Iterative design and delivery of high impact, multiple platform, scenario-based interactive mobile learning activities in the health sciences

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ABSTRACT

Mobile learning is an iterative process which follows the action-reflection model of action learning. In mobile learning, the drivers of this model are both new technologies and evidence of the efficacy of specific activities. This paper reports the second phase of The Virtual Human Body (VHB) project, a long running mlearning undertaking at The University of Queensland in the use of scenario-based activities in the teaching of biomedical sciences.

Early results from this phase of the project reaffirm that active mlearning activities need to be scalable in order to be universally accessible, and that a web-based design system allows the leverage of diverse, student-owned technology for academic benefit, permitting simple and easy adaption to new technologies, while literally providing a template for curriculum innovation, in terms of both flexibility of delivery, and dissemination to other curricula.

Author Keywords

mobile learning; interactive mobile learning; active mlearning opportunities; scenario-based mobile learning; biomedical sciences; emerging mobile technologies; SBLi; smartphone interface.

INTRODUCTION

Learning, as we have previously established (Ernst & Harrison, 2012), is an active process (Michael & Modell, 2003) and scenario-based learning is recognised as 'active learning'. Moreover, the efficacy of scenario-based learning in health science education is well documented (Hoffman et al., 2006, Thomas et al., 2009). The University of Queensland's interactive scenario-based learning platform (SBLi^{TM}) has a global uptake for scenario-based learning, and its effectiveness as a learning tool is well established (Breakey et al., 2008; Gossman et al., 2007).

Consequently, the authors set out to design, develop and trial a scenario-based interactive touch-screen application for hand-held devices: a prototype template of a new web-based SBLi^{TM} interface for smart phones that offers active mlearning opportunities (Ernst & Harrison, 2012). We found that both SBLi^{TM} versions offer high impact active learning opportunities, and that the active mlearning version (the SBLi^{TM} smart phone interface) was as effective as the desktop version (Ernst & Harrison, 2012). However, we also found (Ernst & Harrison, 2012) that the SBLi^{TM} structure with its "Location", "Items", "Actions" and "Collection" windows, and similarly structured scenario-based learning tools, do not lend themselves for conversion to a mobile learning environment. Feedback was that ease of usage and navigability of mobile learning applications are vital. Thus we concluded that active mlearning opportunities in future are best offered by uncomplicated web-based mobile learning applications with a HTML and Javascript touch screen interface (Ernst & Harrison, 2012).

Based on this conclusion, we migrated away from the SBLi mobile prototype template and developed a new HTML-based touch screen interface for mobile learning in physiology, anatomy and pharmacology, the Virtual Human Body (VHB). This new active mlearning application was introduced in two stages: a pilot was introduced and evaluated in Semester 2 2011 in BIOM1000 Physiology of the Human Body. User feedback and reflections were incorporated into an expanded version that is currently being introduced in Semester 1 2012 in BIOM2015 Physiology and Pharmacology of Human Disease.

Recognising the iterative nature of both curriculum development and delivery, and of technologies and their application to learning, (Chance, 2010; Muukkone & Lakkala, 2009; Kranch, 2008; Taylor & Evans 2005), the aims of this project were to:

- Recognise the near ubiquity of internet-enabled handheld devices using multiple operating platforms and systems, (Johnson, et al., 2012) and to create active, high-impact, decision-based learning opportunities;
- Create an uncomplicated, easy to navigate web-based HTML interface that ensures normalised access across all devices by working within the mobile browser environment, allowing the leverage of diverse but student-owned technology for academic benefit;
- Facilitate deep learning through consolidated understanding and application of learning in physiology, anatomy and pharmacology.

METHOD

The new VHB pilot was introduced in semester two 2011 to a student cohort of 135 first year health science students enrolled in BIOM1000 Physiology of the Human Body, at The University of Queensland, as a review tool to assist preparation for the end of semester examination. It contained four scenarios supported by multimedia resources and formative assessment tasks.

The four scenarios explored cardiovascular physiology and anatomy in the context of blood pressure regulation and the related pharmacology of antihypertensive drugs along with respiratory physiology, anatomy and pharmacology in the context of asthma. Each scenario commenced by presenting students with an action that elicited a response in the VHB. Alternatively, a sudden symptom (for example a headache or breathing problems) initiated a new scenario. Subsequently, students were presented with a number of hypotheses, as potential explanations for the initial response or symptom, and asked to use physiological tools to test this. This pattern of hypothesise, test and explain was repeated, until the student reached the correct conclusion. The distractor pathways of all hypotheses constitute authentic learning pathways in their own right, and included elevated intracranial pressure, head trauma, myocardial infarction and pulmonary embolus.

At various stages throughout the scenarios, students were presented with explanatory multimedia resources to complement the scenario , and were required to answer a series of formative multiple-choice questions (MCQs), in order to progress further. Similarly, students were offered a set of MCQs, to consolidate their learning at the conclusion of each scenario. As with the distractor hypotheses, all MCQ distracters were backed up by detailed feedback, thus ensuring each MCQ constitutes an authentic learning activity.

The expanded VHB version was redesigned using the open source content management platform DotNetNuke. It detects the type of device and operating system that is accessing the VHB and automatically determines appropriate content modules, including multimedia elements (e.g., video and images), for each particular device type. This required the VHB to have two different formats of video for the same video content—one optimised for mobile devices, the other for desktop computers. The current VHB operates from the mlearn.science.uq.edu.au URL. It was introduced in semester one 2012 to second year health science students enrolled in BIOM2015 Physiology and Pharmacology of Human Disease (n=58) as a review tool for students to prepare for the end of semester examination. However, a word of mouth campaign by the BIOM2015 students resulted in further students enrolled in other health science courses (mainly DENT2052 Advanced Biomedical Sciences for Dentistry (n=72) and PHYL2062/63 Physiology I [for Physiotherapy and Speech Pathology] (n=224)) utilising the VHB as a review tool in preparation for their own, different end of semester examinations.

The additional scenarios of the extended VHB pertain to blood glucose regulation and the pathophysiology of diabetes mellitus, and the physiology of acid-base balance in the context of diabetic ketoacidosis. Distrator hypothesis pathways included anaemia, hypothyroidism, Cushing's disease, alcohol intoxication, gastroenteritis, respiratory acidosis, lactic acidosis and renal tubular acidosis. Overall, the expanded version contained 34 multimedia resources that complement the physiology, anatomy and pharmacology taught in both courses. Some multimedia resources also introduced the learner to physiological and pathological tests including measuring blood pressure by auscultation, glucometry, oral glucose tolerance testing, electrocardiography, spirometry, CT scans, and various blood tests.

Quantitative evaluation is be based on internet traffic statistics, student feedback on perceived efficacy of active mlearning (online student questionnaire with five point Likert-type scales on SurveyMonkey embedded in the VHB), and on comparison of year-to-year learning outcomes as measured by student performance in summative assessment and grade distribution. In addition, staff and student qualitative feedback on the on the VHB has been being sought throughout the project.

RESULTS

Between the release of the pilot on the 14 September 2011 until the end of the semester on 30 November 2011, 74 unique visitors visited the VHB a total of 179 times.

Visits	179
Pages/visit	25
Average time on site	27 min

Table 1. Time on task by platform in 2011.

Most visits were initiated from iPhones (61%), with Windows (21%) and Android-based devices (4%) making up one quarter of unique visitors.

Sixteen students completed the online survey of the pilot. Of these, 13 students (81%) owned a mobile phone that was capable of accessing the internet. Only 4 students used their mobile phone to access the internet daily, and only 2 surveyed students accessed the VHB with their mobile phones.

Informal staff and student feedback pointed to difficulties accessing the VHB with a Windows operated browser, and the need of the VHB to be integrated into the official University of Queensland user authentication protocol, instead of the generic user name and password.

The expended VHB was released on the 22nd of April 2012. It requires the user to follow the official University of Queensland user authentication protocol, and detects the browser accessing the application to automatically scale the screens to suit each particular device. Between the release date and the end of the semester on the 23rd of June 2012, 152 unique visitors visited the expended VHB a total of 384 times.

Visits	384
Pages/visit	52
Average time on site	34 min

Table 2. Time on task by platform in 2012.

During this time in 2012, most visits were initiated from personal computers with a Windows operating system (52%), followed by Macintosh devices (16%) and Linux operated computers (3%). Mobile devices accounted for 29% of all visits. Of those, 80 visits were initiated by Android-based deceives (72% of all mobile device visits), followed by 24 visits initiated by iPhones (22% of all mobile device visits). The remaining mobile device visits originated from iPads and Blackberry devices.

Twenty four students completed the online survey of the extended VHB in 2012. Of these, 20 students (83%) owned a mobile phone capable of accessing the internet. The majority of surveyed students (66%) used their mobile phone to access the internet daily. However, an equal percentage of surveyed students (66%) accessed the VHB using their personal computer. In 2012, only 4 surveyed students accessed the VHB with their mobile phones.

The main reasons students gave for not accessing the VHB with their personal mobile devices were that they did not own an internet-enabled mobile phone, or that they did not wish to use their internet-enabled mobile devices for this learning activity. The surveyed students who did access the VHB with their mobile phone did so mostly via their own ISP. The predominantly identified location at which students accessed the VHB using their mobile devices was their private homes, followed by unspecified locations that allowed students short time frames for learning, for example while "commuting" or "waiting at the doctor's surgery".

All surveyed students in 2012 enjoyed the learning experience. Student feedback specifically praised the useability of the VHB with its uncomplicated, easy to navigate interfaces: over 70% of surveyed students rated the VHB as "very user-friendly". They also agreed that the VHB aided their learning of human physiology, and that the VHB has helped them prepare for the final examination. Over 70% of surveyed students who did access the VHB using their personal computer still agreed with the statement that "Mobile learning applications such as the Virtual Human Body should be more widely used in university courses to aid to learning".

Preliminary analysis of student performance as measured by summative assessment suggests that the number of students receiving a grade of 6 or 7 (on a 1-7 scale; 6 = distinction, 7 = high distinction) increased by 5%, from 40% in 2011 to 45% in 2012. Further analysis including control for cohort variations is underway, and will be presented at the mlearn 2012 conference.

DISCUSSION AND CONCLUSIONS

A little over half of the students accessed the first iteration, primarily from iPhones. The main reasons why students did not access the first iteration were that they either did not own an internet-enabled mobile phone, or did not wish to use their internet-enabled mobile phone for this learning activity, and that conventional Windows-operated browser access from stand-alone personal computers was difficult. Thus, care was taken that the second iteration is easily accessed by devices using multiple operating platforms and systems, including stand-alone personal computers.

Internet traffic statistics reveals a greater uptake of the expanded VHB, principally as a result of improved PC accessibility. However, the unexpected participation of students from other health science courses, although welcomed, do not allow us to measure the increase in participation. Mobile devices were used for almost 30% of all visits, which is similar to the mobile device traffic rate found in our original SBLi™ mobile interface project (Ernst & Harrison, 2012). Interestingly, Android-based devices are now more common among the mobile devices used by students in this project. This may be due to cohort variations, but may also be partly the results of the recent increase of the market share of Android-based devices. According to a recent industry report the market share of Android devices in Australia "has grown … from 32.2% in 2011 to 52% in 2012, while Apple IOS has fallen from 35.6% in 2011 to 35.3%." (Sadauskas, 2012).

About 20% percent of students responded to the online student survey after the pilot in 2011. It was hoped that the new iteration in 2012 would yield a greater survey participation rate as the new iteration itself is now universally accessible, which in turn has encouraged higher uptake rates of this mlearning activity. However, only 15% of students who used the

expanded VHB have responded to the online survey. In particular, students who accessed the VHB with their mobile devices are underrepresented in both surveys. Tentative conclusions based on this limited student feedback include that students find the VHB user-friendly, that the VHB supports student learning of health sciences, and that the VHB helps students to prepare for summative assessment. Further, students who only used their personal computer to access the VHB still perceive mobile learning applications such as the VHB as a desirable and beneficial university course component.

We reaffirm that in the mobile learning environment, both the curriculum, and the technologies that support that curriculum, are iterative. The back end of the original SBLI^{TM} mobile interface was too maladaptive, forcing us to recognise the principle of platform ubiquity. This meant our learning activities needed to be scalable in order to be universally accessible. For instance, the current VHB version has two different types of video file for the same video content – one for mobile devices, the other for computers.

This is not a problem unique to mobile learning activities. In recent years traditional television broadcasters have had to shift to new viewing modes. In the process, they have discovered the need to scale their outputs for delivery on devices ranging in size from mobile phones to stadia screens (Zhou, 2012). Together, this convinces us of the benefit associated with the utilisation of a web-based design system that allows the leverage of diverse but student-owned technology for academic benefit. This permits simple and easy adaption to new technologies, while literally providing a template for curriculum innovation, in terms of both flexibility of delivery, and dissemination to other curricula.

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