New and Emerging Applications of Tablet Computers such as iPad in Mathematics and Science Education.

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Abstract

This research paves the way for work and development in adopting the latest technologies in tablet computing in learning and teaching mathematics and science related topics. In particular, the more human-like interface features, offered by Apple’s iPad and other touch devices is being investigated for educational development. Preliminary studies by the author have demonstrated that students have a preference for using a device such as iPad in helping them with their studies. They have reported the unique touch interface, portability and easy eBook reading abilities as some of the significant features of iPad. This study has also identified the teaching capabilities of iPad from the teacher’s point of view. As part of this component of the research, the iPad was used to actively involve students in discussing and undertaking a series of specially developed case studies in classroom.

A number of useful and relevant apps for learning and teaching mathematics and science have also been identified as part of this research project.

Key words: Technology, interface, Education

Computers’ Application in Education – An Evolution

When back in the 1980s, Commodore 64 (C64) entered the homers of several hundred thousands of people in different parts of the world; it revolutionized how one should work with and use computers. That is whenever and to a certain extent wherever one wishes. In other words, computers were not restricted to only computer labs of learning and industrial organizations. The other significant contribution to computer aided learning was the multimedia features of these relatively inexpensive home computers.

Numerous software packages for educational purposes were designed and developed for personal computers such as Commodore 64. They included programs with abilities to teach with text, sound, images and relevant graphs. A significant approach to reinforcing learning was the use of multimedia quizzes with sound and colour for learning enhancement. See Schembri, T., & Boisseau, O. (2001) for details on Commodore 64.

The progress in the technology, its capabilities and educational applications have continued and enhanced exponentially over the recent years. The latest developments focus on the web based learning systems for the purposes of better understanding. For further information, see Chau (2007). Although the Internet based learning plays a major role in
education and its delivery, the latest hardware features promise exciting developments. These features have enabled the application developers create interesting and educationally effective apps.

The iPad’s Potential Use in Education

When Apple introduced iPad in 2010, its potential and applications in education were realized and considered by many academics around the world. In one university alone, with which the author is familiar, there are around 400 of these devices. Academics and others involved in education are eager to find ways of using these sleek devices. With the release of iPad in 2010, the Touch technology has had even more serious implications for education. Just before the formal launch of iPad in the US, Fry S (2010) had the following comment after interviewing Steve Jobs (Apple’s CEO) and reviewing the product for Time Magazine:

“When I eventually got my hands on one, I discovered that one doesn’t relate to it as “tool”; the experience is closer to one’s relationship with a person or an animal.”

According to Fry (2010), Tracy Futhey, of Duke University, was quite optimistic about iPad’s potential in education and commented that:

“The iPad is going to herald a revolution in mashing up text, video, course materials, students input ... We are very excited.”

Putting the speculations aside, the burning question, at the moment, is: What makes iPad superior to conventional notebook type computers?

iPad offers a different and more natural way of interface. For instance Apple’s tap, pinch and draw capabilities using fingers on iPad, iPhone or even iPod are good examples.

The experience through the Apple’s Touch technology does certainly create a more natural interface between the user and the machine. To demonstrate this capability, applications which utilize the touch features intensively may be referenced here. For instance, the painting and drawing apps for iPhone enable a user to experiment with painting in a totally innovative fashion. The painter uses iPhone screen as a canvas and the fingers as brushes. The colours are selected by tapping and touching a colour wheel. The chosen colour is placed on the user’s palette and the index finger then starts drawing and painting on the screen. iPhone is extremely responsive to strokes and the tiniest detail as desired by the painter are depicted on the canvas. The pinch and zoom feature is used to draw and paint the fine details. The following image (Figure 1) was painted by the author using Brushes app on the iPhone. The painting experience does certainly create a much closer relationship between the painter and the subject. Hence, this experiment demonstrates the special technological advantages offered by iPad/iPhone.
Figure 1 – Diamond Head and a Waterfall Scene Painted by Finger on iPhone

Let us do not forget that progress in notebooks has also been taking place. Many modern notebooks are quite technologically advanced and have interesting and useful features. Hence, the hardware features of iPad cannot be the main reasons and basis for its popularity of use in fields such as education.

One of the main contributory factors towards the popularity of iPad and the desire to explore its potential in learning and teaching is the availability of the apps. These apps are basically pieces of software programs (in traditional terms) which run on devices such as iPad and iPhone. They cover numerous fields such as languages, arts, music, science, mathematics and statistics. The list is continually growing. These apps are readily available at reasonably modest prices on the app store and are accessible via Apple’s iTunes. According to the iTunes’s app store prices, the majority of the educational apps cost under the $10 mark. A very large proportion of these sell for an amount less than five dollars (AUD and USD are almost the same at the time of writing). The apps have several distinct features and advantages over the conventional programs. Firstly, they are inexpensive. For a fraction of the price of a traditional PC software package, one can purchase an app. In terms of features, they are not too far behind their older cousins either. For instance, the author has recently investigated the suitability of an app for teaching the fundamentals of planning, execution and control in a Project Management. The outcome of this investigation was a pleasant surprise compared with the large-scale packages such as MS Project. This app (Project Planner) priced only $3.99 satisfies the needs of teaching the basics of Plan, Execute, Control and Report quite adequately.

Another innovative technology which certainly has a place in the modern approaches to learning is the Amazon Kindle. Kindle is a specially developed hardware and software packaged into a very compact and attractive tablet. Kindle has free international electronic book, magazine or document download capabilities via 3G and wireless connection. Kindle with its whispenet synchronization between the user’s different devices, is a very good example of seamless technology for learning. For further information on seamless learning, see Looi (2010). Hence the user can download numerous items of interest from the Amazon’s Kindle Store. In addition to its very useful features such as an active dictionary and free 3G access to Wikipedia and the Internet, it is equipped with an experimental text to

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speech function. When switched on, this function allows the reader to listen to the text on the page. The author has experimented with this feature for the purposes of speed reading training. This experiment was carried out by setting the speech pace to fast and the text on the screen was scanned at the same speed by the author. It was observed that the need for sub-vocalization was removed from the process. Although sub-vocalization is an important factor in comprehension, it is also an inhibitor in achieving higher speeds. The author has comfortably achieved speeds above 250 words per minute with a close to full comprehension outcome.

One of the main features of the Amazon Kindle is its ability to access several hundreds of thousands of books from the Kindle Store. There are also several major international magazines, periodicals and newspapers available on the site. The book collection includes a comprehensive coverage of topics in mathematics and science. The list of these books, in size and coverage, is growing all the time. It must be mentioned that Amazon has also developed and provided a Kindle eReader app for iPad and iPhone which is free to download and use. The app contains most of the features and functionalities of the very successful Kindle eReader. The eReader capabilities of iPad, in general, are certainly a preferred feature amongst the learners. According to the feedback collected from the author’s students in three different classes, this feature is definitely amongst the top three. Although text is a traditional learning mode, it continues to remain one of the most effective forms of media. With the technological advancement in the tablet computers such as iPad, text can become even more powerful in terms of learning and also an appealing way of fully immersing in the topic. The features such as quick access to books, reasonable prices of eBooks, portability of a large collection and text to speech capabilities will certainly help this popularity.

These and similar technologies are very likely to become readily available on other tablet computers. They have a great potential for education in many fields. They can even build on the immersive and real-time engagement as in Virtual Reality in online courses. For challenges of using virtual reality in online courses, see Stewart et al (2010). In order to test the technology’s acceptance and perceptions about its suitability and effectiveness, a series of surveys were conducted by the author in the past two years. As a challenge to determine these technologies’ serious uses in education, the author set himself the task of undertaking the research and writing this paper utilizing several apps on an iPhone. Some examples included apps on communication (text and voice mail), data collection and Statistics, MS Word, document scanning and PDF converter and image cropping. The statistical analysis was also carried out using an iPhone app. The next sections presents the methodology and results for this ongoing work.

**Learners’ Perceptions and Preferences**

In 2010, the author conducted an investigation into the educational applications of the latest developments in modern computing. The main purpose was to determine the learners’ needs and preferences in terms of the latest developments. The participants of this investigation were people who were either directly involved in some form of learning for
themselves or closely related to others such as their children or spouses. Adults of both genders from totally different walks of life and backgrounds were selected and contacted for the survey and data collection in this study. These people included college and university students, professionals such as nurses, dentists, technicians and teachers. The study included respondents with varying cultural, linguistic and geographical characteristics too. An aspect of this investigation was to study and compare the levels of interaction-enjoyment for both computer and human teacher. The respondents were asked to rate their perception of the level of enjoyment on a 1 to 5 scale. An initial analysis of the responses determined that the interaction in terms of enjoyment for human teacher has a much larger mean (4.1) than computer teacher (2.8). As Normal Distribution curves in Figure 2 show, the standard deviation for human teacher is also smaller than computer teacher and the respondents appear to have preferences very close to 4 (3 and 5). A t-test even at 1% level of significance indicated that indeed the null hypothesis of identical population means (for computer and human teachers) ought to be rejected. Therefore, it can be concluded that learners, in general, perceive that the learning process with an actual (human) teacher is more enjoyable than a virtual (computer) teacher.

Figure 2 – Difference between the Means of the Responses – Computer and Human Teachers

This finding is rather interesting because the respondents would perceive a computer teacher to have a place in the future education. Hence, the innovative approaches offered by iPad and the available apps is, without a doubt, embraced by the users but education, in its traditional format, is definitely preferred. The respondents’ very positive response (Figure 3) to the following question (Q7) is demonstrative of their belief in future technologies for learning and teaching.

Please rate the effectiveness of the following scenario which may take place in the future:

You buy/borrow a book on a topic of your choice, take it home and open it. You then ask the book in your language of choice some questions. The book starts talking and explaining to you by showing you 3 dimensional images. It then invites you to physically (but virtually) interact with them. So, it helps you to learn your topic (e.g. a craft or a skill) by letting you experiment; and it gives you feedback all the time! 1 (Low) 2 3 4 5 (High)
Conclusions

The main purpose of this paper was to establish the main reasons and motives for iPad's popularity. The availability of numerous apps related to mathematics and science learning is also a very positive feature. App developers are continuously producing new applications and updating the existing ones. It was concluded that iPad's sleek and contemporary design should not be the sole contributing factor to a desire to explore the educational applications for it. There are other reasons which should be considered. For instance, due to its special features such as portability, software (app) cost effectiveness and easy access, iPad does offer a great deal to learning and teaching in general.

Although there seems to be a positive belief in the future of iPad-like devices in learning and teaching, the learners still have a preference for having a human teacher. The outcome of the investigation conducted by the author, regarding the effectiveness and level of enjoyment with an actual teacher support this finding. The respondents, however, are certainly in favour of an advanced and intelligent system which can respond to learners’ needs. Hence, tablet computers such as iPad will have a place in mathematics and science education.

References