Device Readiness of Tablet Computer for Classroom Use

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ABSTRACT

Tablet computer is an intriguing piece of device in today's portable computing technology. It has many potential usages as work machine, educational tool or as entertainment gizmo. One of the potential usages of tablet computer is in education where it has the potential to replace textbook and provide essential tools for learning. It opens up new and exciting methods of delivering knowledge to the student. Although tablet computer is a powerful hardware supported by thousands of applications and games, the implementation readiness of the device is crucial when considering for reliable use of tablet computers in classroom environment. Thus, this paper attempts to discuss issues related to tablet computer implementation readiness for classroom use in term of hardware, cost, software, digital content, infrastructure and security. The potential issues highlighted might hinder the potential of tablet computer to be successfully implemented in classroom environment

Keywords:Tablet computer, classroom technology, education.

I INTRODUCTION

Tablet computer is a personal computer with true mobility design in mind. Unlike notebook computer, tablet computer is a lightweight device where user can easily carry everywhere compared to notebook computer where it is heavy and cumbersome to use. User interaction with the tablet computer is more simplified through touch screen operation without any physical input devices attached such as mouse or keyboard. Power requirement is also much lower compared to a notebook computer. Furthermore, the embedded Wi-Fi/3G/4G data connection allows tablet users to access Internet connectivity anytime and anywhere. In general the characteristics of tablet computers are lightweight, low power consumption, simplified operation, always on connectivity and compact design device making them as the ultimate choices for people with on the go lifestyle.

Tablet computer however will not yet to replace the role of workhorse computer in the workplace anytime soon but recently it has been gradually adopt at many different business entities. For example shop owners in United Kingdom start using tablet computersin daily business activities such as payment, product display information, online payment, and etc. (Fiona, 2011). Tablet can also play advertising video through YouTube thus providing customer with more information on the product or customized the product to their liking through the use of special applications in the tablet. In addition, tablets computer has been used in other workplaces such as healthcare information (Microsoft White Paper, 2012) where doctors can easily access complete patient digital information, in education where teachers and students can use in teaching and learning process, in warehousing management where record keeping can be made easily, architect where they can check building plan and many more. In short, tablet computer could bring significant impact on workplace environment depending on type of operation needed and where it will be used.

Education system seems to be one of the "perfect" environments that most suited for tablet computer usage. Teaching involves with delivery of knowledge to the student and tablet computer can provide such a tool. It can empower by providing knowledge tools to the students and teachers. Students can use tablet computer to write report, doing research, read digital document such as digital textbooks, taking notes, making presentation, online collaboration on group project, online discussion and many more. Teachers on the other hand can make use of tablet for delivering quizzes, taking attendance, sharing information, having online interaction with student and many more other activities. It seems that tablet computer can provide leverage to the educational system by providing the tool to the student in pursuing their knowledge. Yet there are still important issues could arise and there is a need to understand those issues before it can be widespread implemented.

II ICT IN EDUCATION

Information Technology and Communication (ICT) has been always an essential tool in modern world. Businesses depend on ICT technology to grow, global trade between countries also depend highly on the ICT technology. All aspect of life can be said evolved based on it. The exposure of ICT in education is very important to expose student with current technology (Tinio, 2003; Gerry,2008).

Learning to use computers, software and browsing the Internet are some essential knowledge student should have.

In Malaysia the concept of ICT in education, as seen by the Ministry of Education, includes systems that enable information gathering, management, manipulation, access and communication in various forms (Ong, 2006). Several ICT Initiatives by Government Agencies are the Smart School System, MySchoolNet, ICT training in school, the Computerisation Programme in Schools, the Electronic Book Project and Penang E-Learning Community Project. Through these projects, the government shows great effort to instigate ICT in Malaysian education system.

Generally student exposure to ICT technology in school was through computer labs. However the numbers of computers in computer lab is quite limited and student need to share computers most of the time. During class the use of computer also limited or only to the teachers who use computer for teaching purpose as slide presentation, video showcase and etc. Students on the other hand still rely on textbook as main source of information.

One of the Malaysian government initiatives to provide netbook to student is through 1Malaysia netbook project (The Star, 2010). RM 1 billion has been allocated for the purpose and 1 million netbooks are planning to be delivered. Such initiative shows the seriousness of the government to promote the use of ICT technology in education. Figure 1 shows the 1Malaysia netbook provide to the school student.

Figure 1. Student with Netbook 1Malaysia

Providing student with netbook is a good initiative by the Malaysian government. During the initiative netbook seems the ideal computer for student where tablet computer still in infancy. Students are able to access class materials using the netbook and can also use it during the class. However the use of netbook is limited due to its low processing power,

low interactivity, low battery life, limited number of applications, cumbersome to use and low durability.

III TABLET COMPUTER IN EDUCATION

For years educators and computer vendors have explored ways in which technology could aid with learning. Back in the 1980s when personal computers (PCs) first became affordable, technology was considered something to be taught, but now is considered an essential medium by which students learn.

The use of tablet computer in school was started due to popularity of iPad tablet in the United States. Several pilot projects introducing iPad computer in the classroom has been conducted (more discussion on the use of iPad tablet in the United States School available from Micheal (2012) and Twinning et. al (2004)).

According to Phil Schiller from Apple Inc. more than 1.5 million iPads were in use in the United States for education settings, leveraging more than 20,000 education applications. This shows the confident of United States Education System towards the use of iPad in education.

The use of iPad also shows significant interest among student in the class. Recent study done by Michael (2012) shows that 97 percent of the participating teachers in Manhattan Beach perceived that the iPad makes class more engaging.

Figure 2. Student with iPad

However to implement such big project, it requires support by the government. Country such as India and Thailand's has started to provide to their underprivileged student with tablet computer (CBS News, 2012).

IV TABLET COMPUTER vs. TEXTBOOK

Student nowadays no matter in any level of education, they are relying on textbook to learn subject matter. Textbook most of the time is heavy and cumbersome. It is hard for the student especially for small size students to carry around several textbooks heading towards the class and

back home. Lifting heavy burdens for a long time or distance is not good for anyone, moreover the children. A recent study found that half of the schoolchildren studied had pain in the back or shoulders (Parang, 2010). Carrying a heavy bag on the back causes forward leaning and bad posture, which can lead to improper weight bearing on the spine and pains and aches in the back and shoulders.

The cost of buying text book can be varied but in total is substantial amount of money. For example the average cost for one textbook for primary school in Malaysia can reach around RM10 to RM40 depending on the subject and schooling level. Although the textbooks cost has been sponsored by the government of Malaysia, the cost still need to be taken out from the taxes and other government incomes. For university level student, the cost is much higher averaging around RM100 to RM300. If a student per semester taking 4-5 subjects and assuming they buy all the textbooks, they need to spend around RM500 to RM1500. Thus the cost of buying textbook is a burden to student or government.

Today's knowledge grew rapidly due to the advancement in science and technology. Many new discoveries were made every day thus making the content of a textbook quickly fading. Textbook most of the time remains unchanged for certain periods of time. New knowledge content cannot easily be inserted into the textbook due to the high printing and distribution cost. Student will be stuck with outdated knowledge with the current printed textbox. Electronic textbook on the other hand can provide up-to-date knowledge where it can be constantly updating its content through online updates.

Tablet computer can become good replacement for a textbook. In term of size, it can be in many sizes from 7 inch to 10 inch and can be easily stored in a small bag. It is also lightweight with less than 600 gram (weight of a single average size textbook) easily to carry around. Furthermore tablet PC can hold countless number of digital textbook depending on the storage available and not to mention cloud storage. The content of the digital textbook can also regularly be updated.

Although tablet computer seems a perfect solution replacing textbook, nevertheless a few issues might arise such as health issue from reading through digital screen, responsiveness of the device, the high cost of the tablet, safety, security and others (it will be discuss in the following topics).

Tablet computer can be a good replacement for textbook given the advantages in term of size, weight, interactivity and able to update content. However a few issues needed further investigation and clarification.

V   ISSUES AND CHALLENGES OF TABLET USAGE IN CLASSROOM

This section will further explore readiness of current tablet computer technology in education environment. The readiness of the tablet computer technology in term of hardware, applications, cost, digital content and security needed to be addressed before hand.

A.   Hardware

Good performance tablet highly depends on the speed of the processor and the amount of memory it has. Processor and memory is the brain and veins of any computers. Tablet computer although with its small size can pack with powerful processor that equivalent to a computer notebook. For example Samsung galaxy tab 7.0 plus equip with 1.2GHz dual core processor more than enough to run any high demand tablet applications. However there is tradeoff between price and processor speed. Higher end processor will incur cost more compared to low end processor. Yet, options for medium performance processor that at least can support for applications in education can be conspired thus lower the ownership cost of a tablet computer.

Storage capacity for today's tablet computer is mediocre between 8GB to 64GB. By today's standard it seems quite small compared to a notebook computer that can reach hundreds of GB of storage. However, tablet computer can further expand by having external storage (such as microsd, and flash drive) or even better through free online cloud storage such as Dropbox and box.net.

Data connectivity such as Wi-Fi or broadband connection is a vital component for a tablet computer. It allows for full use of the tablet mobility functions such as email, browsing, downloading applications and many more. Most of today's tablet often equipped with either or both data connectivity options. Faster connectivity through broadband connectivity such as 3G and LTE (Long Term Evolution) might incur more cost for the tablet.

Tablet computer also comes in many different screen sizes from 7 inch to 10 inch screen (Figure 3). Each screen size is for different type of users. The smaller the screen the lighter and easier for student to carry but lesser viewable screen compared to 10 inch screen which has the biggest screen but quite cumbersome to carry. Further investigation is needed to identify the most suitable screen size for classroom usage.

Figure 3. Variety of Tablet Sizes

Figure 4. Akash Tablet Used by University Student

Another factor that needed to consider is the robustness of the tablet. Daily classroom interaction and usage requires the tablet to be robust. Drop, water spills, and dirt parts of being student. Unfortunately not many today's tablets were able to withstand such condition not without additional protection accessory such as DryCase and Just Air. Panasonic Toughpad is one of the tablets that can endure such extreme conditions however the price can be quite expensive. The design of tablet computer for classroom should consider this aspect.

In short, the selection of suitable tablet hardware for classroom requires further investigation, testing and evaluation. The hardware requirementshould match with the classroom needs. However there is tradeoff between good performance tablet and price.

B. Cost

Cost is perhaps one of the important factors that might hinder the adoption of tablet computer in education sector. The cost for a good performance tablet can easily reach more than RM1000. However there's option to reduce the cost either through government subsided price or development of custom tablet funded project. A good case study is an Akash tablet project in India (Aakash, 2012). The project is an effort by government of India to provide underprivileged student with the access to computer and Internet (Figure 4). However since the number of student in India is too many, they need to come out with cost effective solution. The government of India was able to reduce the cost of a single tablet to less than RM200. They accomplish this by setting up a local production factory in India and mass produce the device. With such low production price, Indian government is able to fully sponsor the Akash tablet to their underprivileged student.

One other option to reduce the cost is to have collaboration with China tablet makers.China is one of the leading tablet makers in the world and most of mainstream tablet manufacturer assembled their tablet in China. Surprisingly there's a lot of good quality China made tablet such as Novo elf, Haipad, and Flytouch(refer to Figure 5) that is cheap but has good performance hardware and comparable to the mainstream yet expensive tablet. Average price for good performance China made tablet is around RM350-RM550 depending on the size and performance. Hundreds of models come from China tablet factory with wide variety of hardware options. With such wide variety of customized tablet offered by China tablet makers, this can be a good starting point to have low cost high performance tablet. Having such collaboration with China tablet makers can help in reducing the cost of the tablet and meeting the requirement of education level tablet.

Figure5.China Made Tablet

C. Software

Software for the tablet can be categorized into operating system and user application. There are several mainstream operating systems build for tablet computer such as Apple IOS, Google Android, Blackberry OS, and Windows 8. However based on Robin (2012) study, (refer to Table 1), IOS and android shows the dominant trait.

Table 1. Tablet Operating System Marketshare

Exhibit 1: Global Tablet Operating System Shipments and Market Share in Q4 2011

Global Tablet OS Shipments (Millions of Units)	Q4 '10	Q4 '11
Apple iOS	7.3	15.4
Android	3.1	10.5
Microsoft	0.0	0.4
Others	0.3	0.5
Total	10.7	26.8

Global Tablet OS Marketshare %	Q4 '10	Q4 '11
Apple iOS	68.2%	57.6%
Android	29.0%	39.1%
Microsoft	0.0%	1.5%
Others	2.8%	1.9%
Total	100.0%	100.0%

Growth Year-over-Year %	N / A	150%

Although Apple IOS has the highest market share in tablet operating system domination, our interest is more towards Google Android operating system. IOS operating system is tied to its own hardware thus making the selection of device limited and it's also a closed source systems which render customization useless. Google Android on the other hand is an open source operating system which can be customized and installed on many tablets. Any tablet makers can customize Android operating system based on their own preference and hardware selection by modifying the operating source code. Currently Android 4.0 is the latest Android operating system where it offers the most intuitive interface design for tablet computer to date.

Google Android provides user software solution through Google Play where user can download thousands of applications, games, movies, and e-book. According to Google there are over 450,000 titles available as of March 2012 (Andy, 2012). There are also thousands of free applications on the Google Play (refer to figure 6) where user can download. For paid applications user only need to pay small amount of money.

The availability of application that can support the use of tablet computer in the classroom is also important. Each level of education will require certain type of software to support its delivery.Pre-school education will need applications that can support the development of basic skills such as reading and writing. Stimulating application interface must be able to upkeep the development of basic skills. Higher level education such as primary and secondary level focusing on much higher cognitive thus requires more suitable applications to support for their level of development. Identification of applications supporting each level of education is highly needed.

Other common classroom applications such as e-textbook reader, internet browser, email, office applications, and collaboration software must be identified and classified. The following applications are some of the examples of applications (but not limited to) that can benefit classroom environment

Figure 6. Google Play

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Foxit PDF – allow editing of pdf file. Student can read, highlight, add notes, and scribble on the file.
Evernote – Advanced note taking during class where student can log, capture video/voice/pictures, share ideas.
Skitch – Share and discussion through image manipulations.
Polaris – Office document editor for assignment, presentation, and spreadsheet.
Kamus Pro – Online Malay-English dictionary
Dolpin HD – web browser for online research.
Skype, viber – Online collaboration
Dropbox, box.net – Free online cloud storage

Other than listed above,there are thousands of applications for all level of education starting from kindergarten level up to university level available for download or purchase through Google Play. However more research is needed to identify, classify and test the usability of the software's that is suited for classroom environment.

Development of applications is also one of the challenges. New applications will definitely be needed to support all level of educations. New breed of software developerswill need to be trained to support development of application supporting tablet computers.

D.   Digital Content
Tablet computers in the classroom are no use without content to deliver. Development of classroom content such as digital textbook, videos,

quizzes and other materials for specific subject will present a challenge on its own. For example textbook publisher will have to look for a different business model for selling, delivering, updating content, standardization, licensing and protection of digital document. Piracy of digital content might be a big issue in tablet computer environment. Mechanism is needed to protect digital content.

Development of digital content also must focus on utilizing features provided by the tablet computer such as touch screen, internet connectivity and etc. The content also must be flexible, updateable, interactive, and intuitive where able to attract student to the subject taken.

Recent effort by Maxis Corporation, one of the communication providers in Malaysia is to provide an online e-book bookstore (Hadi, 2012).To increase the number of e-book, they had liaised with news publisher, other renowned authors, and institutions of higher learningto convert physical books to e-book format and sell through Maxis online bookstore.

E.   Infrastructure

Infrastructure to support the operation of tablet computer is also important. Infrastructures that are required to support the usage of tablet computer in the classroom areInternet connectivity, charging station, repair and services.

Providing full Internet access through Wi-Fi for the entire academic compound might poses another challenge in term of financial obligation. Allowing full access to the Internet for the whole academic buildings will requires good Internet bandwidth which is expensive. Other option is through 3G connection through packages offered by local broadband provider. Recent effort by government of Malaysia to provide cheap Internet connectivity to the masses is through 1Malaysia Broadband project. Through this project, public will only need to pay as low as RM25 per month to get access to the Internet. However, 3G broadband coverage throughout Malaysia is still limited and the tablet itself must support broadband connectivity.

Charging is also another problem for the tablet device. Although most tabletscomputer can hold enough power for daily operation without charging, (depend on battery configuration), charging station is still needed. Continuous usage of the tablet might drain its battery much faster. Tablet with removable battery or portable battery charger can be alternative solution towards battery power shortage.

Repair and service center for the tablet computer is also critical. Any problem with the device user should be able to send for repair and get back their device fast. Establishing such center will also become another challenge such as location of the center, trained technical personnel, warranty and so on.

F.   Security

Safe keep of the tablet computer is also critical issue where such device prone to be stolen. Student should have be able to safe keep their tablet during outside activities. Having personal locker or safe location to temporarily keep their tablet will lower the risk of stolen. However such option will require additional cost to the school. Another idea perhaps through special software that can track missing tablet or maybe through enforcement policies for student to take care of their tablet can be put forward. A mechanism definitely needed to ensure the safety of the device.

Data security is another aspect of security to look into. User account profile is set to tablet computer and tied to other services such as payment, social network, email and other services. Securing user data requires special attention since it can be used for other malicious act.

VI   Conclusion

This article only focuses on the device readiness of the tablet computer technology in classroom environment. Nevertheless, this suggests the opportunity for further research in this topic. Further study is needed to accurately determine the effectiveness and the challenges of implementing the tablet computer in classroom such as technology readiness of teachers and students and exploring the positive and negative aspects of the tablet computer implementation in classroom. Each challenges tabled out in this paper has the potential to further expand and contribute towards more possible or permanent solutions.

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