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Use of an Electronic Voting System to facilitate interactive engagement and enhance active learning of undergraduate students in Biomedical Science

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Introduction

Student engagement is a persistent issue in traditional mode of delivery of lectures and tutorials. This pilot study investigated whether active learning approaches with the support of technology can establish interactive learning environments and promote engagement as well as enhance student learning. *PollEverywhere*, an Electronic voting system (EVS) was used in small group tutorials to enhance tutor-learner dialogue and peer interactions as a means of active learning. The preliminary evaluation of this study shows that providing immediate feedback, the anonymous nature of the EVS response, and the ability of learners to identify their weakest areas, helped them to engage in deep learning.

Learning is a lifelong cognitive process to acquire knowledge and skills through interaction between tutor and learner as described by many educational theories (Kolb, 1984; Laurillard, 2002; Vygotsky, 1978). Despite many learning models and theories are based on the cognitive processing and feedback, the traditional university methods of teaching tend to restrain the promotion of such dialogue; yet it may facilitate learners to actively participate in the learning process. Learning is also further enhanced by designing and application of interactive formative assessments as well as a good feedback practice. As academic practitioners we need to formulate an environment which can facilitate learners to construct meaningful concepts and develop problem-solving skills that could lead to 'deep learning' (Entwistle and Ramsden, 1983). The learners must engage in a 'meaningful learning' which could enable them to use the knowledge acquired in the initial learning situation to solve problems in a new distinct situation (McDermott, 1993). Since majority of the learners of the twenty first century are digital natives in a rapidly changing digital world, educational technology can be integrated to create effective learning environments and transform the traditional teaching methods such as lectures and tutorials to include dialogue to facilitate interactive engagement.

The Educational Context and learners

Biomedical science is a field which requires acquisition of knowledge through experience and obtaining competence through reflective practice (see the work of Kolb, 1984; and Moon, 1994, in this regard). The learners are required to establish connections between ideas and concepts by engaging with the distributed knowledge through technology embedded activities and by forming a wider network with stakeholders to obtain their knowledge, training and competence (see for example, Siemens, 2005). Although the learners need to be autonomous and should be engaged in aggregating, relating, creating, and sharing activities (Kop, 2011), the tutor still has a role to guide and establish the relevant connections for the learners as there is enormous information available and the learners may not be able to utilise the appropriate material. The volunteers for this pilot study constituted six students from a level 5 module and seven from a level 6 module of the undergraduate degree course in biomedical science which is an Institute of Biomedical Science (IBMS) accredited course that helps the learners to obtain professional status with Health Professional Council (HPC). The pilot group included young learners and mature learners as well as some international students. These learners have considerable understanding of e-Learning as it has been significantly embedded in the teaching curriculum by the School of Human Sciences at London Metropolitan University through [1]*WebLearn* and this includes online assessments and feedback, online quizzes, discussion boards and e-portfolios.

The purpose of the intervention

The lectures for biomedical sciences course at London Metropolitan University are usually conducted in large groups which have limited opportunities for extended dialogues between a tutor and learners. Despite e-Learning being embedded in the current teaching curriculum, student engagement is still a persisting concern during lectures and tutorials. The purpose of this pilot study was to create interactive tutorial sessions to enhance active participation using an electronic voting system. This study also aimed to create opportunities for learners to assess their own understanding by responding to the task and with immediate feedback from the tutor. Further opportunities for students to enhance learning through peer instructions (Mazur, 1997) which could create an effective learning community were investigated. Furthermore, from a tutor's perspective, the tool may help to assess the learners' understanding of the session instantly and help to evaluate teaching which enable educators to adapt a different strategy for the remaining session.

The technology

Learning technologies are an integral part of twenty-first century learning as it enables learners to fit learning into their complex and demanding lives with the flexibility of access to resources (JISC, 2009). A wide range of technology tools including Web 2.0 were explored and Electronic Voting System (EVS) has been

[1] *WebLearn* is the Virtual Learning Environment (VLE) used at London Metropolitan University.

chosen as the suitable intervention for the project as many studies described that it has the potential to integrate learning environments and facilitate student engagement as well as useful for providing feedback in real time (Draper & Brown, 2004; Kennedy & Cutts, 2005; Palmer *et al.,* 2005; Fies & Marshall, 2006; Bruff, 2009; Jefferies, 2011).

There are many types of EVS available, some of which uses handheld audience response systems such as *TurningPoint, Powervote, Showmode,* and *Interwrite PRS* whereas others use mobile phones and laptops as voting devices. The EVS system chosen for this study is '*PollEverywhere*' from *www.PollEverywhere.com* and it is a free web-based software for the use in a class size of less than 30 students. *PollEverywhere* can be accessed via a generic networked computer and it allows the lecturers to create polls with multiple choice questions (MCQ) as well as open-ended questions. The learners can respond by text, *Twitter* or submit response at *PollEv.com* using their Smartphones or laptops. The Live Text Wall / Live Chart will show the responses received and the poll results can be downloaded directly as a *PowerPoint* presentation once the poll is completed. This system allows the students to receive feedback instantly and tutors can evaluate the teaching with immediate poll questions.

The learning exercise

The study was designed based on the Principles of Good Teaching and Learning (Chickering and Gamson, 1999) and underpinning theories of online learning community (see for example, Kear, 2011) to implement in tutorial sessions for two modules. Small group tutorials can be stimulating and create non-threatening learning environments for interactive engagement (Novak, 1998). A well-constructed interactive tutorial with the use of technology could improve tutor-learner dialogue (Laurillard, 2002), peer interactions (Mazur, 1997), and facilitate active and collaborative learning through social constructivism (Vygotsky, 1987; Derry 1999; McMahon, 1997: Lave and Wenger, 1991).

Tutorial sessions were constructed with ten questions including multiple choice questions (MCQs), true or false questions and open-ended questions that reflect the material covered in the lecture to evaluate student understanding. Since the implementation was carried out in the regular tutorial settings (Figure 1a & 1b), sessions also included other questions which were part of the overall discussion. Once the questions were presented on the online poll, peer discussions were encouraged prior to voting. Tutor lead discussions were initiated after each poll focussing primarily on the incorrect answers to encourage learners to work through to obtain the correct answer. In addition, some evaluation questions were designed as polls to collect immediate feedback from the learners regarding the sessions.

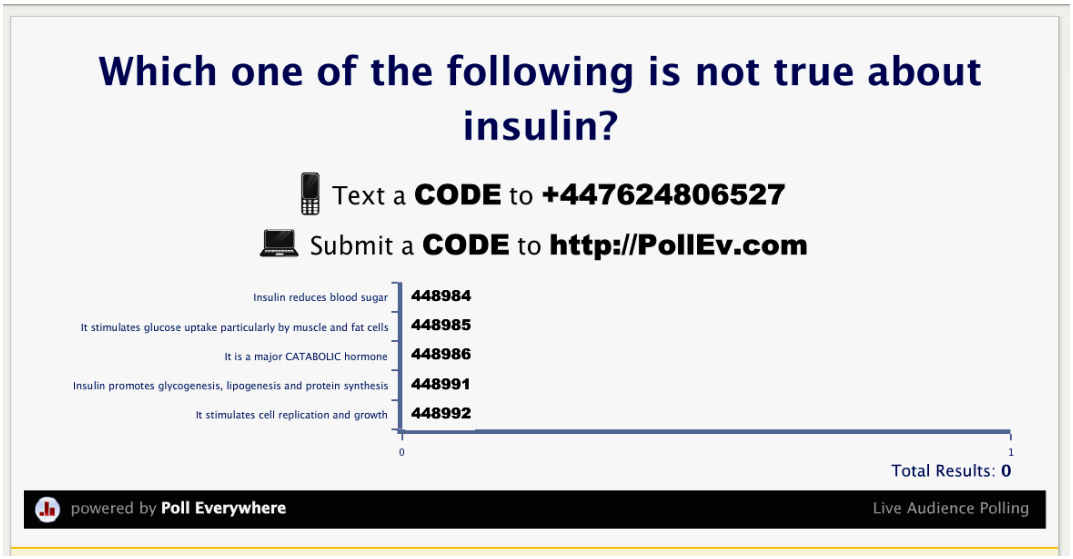

Figure 1a: A screen shot of a poll question with the answering options.

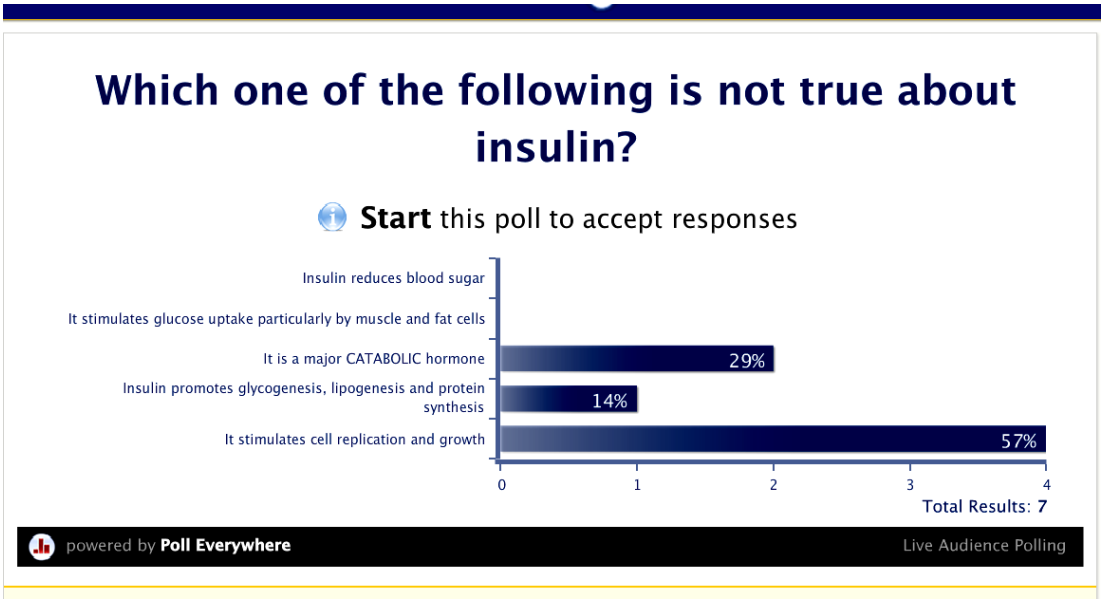

Figure 1b: A screen shot showing a poll question with student responses.

Impact on student learning

There was considerable evidence from student feedback to indicate that the intervention had created variety in the learning environment due to breaks during the sessions in contrast to a traditional tutor-lead session. It has previously been reported that breaks in lectures with interactive activities improved student concentration (Bligh, 1998). Cain *et al.,* (2009) reported that for 99% students it helped them to maintain attention in lectures and also improved their attendance.

The efficacy of peer interactions are described by Mazur, 1997, for example. The effectiveness of interactive engagement in improving student learning was extensively studied by Hake (1998) and provided strong evidence to suggest that it can enhance learning. A positive correlation was observed with the integration of EVS and improved student performance in their mid-course and final assessments

(Kennedy and Cutts, 2005). Crouch and Mazur (2001) also reported that interactive engagement resulted in more than doubling of measured learning when it was used in teaching mechanics. Furthermore, the nature of MCQs with a degree of difficulty in excluding incorrect answers also stimulated peer discussions. A number of students in the study were enthusiastic about the poll questions and the majority of the students who agreed to participate responded to the questions on most occasions. It was also evident that the anonymous nature of the response encouraged wider participation and provided opportunity for less vocal students to engage in a non-threatening environment. As the sessions progressed, it was apparent that there was an increase in peer-peer interactions and the live chart acted as an initiator for discussions.

The variety of questions used in this pilot study encouraged most learners to think more critically about the course material and the requirement to response to questions prompted mental processing otherwise this interactivity may lack in the traditional tutorial setting. Most students were motivated when they can see their responses had a direct effect on the poll. Student feedback suggested that the polls helped them to engage with the subject content and facilitated their understanding of the course material (Appendix I). Since the intervention was designed around the general theme of the tutorial, the overall discussion was extended with the inclusion of non-poll questions which provided opportunities for students to engage with complex material and encapsulate key concepts. Cain and Robinson (2008) reported that a large number of students involved in health and pharmacy studies experienced increased involvement with the lectures. Enhanced student learning was also demonstrated with the use of EVS in interactive lectures compared with traditional lecture format (Masikunis *et al.,* 2009).

One of the most successful outcomes of this study was that most students were fascinated by the quality of immediate feedback received and how that helped them to assess their own understanding of the course material. A number of students felt that the feedback was useful to assess their own performance in relation to the rest of the class without being noticed by their peers due to the anonymity. The poll questions were also acting as formative feedback, instructing the learners to identify their weakest areas and assisting them to focus on such material further for their summative assessments. In terms of revision for exams, eight volunteers thought it had helped them very much and five thought it was useful to some extent. The immediate feedback obtained by *PollEverywhere* helped the tutor to address the misconceptions, especially focussing on the incorrect answers, and promoted further discussions. Several studies had reported that effective feedback provided by EVS can promote student understanding and performance (Beatty, 2004; Draper and Brown, 2004; Palmer *et al.,* 2005; Collins *et al.,* 2007; Rubner, 2012).

The feedback provided by the students was very useful to understand how well the class understood the subject material which could enable a tutor to adjust the

sessions based on the earlier learning outcomes of difficult material with a contingent teaching approach (Wood *et al.,* 1978). Evaluation questionnaires also provided valuable information on student learning, identifying areas for more focus, delivery and gaps in knowledge. Most students stated that using this tool in the tutorial was enjoyable, interesting and innovative as well as easy to use and less distracting which had given them a stimulating learning experience (Appendix II).

The challenges and limitations

There were a number of challenges and limitations that need to be addressed for future implementations. One of major issue was that not all the agreed or anticipated volunteers participated in the sessions and this may be due to the fact that the implementation dates were close to the assessment deadlines or exam period. Since the technology intervention was during a regular tutorial session, there were number of students who were not participating and maintaining student engagement throughout was one of the obstacles. The strategy to establish discussion with non-poll questions in between polls has increased interactions and it was evident that some of these were involved in peer discussion regarding poll questions even they were not voting in the poll. Another challenge was using Smartphones as response devices. There was a significant delay in submitting web response due to University wireless network connection. Despite all the students being instructed to operate their phones in silent mode, there were a small number of occasions where some level of distraction. Furthermore, the free version of the software does not allow the tutor to identify who was responding to which answer, hence it is difficult to offer a personalised feedback. In certain circumstances biomedical science requires a depth of explanation for key concepts and the type of questions that can be created with *PollEverywhere* could be a limiting factor. One possible solution for this issue is to link the session with some *WebLearn* activity to encourage or establish further discussions.

Future impact

Future interventions should be conducted earlier in the semester and use the technology to prepare revision sessions to familiarise students with exam style questions and concentrate on the issues reflected in earlier sessions. One possible way to encourage participation by offering some course marks through some extended *WebLearn* activities. With regards to the limitation with MCQs, a discussion board could be set up for each question which could extend the discussion on the subject or to clarify issues by students and the tutor (Kennedy and Cutts, 2005). In addition, a copy of the poll questions with responses and tutor's discussion can be incorporated into *Weblearn* for students to access and reflect for exam preparation. It is also vital to design further sessions to address whether the outcome of this study was a one-off effect. It is also possible to upgrade to a paid version which allow the allocation codes for each student. The anonymity can be still kept within peers but a tutor could monitor individual responses and provide personalised feedback. A recent study by Rubner (2012) described the use of '*mbclick*', a new EVS that can provide individual feedback with the use of students'

own mobile phones. Remediation is a key to learning and it is important to ensure that enough motivation is given to the students to work out an answer or response. An end of session revision of questions can be designed with *WebLearn* to assess the learning outcome and determine the impact of technology on student learning.

Recommendations

PollEverywhere was found to be a useful tool for small group teaching from this pilot study as it has initiated dialogue and created variety in the learning environment. In addition, it is free for a class size up to 30 students, easy to set-up and involves automated marking which can save a considerable amount of time. It has the potential benefit for large group lectures where only limited tutor-student interaction is possible. In large group lectures, diagnostic questions can be designed as breaks during long sessions, regaining student focus, stimulating interest and promoting active learning. *PollEverywhere* can be adapted to promote diversity and inclusivity since it encourages the less vocal students to respond and engage in peer discussions. Furthermore, it is an excellent diagnostic tool test what level of knowledge has been acquired and help the learner to assess their own performance. This EVS provides immediate feedback for practitioners to evaluate their own performance and facilitate them to adapt contingent teaching approach.

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Biographical note

Dr Thiru Surentheran has been teaching Biomedical Science in the Faculty of Life Sciences, London Metropolitan University for the past seven years. He has specific interest in researching e-Learning and applying pedagogical interventions to enhance student engagement, motivation and professional development.
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Appendix I: Summary of evaluation questions and the student responses.

Survey Question	Yes, Very much	To Some extent	Not at all
Do you find the tool easy to use?	10	3	0
Does this tool help you to actively engage with the subject content?	9	4	0
Does this tool help you to assess your own understanding of the course material?	10	3	0
Does this tool help you to revise material for the exams?	8	5	0
Does this session allow you to interact with each other to share knowledge?	12	1	0
Will you be happy to use this in the future?	11	2	0

Appendix II: Summary of students' overall experience of using *PollEverywhere* tool.

Learners' Experience	Yes, Very much	Yes	Somewhat	No, Not much	Not at all
Interesting?	9	3	1	0	0
Enjoyable?	8	3	2	0	0
Innovative?	9	3	1	0	0
Confusing?	0	0	1	2	10
Unnecessary?	0	0	0	3	10
Distracting?	0	0	0	1	12