback. However, the boundary between online quizzes and AES is by no means absolute as the questions involved may simultaneously contain elements of both assessment and feedback. Apart from mixing online quizzes with survey questions, a recently reported integration of prelecture AES and in-class revision (AESIR) combines the informal use of electronic polling with specific pedagogical objectives to enhance the effectiveness of lecturing (Tong, 2012). When it is linked to AES, in-class revision (IR) is referred to as teaching in a revision session or lecture during which AES results are released with the related course content discussed.

AESIR can play an important role to link any teaching sessions that are separated by a time gap, such as weekly lectures, revision session after a study/holiday break or at the beginning of the second module of two related courses (Tong, 2011, 2012). This is particularly important as the teaching of inter- and multidisciplinary subjects is becoming increasingly common (eg, Tong, 2010, 2012). The study reported by Tong (2012) involved investigating students' evaluation of

AESIR applied to an undergraduate science module with a relatively small student cohort (28 students). With regard to its implementation, the anonymous AES contained online polling questions asking the students whether they were "comfortable" with some key mathematical equations introduced in the course. As the AES were conducted primarily to elicit the students' self-assessment of their confidence in key topics covered in the module, the polling did not require them to perform any calculations. The polling results were released in the subsequent IR lecture as a way to help students focus on key skills and content, and the polling questions were used to structure the revision lecture itself. The quantitative and qualitative evaluations showed that the students were positive about the use of AES in prompting and encouraging them to study the mathematical content in the module before the examination.

Although AESIR were successfully implemented in Tong (2012), the integration of AES and IR, particularly issues related to students' participation, remains largely unstudied. For instance, students who did not participate in the AES were not included in the evaluation. It seemed reasonable at the time to assume that students who did not participate in the polling would not be fully engaged in the follow-up lecture. This was because prelecture AES formed the first stage of the AESIR approach, and any student who did not participate in the AES would not have fully experienced this core and integral part of the AESIR. If this view were true, AESIR would not represent an inclusive teaching tool. As significant levels of nonparticipation in the prelecture polling are normally to be expected (eg, Anderson & Simpson, 2004), the implication is that AESIR may only bring limited pedagogical benefits to those who attended.

In this paper, we report quantitative findings involving a cohort of students who attended the IR lecture of an AESIR project, including those who chose not to participate in the prelecture AES. Unlike the previous study (Tong, 2012), the project is based on the application of AESIR to a larger group of students on an undergraduate accounting course in a business school in the UK. The main aim of this study is to use a quantitative questionnaire for evaluating the views of the students who participated in the prelecture AES as well as those who did not. The theme of the evaluation is on the use of AES, a core part of the teaching-and-learning project. Our goal is to see if prelecture AES participation is a prerequisite for having an engaging learning experience in the revision lecture. This study is therefore highly relevant to the design and implementation of any teaching activity that is dependent on students' participation in asynchronous surveys.

It is important to note that our data do not represent definitive and generalizable measurements of the students' views. Instead, our rationale is to find out if AESIR can also function as an effective and engaging pedagogical tool to those who did not take part in the prelecture polling. The findings are crucial to the inclusive implementation of AESIR. In addition, this study also serves the purpose of showing how AESIR can be implemented in a different discipline (ie, business subject) and pedagogical contexts (ie, large-group teaching of full-time undergraduates).

Method

Participants

The project involved 142 students attending the 2nd-year undergraduate module "Management Accounting" at Durham University in the UK. Fifty-five per cent of the students were female, and the mean age was 20. Note that our study does not include evaluations based on the gender of the students. One of the authors of this paper (Chow) was the module lecturer.

Materials

AES polling platform

The online polling for this study was implemented using a polling platform provided by the Bristol Online Survey. The polling platform was a subscription-only service available to staff at Durham University for research and teaching purposes.

AES polling questions

The design of 57 questions included in the AES (Appendix) was based on the learning objectives of the key topics introduced in the module, and the questions were therefore linked to the examination. In fact, all polling questions were fully aligned with the examination requirements by taking into account (1) definitions of concepts in accounting, (2) application of these concepts to a particular problem set, and (3) critical evaluation of these concepts: considerations of the limitations and ways in which these limitations could be improved or attenuated.

For instance, the very first polling question on the "treatment of costs in a manufacturing environment" (Topic 6 in the Appendix) was about defining accounting concepts in action: "What are the different types of fixed costs?" The next two questions were about application: students were asked if they could quantify the costs identified and present their calculations in a clear way (ie, prepare cost accounts). The final three questions required students to reflect on limitations of the concept and ways in which improvements could be made. In terms of skill sets, questions on both quantitative and written skills were included (Appendix). This is because application of concepts requires numerical skills, whereas critical evaluation tests one's ability of articulating the issues in a more discursive fashion. In this regard, the division of topics into subtopics was important, as this provided a "checklist" of competences (both qualitative and quantitative) that students were expected to have mastered in the subject. Note, however, that the design of our online polling did not enable us to obtain insights into the individual students' responses of the subject because the AES amalgamated results anonymously.

Set-up of IR

The substantial syllabus of the module meant that trade-offs were made in favour of a more in-depth but narrower coverage selected topics against a wider coverage of all topics at a relatively superficial level. The topic selection process was based on a cut-off point using the results from the online poll. The AES questions were designed to collect students' opinions on how comfortable they were in each subject-skill area, and the AES covered the entire set of subtopics within the syllabus. It was therefore possible to rank the students' needs based on the scores. The use of AES as a comprehensive checklist of all topics and subtopics within the syllabus was different from Tong's (2012) approach, which focused exclusively on the equations introduced in the science module.

The use of AES as a prioritization tool was to increase students' ability to influence the choice of revision topics covered, which differed from Tong's (2011) more lecturer-centric approach with preselected topics (ie, use of equations in geophysics). The significantly larger student cohort made it more difficult for a lecturer to have closer understanding of the students' ability and to monitor their progress. It was for this reason that the AES had to be adapted from Tong's (2012) AES approach, which was designed for small-group teaching with highly specific learning requirements, to a larger group with diverse learning needs.

Evaluation questionnaire

The evaluation took the form of an in-class, paper-based anonymous evaluation (ie, no personal information collected), which comprised a single questionnaire designed to measure students' evaluation. The questions in the evaluation questionnaire were developed based on the instruments employed by Tong (2012). In order to identify any differences between students with different levels of engagement with the prelecture AES, we also asked them in the evaluation questionnaire whether they had participated in the online polling. The evaluation questions are listed as follows:

Did you participate in the online polling? Yes/No

1. The use of "online polling" makes, or will make, a difference to my preparation for the end of term revision session in Management Accounting.
2. The "online polling" prompted, or will prompt, me to look at the course materials.
3. The release of results of the "online polling" was helpful in my learning process.
4. I prefer to know the results of the "online polling."
5. I would like "online polling" to be used in other courses.
6. "Online polling" is a useful way to gather my opinion/thoughts on course content or activities via the Internet.

The main aim of Questions 1 and 2 was to evaluate the effects of the AES on students' preparation for the module examination. Questions 3 and 4 were designed to study the students' views on the release of online polling results in the revision lectures. Questions 5 and 6 were used to probe students' views on whether AES should be extended beyond the confines of the module revision session. Note that none of the evaluation questions required participation in the prelecture AES. The use of online polling results in the revision lecture was chosen as the theme underlying all evaluation questions because it is a crucial element of AESIR, representing the main interface between AES and IR. All students attending the revision lectures, regardless of whether they had participated in the prelecture AES, had common exposure to the use of online polling results in the revision lecture.

Scoring
AES polling questions
The five possible responses for all 57 AES polling questions (Appendix) were given the corresponding numerical scores:

- "I know it well enough to be able to explain it to others." (1)
- "I know enough to provide a decent attempt at an answer." (2)
- "I think I know it, but I am not very sure." (3)
- "It sounds vaguely familiar, but I really don't know." (4)
- "I am really confused and probably need help." (5)

Evaluation questionnaire
All questions used a 5-point Likert scale ranging from 5 (*strongly agree*), 4 (*agree*), 3 (*neutral*), 2 (*disagree*) to 1 (*strongly disagree*). The numbers indicate the numerical scores assigned to the five possible responses to the evaluation questions.

Procedure
Our AESIR project took place during the 2010–11 academic year. The pre-AESIR teaching comprised 19 one-hour lectures and 8 one-hour seminars (from October to March), and attendance of the 19 lectures remained steady over the academic year. The AESIR consisted of three stages, namely AES, IR and evaluation.

Stage 1: AES polling
Invitation to participate in the AES polling (see Materials section above) was sent to all students studying the module on April 24, 2011. The polling closed on May 1, 2011, the day before the first revision lecture.

Stage 2: revision lecture
The revision lecture was split into two sessions (May 2 and 9, 2011) in order to cover the materials taught over two academic terms (ie, October to December, and January to March). Please refer to the Materials section above for the set-up of the IR. The results of the AES were released at the start

of the first session and also repeated at the start of the second. The mean scores for all topics that made up the AES questions used in the online poll were shown to the students.

A cut-off point was set at the 3.0 level (ie, students feeling not sure of the respective content; see Scoring section above for the scoring method used in AES polling questions). This means that 32 questions (out of 57) with scores above 3.0 were included in the IR (Appendix). While the selection of the 3.0 threshold was arbitrary, it nevertheless provided a basis for prioritization given the limited time available during the revision lectures.

The lecturer discussed with the class the responses to the AES questions, and then explained how these responses, together with other issues that the lecturer also wished to cover, were to be used to structure the revision lecture. The lecture slides used by the lecturer during the revision lecture provided explicit references to teaching materials that students could use as a revision checklist to ensure that they had covered all of the learning objectives identified within the subtopics contained within the online poll.

A checklist that matched learning objectives with related examination questions was provided to the students as an additional tool for enhancing the revision experience. Note that all lecture slides and the checklist were shown to the students during the revision lecture, and were available to all students after the lecture on the module site on Blackboard (Blackboard Inc., Washington, DC, USA), the virtual learning platform. The checklist allowed students to see how the online polling scores were linked to the learning objectives and to the course material. In other words, online polling was not only useful for generating average responses with which the students could compare their scores, but could also be tailored for individual needs in subsequent private revision by identifying subtopics with scores that deviated significantly from the class average.

Stage 3: evaluation
Evaluation of AESIR was conducted towards the end of the second revision session held on May 9, 2011. (Please refer to the Materials and Scoring sections above for details on the evaluation questionnaire.) All students were invited to complete the evaluation questionnaire. The results collected were then analyzed using standard statistical software, and we calculated the mean evaluations and tested their statistical significance.

Results
Participation rates
Twenty-eight students participated in the AES polling (Stage 1), and an estimated 80 students attended the revision lecture (Stage 2). The rate of participation in the revision lecture was therefore approximately $80/142 = 56\%$. As for the evaluation (Stage 3), 43 students completed and returned the evaluation questionnaire. One of the completed questionnaires (out of the 43 responses) did not indicate whether the student had participated in the AES. The rate of participation in the evaluation as a percentage of the total number of students enrolled on the module was $43/142 = 30\%$, whereas the rate of participation in the evaluation as a percentage of the students attending the revision lecture was estimated to be around 50% (43/80).

The evaluation response rate of those who did participate in the prelecture AES (Group 1) was higher than those who did not (Group 2). For Group 1, the response rate was calculated with the numerator being the number of students who participated in the prelecture AES and completed the evaluation questionnaire (21 students) over the total participation in the prelecture AES (28 students). These figures give a response rate of $21/28 = 75\%$ for Group 1. It is conceivable that not all of the 28 prerevision AES participants attended the revision lecture, which means that 75% may represent an underestimate of the true response rate. For Group 2, the response rate for the group of students who did not take part in the AES (also 21 students) was lower, at $21/(80-28) = 40\%$. The denominator here is the difference between the estimated IR attendance (80

students) and those that participated in the prerevision AES (28 students). Forty per cent represents an upper-bound (ie, over-) estimate of the true response rate for Group 2.

Evaluation results

Table 1 shows the mean scores and their standard deviations of the responses to the six evaluation questions. Note that our evaluation data and statistics are nonparametric, and the standard deviations are shown here to give an indication about the spread of the students' responses. Results are presented in three parts: (1) 21 students who participated in the prelecture AES (Group 1), (2) 21 students who did not participate in the AES by their own choice (Group 2) and (3) all 43 responses. One of the completed questionnaires (out of the 43 responses) was included only in the analysis of the combined group because the student did not indicate whether he or she participated in the AES. It is important to note that *all* students were invited to participate in the AES (ie, including those who did not take part). In other words, the two groups of students in this study were not "assigned" to the corresponding groups prior to the AESIR.

We computed the widely used Cronbach's alpha to test the reliability of the data set involving responses to all evaluation questions from all 43 participants. A high alpha value of 0.90 was obtained, suggesting that the data were reliable and internally consistent. Given a relatively small sample size of unknown distribution, we used a more conservative nonparametric test to evaluate the differences because it does not assume normality. More specifically, we applied the Wilcoxon signed-ranks test to the combined sample (ie, all 43 participants) to evaluate if the median was significantly above the level of 3.0 ("neutral" in the evaluation questionnaire). Our results show that the median responses for all six questions are statistically significant (Table 1), indicating that the majority of students who participated in the evaluation rated the AES positively for all six areas covered by the evaluation questions. This finding is also reflected by the high percentages of participants who chose *agree* or *strongly agree* to the six evaluation questions (53–72%; Table 1).

By comparing the responses to all evaluation questions, the group of students who participated in the prelecture AES scored higher in all but one question (Question 4). It may be tempting to

Table 1: Quantitative evaluation of the students' view of AES

	Group 1: AES participants Mean (SD)	Group 2: AES nonparticipants Mean (SD)	Mann–Whitney	All participants Mean (SD)	Wilcoxon signed-ranks (test = 3)	"Agree" or "strongly agree" as % of all participants
1 Impact on revision?	3.8 (0.91)	3.4 (1.02)	$Z = -1.3$ $p > 0.05$	3.60 (0.98)	$p < 0.001$	63
2 Prompt to look at material?	4.0 (0.87)	3.6 (1.07)	$Z = -1.1$ $p > 0.05$	3.81 (0.98)	$p < 0.001$	72
3 Good to show results?	3.6 (0.91)	3.5 (1.03)	$Z = -0.94$ $p > 0.05$	3.53 (0.96)	$p < 0.001$	53
4 Want to know results?	3.6 (1.00)	3.7 (1.01)	$Z = -0.65$ $p > 0.05$	3.67 (0.99)	$p < 0.001$	60
5 AES in other courses	4.0 (0.69)	3.5 (1.08)	$Z = -1.6$ $p > 0.05$	3.77 (0.92)	$p < 0.001$	65
6 AES: an innovative platform?	4.0 (0.62)	3.6 (0.92)	$Z = -1.1$ $p > 0.05$	3.79 (0.80)	$p < 0.001$	65

Note: there were 43 students under "All participants" as one student did not indicate whether he or she participated in the prelecture AES. The evaluation statements were scored on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). See text for details.
AES, asynchronous electronic survey; SD, standard deviation.

conclude that those who participated in the AES had a more positive review of the revision approach involving online polling. However, there was actually no significant difference between them because of the variability in both groups, as is evident from the standard deviations (0.80–0.99 in Table 1). In fact, the following analysis shows that both groups had positive views of the AES approach (including Question 4). We performed a Mann–Whitney test for differences between participants who did and those who did not respond to the prelecture AES. No significant differences at the 5% level were found for all six questions (all with $p > 0.05$), showing that the two groups did not statistically differ in their overall evaluations.

Discussion and conclusions

Although this case study may have some contextual limitations (ie, business subject etc), it nevertheless highlights some pedagogical considerations that are important for implementing AESIR effectively in any subject. In particular, successful and inclusive use of AESIR depends on our ability to engage with as many students as we can during the revision lectures, irrespective of whether or not they have participated in the prelecture AES. On the basis of those who took part in the evaluation, our results show, somewhat surprisingly, that the students who did not participate in the AES were also positive about the use of AES results in the IR lecture. It is a significant result given that the two groups of students had fundamentally different experiences in their engagement with the key pedagogical component (ie, prelecture AES). While this quantitative study does not aim to explain why the two groups of students showed statistically insignificant differences in their evaluations, we nevertheless attempt to outline some possible reasons that are compatible with our observations.

Tong (2012) observed that some students felt positive about their learning experience with AESIR because they were motivated in the post-AES lecture to find out about their peers' views when the online polling results were released in the lecture. This "curiosity factor" can also be used to explain our observations because this possible explanation is not dependent on the student's prior AES participation. It is also possible that students from either group found the AESIR an engaging, student-centred approach to structure the post-AES lecturing. Again this possible explanation does not require the students to have participated in the AES component. It appears that AES participation can effectively be regarded as an essential (ie, some student responses are needed at the very least) but not a necessary condition for successful implementation. This view has important implications because high levels of participation in prelecture AES are not common. Without the "prerequisite" of AES participation, AESIR are more likely to be adopted as a teaching tool as it can be more readily implemented in an inclusive way. Compared with prelecture polling participation, the design of the online polling questions may be more critical to the success of AESIR as the polling questions are ultimately used to structure the revision lecture.

Apart from students' generally positive views on the use of AES as a lecturing device, it is important to study some specific measures of how effective the AES were in achieving its intended pedagogical goal—helping the students with examination revision. As our results show, students who did not participate in the AES also agreed, on the whole, that the use of AES had made a difference to their examination preparation and prompted them to engage with the course materials. As it is only fair from an ethical viewpoint to give all students the same learning opportunities, participation in the AES was open to all students, with some choosing to participate, while others did not. It is therefore possible, if not highly likely, that the two student groups had significantly different reasons for their views. After all, the group of students who did not take part in the AES based their views on their partial experience with the online polling. The complexity involved in the participation process from the learners' perspective could form the basis for future studies aimed at investigating the decisions behind the students' engagement in the AES.

In terms of the broader application of AES, both groups of students also showed generally positive evaluations. They generally agreed that the use of AES was an innovative way to collect their views. This finding suggests that, like other conventional forms of AES (eg, Ko & Rossen, 2010), online polling used in conjunction with revision lectures can serve as a versatile feedback-gathering tool both for students and lecturers. It is interesting to observe that the students who did not participate in the AES were just as positive about the use of prelecture online polling in other modules as the other group. Despite their positive evaluation, it is possible that survey fatigues could potentially dampen students' interest and produce inaccurate data in AES (Savage & Waldman, 2008; Tong, 2012).

Our findings in this study obviously do not include the views from those who did not take part in the evaluation, and the data do not allow us to study the students who were apathetic about AESIR. It is therefore important to interpret the results from this study with caution. For example, it is not possible to conclude that participation in AES is irrelevant to the successful implementation of AESIR on the basis that the two groups were equally positive (within statistical significance) in their views. This is particularly true given the lower completion rate in the evaluation for those who did not take part in the prelecture AES. In fact, we, the educators, do strive to increase the students' participation in AES. After all, lectures based on polling results would not be possible if no (or very few) students contributed to the AES. What our data actually show, however, is that AESIR can be just as engaging to students who participated in the online survey as to those who did not. This is significant because those who participated in the AES and completed the evaluation were arguably among the most enthusiastic about using AESIR in teaching the module, given their positive views and high evaluation return rate.

It is important to note that our evaluation was restricted to the key identified aspects about AES, and it is quite possible that the two groups of students may show statistically significant differences in their evaluations of other areas. Nevertheless, our study does highlight positive aspects about the use of AES in contrasting contexts compared with the previous study reported in Tong (2012)—part-time versus full-time; science versus business; small versus large groups. Given that students from both studies would like AESIR to be used as a platform in the teaching of other modules, it will be useful to study how their evaluations may change as AESIR are applied to other courses that they study. Our study provides the basis for further investigations into the pedagogical use of electronic surveys, and not necessarily limited to AESIR-based investigations. Our findings may also inform the design of qualitative investigations for enhancing our understanding of the pedagogical uses of AES that aim to engage with as many students as possible.

References

Anderson, B. & Simpson, M. (2004). Group and class contexts for learning and support online: learning and affective support online in small group and class contexts. *The International Review of Research in Open and Distance Learning*, 5. http://www.irrodl.org/index.php/irrodl/article/view/208/291

Baggaley, J., Kane, T. & Wade, B. (2002). Online polling services. *International Review of Research in Open and Distance Learning*, 3, 2. Technical Evaluation Report 12.

Das, M., Ester, P. & Kaczmirek, L. (Eds) (2011). *Social and behavioral research and the internet: advances in applied methods and research strategies*. London: Routledge.

Draper, S. & Brown, M. (2004). Increasing interactivity in lectures using an electronic voting system. *Journal of Computer Assisted Learning*, 20, 81–94.

Easton, C. (2009). An examination of clicker technology use in legal education. *Journal of Information, Law and Technology (JILT)*, 3. Retrieved June 5, 2011, from http://go.warwick.ac.uk/jilt/2009_3/easton

Fies, C. & Marshall, J. (2006). Classroom response systems: a review of the literature. *Journal of Science Education and Technology*, 15, 1, 101–109.

Kay, R. H. & LeSage, A. (2009). Examining the benefits and challenges of using audience response systems: a review of the literature. *Computers & Education*, 53, 819–827.

Klaas, J. (2003). Best practices in online polling. *International Review of Research in Open and Distance Learning*, 4, 23.

Klaas, J. & Baggaley, J. (2003). Online polling as collaborative tool. *International Review of Research in Open and Distance Learning*, *4*, 22.

Ko, S. & Rossen, S. (2010). *Teaching online: a practical guide* (3rd ed.). New York: Routledge.

Moss, J. & Hendry, G. (2002). Use of electronic surveys in course evaluation. *British Journal of Educational Technology*, *33*, 583–592.

Savage, S. J. & Waldman, D. M. (2008). Learning and fatigue during choice experiments: a comparison of online and mail survey modes. *Journal of Applied Econometrics*, *23*, 3, 351–371.

Stahl, B. C. (2005). E-voting: an example of collaborative e-teaching and e-learning. *Interactive Technology and Smart Education*, *2*, 101–111.

Tong, C. H. (2010). Let interdisciplinary research begin in undergraduate years. *Nature*, *463*, 157.

Tong, V. C. H. (2011). Linking summative assessments? Electronic feedback and feedforward in module design. *British Journal of Educational Technology*, *42*, E152–E155.

Tong, V. C. H. (2012). Using asynchronous electronic surveys to help in-class revision: a case study. *British Journal of Educational Technology*, *43*, 465–473.

Wang, Y.-S. (2003). Assessment of learner satisfaction with asynchronous electronic learning systems. *Information & Management*, *41*, 75–86.

Appendix: AES used in this study and the mean scores

Note that the numbers in bold indicate/show the mean score of the question from the AES.

I know it well enough to be able to explain it to others.	I know enough to provide a decent attempt at an answer.	I think I know it, but I am not very sure.	It sounds vaguely familiar, but I really don't know.	I am really confused and probably need help.
1	2	3	4	5

Please answer the following questions by using the table above (ie, write down 1, 2, 3, 4 or 5 next to the question). For instance, if you feel that you think you know how to answer the question but not very sure, please answer "3".

Topic 1: introduction to cost terms and purposes
Do you understand the meaning of the following terminologies? Cost object; cost tracing; cost allocation; cost driver; unit costs; variable and fixed costs **2.3**

Topic 2: job costing
Do you understand what is "actual" versus "normal" costing? **2.9**
Do you understand why over- or under-allocated indirect costs occur? **2.8**
Can you calculate the different "proration" approaches and explain the reason(s) for selecting such approaches? **3.9**

Topic 3: process costing
Do you understand the differences between job versus process costing? **2.6**
Can you calculate process costing using first-in-first-out (FIFO)? **2.4**
Can you calculate process costing using weighted average cost (WACO)? **2.8**
Do you understand standard costing? **3.1**

Topic 4: cost allocation
Do you understand the ideas underpinning the following criteria for cost allocation? Cause and effect; Benefits-receive; Fairness; Ability-to-bear **3.1**
In terms of allocating support department costs, can you calculate:
Direct allocation method **2.6**
Step down (sequential) method **2.9**
Reciprocal allocation method **3.1**

Topic 5: joint cost situations
Can you calculate the sales value at split off method? **2.8**
Can you calculate the estimated net realizable value method? **3.0**
Can you calculate the constant gross margin percentage net realizable value method? **3.0**
Can you calculate the physical measures method? **3.1**
Do you understand the irrelevance of joint costs in decision making? **3.2**

Topic 6: income effects of alternative stock costing methods
Do you know how manufacturing fixed costs are treated under variable versus absorption costing? **3.1**
Can you construct variable costing income statements for more than one period? **3.3**
Can you construct absorption costing income statements for more than one period? **3.4**
Do you understand the distortions caused by absorption costing on profit figures, and how this affects managerial behaviour and incentives? **3.6**
Are you able to suggest ways in which such distortionary behaviours caused by the use of absorption costing can be minimized? **3.8**
Do you know the following equation?
(Absorption costing operating profit) − (variable costing operating profit) = (fixed manufacturing costs of closing stock under absorption costing) − (fixed manufacturing costs of opening stock under absorption costing) **3.6**

Topic 7: cost–volume–profit analysis
Do you understand the assumptions underpinning cost–volume–profit analysis? **3.0**
Can you calculate break-even? **1.8**
Do you understand what sensitivity analysis is? **2.7**
Can you calculate the effects of different revenue mixes? **3.3**

Topic 8: relevant information for decision making
Are you able to identify what are relevant costs and revenues versus irrelevant costs and revenues? **3.0**
Do you understand the criteria for selecting relevant costs in one-off special orders (vs. repeated orders)? **3.3**
Can you calculate relevant costs and revenues under capacity-constrained decisions? **2.9**

Topic 9: activity-based costing
Can you explain the differences between activity-based costing versus more traditional systems of costing? **2.9**
Can you calculate unit product costs under activity-based costing versus traditional systems of costing? **3.0**
Do you understand the conditions when implementing activity-based costing are most/least effective within an organization? **3.1**

Topic 10: pricing and customer profitability analysis
Do you understand what the major influences on pricing decisions are? **2.7**
Can you distinguish the differences between short versus longer term pricing considerations? **3.0**
Do you understand cost incurrence and lock-in costs? **3.4**
Can you calculate differences in customer profitability and rank customers using hierarchical criteria (cost base; revenue; profitability)? **3.2**
Can you discuss the strengths/limitations of relying on customer profitability analysis for decision making? **3.3**

Topic 11: budgets
Do you understand what a master budget is? **2.9**
Why is it important that management accounts prepare budgets? **2.4**
Can you prepare a cash budget for more than one period? **2.9**

Topic 12: variance analysis I
Do you understand the difference between a static budget and a flex budget? **2.6**
Can you prepare a flexible budget and calculate sales-volume variances? **2.9**
Can you calculate price and efficiency variances for direct cost input categories (ie, materials and labour)? **3.1**

Topic 13: variance analysis II
Can you calculate and interpret variable overhead spending and efficiency variances? **3.5**
Can you calculate the budgeted fixed overhead rate? **3.2**
Can you explain why the production-volume variance is not a good indicator of unused capacity? **3.6**
Do you understand why there is never a production-volume variance for variable manufacturing overheads, and why there is never an efficiency variance for fixed manufacturing overheads? **3.7**

Topic 14: yield, mix and quantity effects
Do you understand what a substitutable product is and how it impacts on the yield and mix? **3.5**
Can you calculate total direct materials yield and mix variances? **3.5**
Can you calculate direct manufacturing labour yield and mix variances? **3.5**
Can you calculate the static and flexible budget variances? **3.5**
Can you calculate the sales mix and sales quantity variances? **3.3**
Can you calculate market share and market size variances? **3.4**

Topic 15: management control systems
Can you describe what a management control system is for? **3.4**
Can you briefly illustrate, using actual organizations, the types of information gathered within a management control system? **3.3**
Can you explain the behavioural effects (both positive and negative) induced by a management control system? **3.5**