

I can see what you are doing: Using collaboration software to improve student engagement during computer-screen-based tutorials

George P. Banky

Engineering and Science Education Research Group, Faculty of Engineering and Industrial Sciences, Swinburne University of Technology
Corresponding Author Email: gbanky@swin.edu.au

BACKGROUND

Active collaborative learning and membership in learning communities have been identified by researchers to engage learners. In this pilot study a commercially available software utility was used to establish such an environment in a computer laboratory. Others have found the learner-centred education can be facilitated by integrating the tablet PCs for the students. Research by the author showed that experiential learning of basic electronics, using circuit simulation software, facilitates student engagement resulting in deep learning.

PURPOSE

This research addressed the following issues: will collaborative learning result in more student engagement and what type of software will support such activity.

DESIGN/METHOD

The tutorials for first-year electronic systems students were timetabled into a computer laboratory that had a network of tablet PCs with circuit simulation software, which in 2012 were installed with a collaboration software as well. The students were asked to show, on the screens, their solutions to problems and verify their results with appropriate circuit simulations. The collected data included anonymous survey responses, mean marks for assessable components and tutorial attendance figures for 2011 (pre-intervention) and 2012 (post-intervention).

RESULTS

The student use of the simulation software increased. Mean assignment and tutorial participation marks improved. Other assessable subject components appeared to have worsened. Finally, 12% of the respondents to an anonymous post-event survey were negative about the intervention.

CONCLUSIONS

Student engagement, as reflected in tutorial attendance and assignment marks, were better in 2012. Exam result comparison with 2011 cohort contradicted the findings by others who completed student collaboration studies using networked tablet PCs. Free-form responses in the anonymous student survey were favourable. All these issues need further investigation.

KEYWORDS

Computer-screen-based student learning, collaboration software, student engagement, tablet PC

Introduction

Active collaborative learning, as well as membership in learning communities, have been identified by researchers to engage learners (Leach & Zepke, 2011). Donovan and Loch argue that students appreciate collaboration, since it enables them “to observe other students solving problems, and to receive prompt feedback on misconceptions” (Donovan & Loch, 2012: 10). Furthermore the consequential formative feedback received by the attending students, from each other as well as the academic, has been found to have the most positive consequences on their learning (Bull, Jackson, & Lancaster, 2009; Koile & Singer, 2006). In general, the evidence is there “that active and collaborative learning techniques enhance student learning ... [and] reduce attrition” (Loch, Galligan, Hobohm, & McDonald, 2011: 941).

In this pilot study a commercially available software utility, *NetSupport School* (<http://www.netsupportsoftware.com>), was used to establish such an environment in the teaching space shown in **Figure 1**. This software facilitates the monitoring, in real-time, over a local-area network, by an academic, in a computer laboratory the on-screen activities of students. Additionally, it also enables the selection of either the academic's or a student's computer for display on the venue's data projector(s). In this way in-class discussion by all the attendees is possible, hence correct solutions, as well as, work with common mistakes may be highlighted for the benefit of all who are present in the room.



Figure 1: Venue used for *NetSupport School* investigation

As already demonstrated in the literature, learner-centred education can be facilitated by integrating the tablet PCs for the students in the face-to-face venue chosen for the study (Loch, et al., 2011). While, previous studies by the author have shown that experiential learning of basic electronics, using circuit simulation software for both private and tutorial

study, facilitates student engagement resulting in deep learning (Banky, 2005, 2008). In other words the environment has been set for a potentially positive outcome.

Purpose

The research questions addressed by this study are:

- Will the students be more engaged, hence perform better, if they have the opportunity to collaboratively participate in a learning community (such as a tutorial)?
- Will the use of a collaboration software, which facilitates the monitoring and sharing of student activity, support the establishment of such a community?

Design/Method

The students, selected for this investigation, were first-year undergraduate engineering students who were studying electronic systems in the first semester of their program at Swinburne University of Technology. In 2012, eleven tutorial classes per week, of no more than twenty students per session, were timetabled for this course. In an attempt to remove teaching bias, the academic, who tutored all these classes in 2011, was also instructing all the classes during the twelve weeks long semester in 2012. The syllabus for both years was identical, as was the material covered in each corresponding tutorial. Student attendances were recorded, since this was an assessable component for the subject. Five assignments, submitted every two weeks and comprising of questions covering the lecture topics of the previous fortnight, were also required submissions from each student during the semester.

The venue selected for this investigation, as seen in **Figure 1**, fundamentally was a computer laboratory that had a network of twenty tablet computers for student use, as well as ten large video screens placed around its walls. On a desk, at the front of the room, the academic had a dual-monitor desktop computer. One monitor was dedicated to displaying the image that was showing on the video screens, while the other showed, in real-time, the thumbnails of the students' on-screen activities, as seen in **Figure 2**.

The tutor, by double-clicking on any of the displayed thumbnails, could share the chosen tablet with his desktop. In effect, the two machines behaved as if they were one: the tablet's screen filled that of the desktop; and the tablet could be controlled by the desktop's keyboard and mouse. Furthermore, by dragging the window showing the student's work to the desktop's other display monitor, the image may be shown on the video screens around the room, thereby presenting it to the rest of the attendees.

During the tutorials the students were asked to show, on the screens of their tablet computers, detailed solutions to electronic circuit analysis problems and/or verify their calculated answers or predictions with a commercially sourced simulation software, *NI Multisim 11* (<http://www.ni.com>), which was also installed on the venue's computers.

In the last week of the semester the students, who attended that tutorial session, were asked to complete an anonymous survey that consisted of the following:

- Likert-scaled questions on the subject components that in their opinion contributed to their understanding;
- a binary question on whether they use *NI Multisim* for the checking of their calculations to assignment and /or text book problems;
- two free-form questions, one on their engagement resulting from the use of *NetSupport School* during the tutorials.

The first five questions of this survey were part of a longitudinal study over the past five years. Some of that study's results have already been reported by the author at past AAEE Conferences (Banky, 2008, 2011; Banky & Wong, 2007).

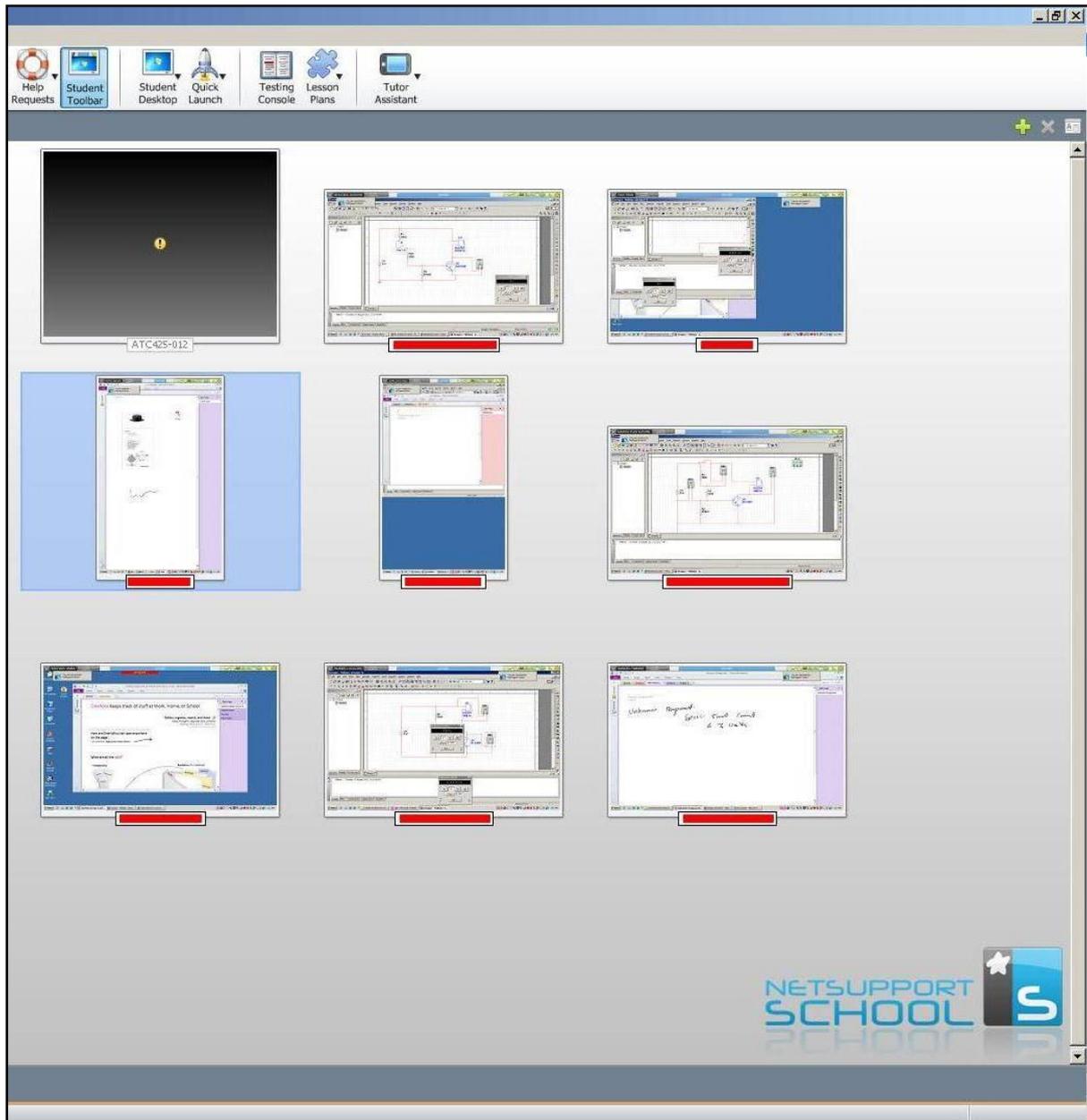


Figure 2: NetSupport School control screen displaying real time “thumbnails” of the connected students’ on-screen activities

Results

Table 1 summarises the data collected for *Question 5* of the post-event survey in 2011 and 2012. While **Table 2** displays the average marks obtained, by completing students, in all the assessable components for the subject for the two years under investigation, as well as the results of a 1-sided t-test comparing these results for the 2011 and 2012 cohorts.

Figure 3 shows a graph of the percentage of enrolled students who attended the tutorials in Academic Week 2 to Academic Week 7 and Academic Week 9 to Academic Week 12 in 2011 and 2012. As can be seen in **Figure 3**, there were no tutorials held in Academic Week 8, due to Anzac Day (a public holiday in Australia) that had over half of the classes falling on it.

Table 1: Analysed results for Question 5 of survey

| | Survey 2012 | | Survey 2011 | |
|--|-------------|------|-------------|------|
| | Y(%) | N(%) | Y(%) | N(%) |
| Question 5: I have used NI Multisim 11 to check my calculations for assignment and/or text book problems. | 94.1 | 0.8 | 84.8 | 8.1 |

Table 2: Average marks obtained for assessable components of the subject

| Year | 2012 | 2011 | 1-tailed t-test for equality of means |
|--|-------|-------|---------------------------------------|
| Enrolled Student Numbers | 192 | 174 | |
| (Mean Exam Mark)/60 | 23.80 | 24.47 | p = 0.665 |
| (Mean Assignment Mark)/15 | 7.63 | 6.48 | p = 0.002 |
| (Mean Tutorial Participation Mark)/5 | 3.70 | 3.45 | p = 0.107 |
| (Mean Laboratory Participation Mark)/20 | 10.54 | 11.26 | p = 0.94 |
| (Total Mark)/100 | 45.65 | 45.65 | p = 0.499 |

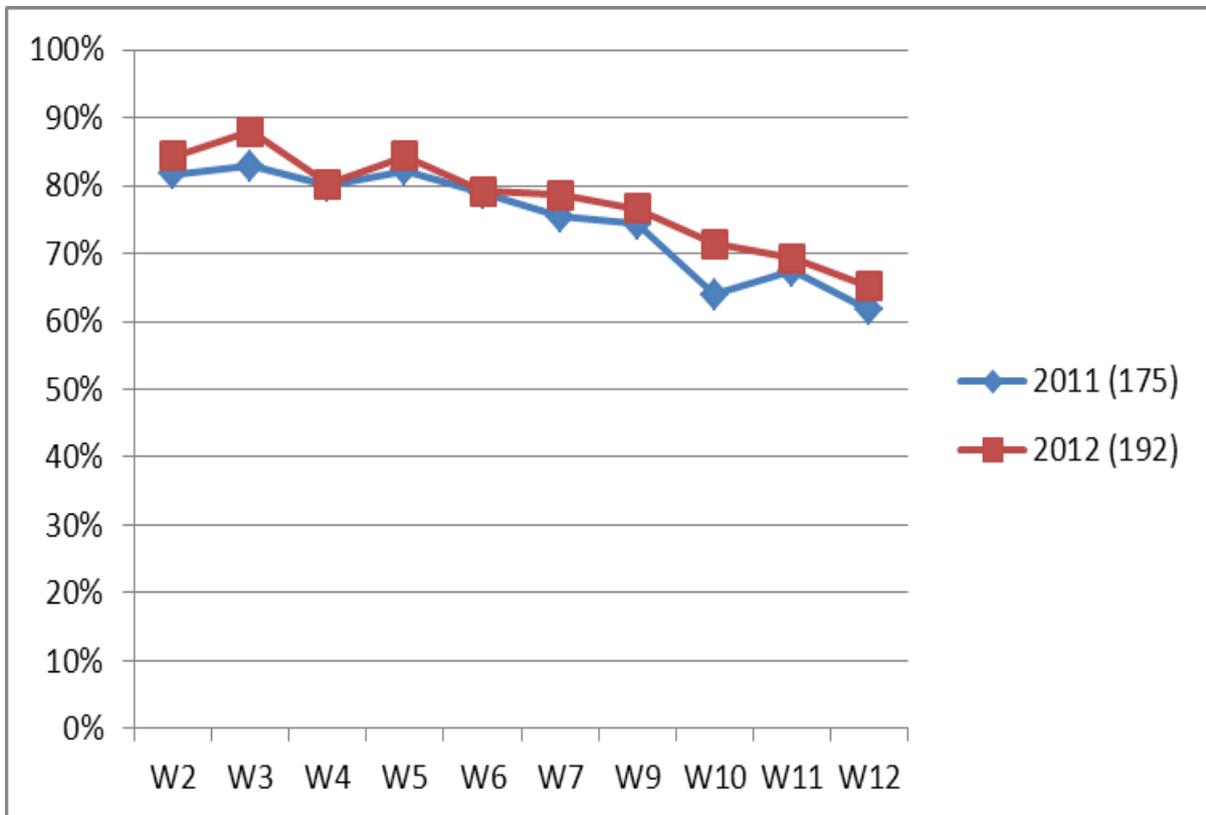


Figure 3: Percentage of enrolled students who attended the tutorials from Academic Week 2 (W2) to Academic Week 7 (W7) and from Academic Week 9 (W9) to Academic Week 12 (W12)

In 2012, ninety-two survey respondents also provided free-form comments in response to **Question 6**, namely: *“Briefly comment on your experiences with NetSupport School as a motivator for engaging with the tutorials”*. Eleven (or 12%) of the comments were negative and fifteen (or 16%) were neutral. Sixty six (or 72%) responded with rather revealing and at times very enthusiastic observations in order to justify their viewpoint.

Examples of favourable student responses included: *“good idea, could be used more”, “helpful motivator”, “it allowed me to see how other students fared”, “it’s very fun (sic.) and makes me feel like I am part of it”, “it’s a very good motivator, it should be used in other subjects”, “program works well to get students involved”, “I like it, it really helps to engage us in the content in the tutes”*.

Some favourable statements were qualified with the following remarks: *“stops people using Facebook and getting distracted”; “I don’t like being put on the spot but at the same time it does motivate you to do the work”, “have to learn the basics otherwise you will look stupid in front of class; good motivator to study”, “good tool - helps us to understand the concept from other perspectives”, “it stopped me from sitting there quietly whilst not understanding the work, or if I potentially understood it I was forced to attempt it”, and “good to see how other students approach and attempt problems”, “knowing you have an obligation to work helps motivate”*

Negative comments included: *“dislike [it] - mistakes are shown badly”, “good; [although] can be intimidating”, “it is not really motivating; it is intrusive, where it often gives the impression that someone is over our shoulder watching our every move; that should not be the purpose of such a software”, “not really motivating, [it is] intrusive; great for showing work to the group though”, and “don’t like sharing [with others]”*

Finally two comments that encapsulated the ‘double edged sword’ that this type of innovation presents: *“uncomfortable being forced to speak to the class on the spot”, and “good idea but seems to fall over in practice as everybody hangs back from working until a volunteer is chosen”*.

Discussion

The results for this pilot study, as seen in **Table 2**, showed that, in 2012, the mean of the assignments improved by 18% and the examination by 9%. While the mean for laboratory participation dropped by 7%. The *1-tailed t test* for the means indicated that:

- the assignment mean for 2012 improved significantly at the 5% significance level;
- the tutorial participation mean in 2012 borderline significant at the 10% significance level, and it may have become more significant with a slightly larger sample size, thus indicating that the 2012 intervention may have had an effect on student engagement during the tutorials;
- The exam mean and laboratory means worsened in 2012.

The last outcome contradicts the findings of Fister and McCarthy (2008) that showed significantly higher exam scores for their mathematics students who participated in their research into the use of wirelessly connected tablet PCs in the classroom. This anomaly may be explained by the fact that since the intervention was only in the tutorials, and not all students attended these, the inclusion of marks of those who did not attend could skew the calculated mean. Additionally, the activities during these pilot tutorials were discussion-based, and highly likely to have been different to those of the mathematics students, in which they most probably solved problems. Further

investigation is planned for 2013, when the tutorial activities will be revised to focus on supervised individual and communal problem solving.

A visual comparison of the 2011 and 2012 responses to Question 5, as seen in **Table 1**, shows an 11% improvement in student private use of the simulation software, *NI Multisim*. This may be explained by the fact that the students were frequently asked to use this software in the tutorials; and the threat of consequential monitoring of this activity resulted in increased practice and subsequent confidence with the software product.

The graphs in **Figure 3**, summarising tutorial attendance numbers show little difference between the pilot group of 2012 and the 2011 reference group. In both cases there was an initial settling period (until Academic Week 5), followed by a decline in the attendance numbers. This issue also needs further investigation.

Finally, free-form student responses reflected a wide cross-section on the perceived value of the intervention. While the respondents' statements highlighted some interesting observations, the consensus appeared to be favourable; only 12% of those who responded appeared to be negative towards its use.

Conclusions

The research results indicate that while the student perception was favourable, this did not translate into significant improvement in some of the assessed components of the subject. While the comparative analysis of the mean marks for each assessed component is not an argument for, say, "exam marks are a good indicators of student learning", it probably articulates a lot about the appropriateness of the "how", the "why" and the "what" of the assessment given to the students. In this case, it does show that both assignment and tutorial performances were affected by the use of *NetSupport School* in 2012.

After seeing, in **Table 2**, the obtained mean values for the "*Total Mark*", one cynical colleague commented that "*it is pity to have expended so much effort with zero result*". However, one recognised side-benefit of this type of research activity, is that it may plant the seed for "campus-wide discussion and coordination of effective university teaching" (Loch, et al., 2011: 942).

References

- Banky, G. P. (2005, September 26 - 29, 2005). *Using circuit simulator software in the study of electronic circuit behaviour*. Paper presented at the 4th ASEE/AaeE Global Colloquium on Engineering Education, Sydney, NSW.
- Banky, G. P. (2008, December 7 - 10, 2008). *Exploring the basics with circuit simulation: Support for self-teaching of electrical engineering fundamentals*. Paper presented at the Australasian Association for Engineering Education 2008 Conference, Yeppoon, Qld.
- Banky, G. P. (2011). O (Big) Brother Where Art Thou: Exploring the capabilities of synchronous online communication while supervising experiential learning from a distance. In S. Grainger & C. Kestell (Eds.), *Engineering Education: An Australian Perspective* Brentwood, UK Multi Science Publishing Co Ltd.
- Banky, G. P., & Wong, K. K. (2007, September 2 - 7, 2007). *Troubleshooting Exercises Using Circuit Simulator Software: Support for Deep Learning in the Study of Electronic Circuits*. Paper presented at the International Conference on Engineering Education, Coimbra, Portugal.

- Bull, S., Jackson, T. J., & Lancaster, M. J. (2009). Students' interest in their misconceptions in first-year electrical circuits and mathematics courses. *International Journal of Electrical Engineering Education*, 47(3), 307 - 318.
- Donovan, D., & Loch, B. (2012). Closing the feedback loop: engaging students in large first-year mathematics test revision sessions using pen-enabled screens. *International Journal of Mathematical Education in Science and Technology*, from <http://dx.doi.org/10.1080/0020739X.2012.678898>
- Fister, K. R., & McCarthy, M. L. (2008). Mathematics instruction and the tablet PC. *International Journal of Mathematical Education in Science and Technology*, 39(3), 285-292.
- Koile, K., & Singer, D. (2006). Improving Learning via Tablet-PC-based In-Class Assessment. *Campus Technology*. Retrieved from <http://download.101com.com/CAM/conf/2006/WPS6.pdf>
- Leach, L., & Zepke, N. (2011). Engaging students in learning: a review of a conceptual organiser. *Higher Education Research & Development*, 30(2), 193-204.
- Loch, B., Galligan, L., Hobohm, C., & McDonald, C. (2011). Learner-centred mathematics and statistics education using netbook tablet PCs. *Journal of Mathematical Education in Science and Technology*, 42(7), 939-949.

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