PEER-TO-PEER COLLABORATIVE LEARNING WITH E-BOOK DEVICES OVER 3G-WIFI AD-HOC NETWORK

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Abstract: This paper describes the experience of evaluating an e-book device based peer-to-peer collaborative learning system with a 3G-WiFi ad-hoc network configuration. Two evaluations were conducted followed by two focus group interviews. Results show that future design of e-book devices should consider the educational affordance of integrating web browser and Internet chat functionality to accelerate the potential adoption of e-book devices for collaborative e-learning or m-learning environments.

1 INTRODUCTION

Learning should be facilitated to take place anywhere at anytime. Since every individual is unique in their learning styles and abilities, different learning strategies should be provisioned in order to enable the most effective learning experiences for each individual. A well known learning strategy is peer-assisted learning, where individuals consciously assist each other to learn, and through the process, become more effective learners themselves (Barkley et al., 2005). Technology can assist and accelerate such a learning process. E-book devices have been around for some time (Burk, 2001). E-book devices offer various benefits over traditional books. For instance most e-book devices are extremely light and capable of storing hundreds of text books within one device. This capability not only lightens the load of primary school children who may need to carry several books to school but also has the added potential of motivating learning. E-book devices offer many other features such as book-marking, long battery life, font size options, zooming option, auto-scroll, network connectivity (wired/wireless), annotation, dictionary, music player, e-ink display, touch screen and virtual keyboard (E-book, 2009). These features provide excellent educational affordance for e-book devices to be integrated into collaborative e-learning (or m-learning) environments. While there are recent studies on the usability of e-book devices as a reading platform (Clark, Goodwin, Samuelson, & Coker, 2008), to the best of our knowledge, there are no studies so far on how e-book devices can be effectively integrated into a collaborative e-learning (or m-learning) environment such as the proposed ubiquitous 3G peer-to-peer learning context. This project seeks to embrace the latest mobile technologies to facilitate such peer-to-peer collaborative learning by on the one hand, enabling it to take place irrespective of the learners' locations, i.e. ubiquitous learning, and on the other hand, enhancing the effectiveness of existing platforms for Computer-Supported Collaborative Learning (CSCL) (Resta & Laferriere, 2007), through more novel means of idea or concept exchange.

2 RELATED WORK

Wilson and Landoni (2003) conducted an evaluation of the usability of portable electronic books. In their study, five e-book readers were used. Of the five e-book readers only three were considered actual e-book devices and the other two were just standard PDAs equipped with book reader software. Their

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evaluation methodology was to measure user satisfaction based on questionnaires. Four key areas were identified: quality, ease of use, likeability and user effect. Size, weight and display quality were issues highlighted in their findings. Most participants reported that navigation through the e-book was quite easy. In a more recent qualitative assessment of the Kindle e-book reader, Clark et al., (2008) discovered that some participants were rather excited about the e-book reader. This type of excitement is similar to the impression given by students in the initial trial of using PDAs (Waycott, 2002) and the ebook pilot study by Northwest Missouri State University (Shieh, 2009). In some sense e-book devices are similar to PDAs but e-book devices normally have a larger screen size and longer battery life span. The assessment by Clark and colleagues also discovered various form factors and design issues such as the outdated style of the devices and the navigation buttons that were too easy to strike accidentally. Technical issues regarding wireless connections were also a problem. Inconsistent wireless access was also reported. Despite all these barriers, the Kindle e-book reader is still one of the top brands in the e-book device market. The study done by Northwest Missouri State University (Shieh, 2009) with 240 students using Sony e-book devices revealed that students were rather frustrated with the limited interactivity capabilities. The limited research in e-book devices clearly indicates that there are gaps in the literature on how to extend e-book devices into more educational affordance that can further enhance the adoption of such a device.

3 RESEARCH QUESTIONS

Text-based interaction is one of the popular modes in computer mediated communication. Despite the advent of voice communication such as Skype it is still an effective medium in the on-line distributed environment. In addition, text chat offers several affordances that allow text conversation to be searched, archived, analyzed and visualized (Looi, 2005) that are not readily available in voice communication. Although voice communication is considered more natural and direct, research has shown that when collaborating at a distance communicating through audio improves both task performance and perceived affordances in comparison to text-chat (Sallnäs, 2002). Collaboration is an important learning process. To make e-book devices more educationally affordance (Kirschner, 2002) collaborative features should be part of the e-book design. Unfortunately most current e-book devices are not equipped with such functionality. Previous evaluations were all based on evaluating the e-book as a reading platform without expanding its educational affordance. With the availability of the new generation of e-book devices such as the iRex e-reader (iRex, 2009) that allows developers to create software based on the available SDK, we think it is timely in this preliminary study to expand the investigation of the e-book device as a collaborative tool rather than a reading platform. To this end our objective is to evaluate an e-book device equipped with a text chat and uploading utility for peer-to-peer collaborative learning. Since voice communication can provide immediacy, the secondary objective is to identify the affordance factors of an e-book device that contains a direct voice communication channel and uploading utility with one that contains a text chat utility only. Hence we have the following research questions:

a) What are the perceived factors related to adopting the e-book device as a peer-to-peer collaborative learning system?

b) What are the affordance factors in a text chat e-book device and a voice communication e-book device as a peer-to-peer collaborative learning system?

4 METHODOLOGY

Because of the limited resources available to the researcher, it was not possible to conduct a quantitative evaluation. Hence, a task based and qualitative exploratory focus group approach is adopted in the evaluation. We conducted two focus groups based on two potential scenarios. Each experiment consists of two students. The first group consists of one male and one female student and the second group consists of two male students. Participants were mainly information system students with IT exposure. We used iRex's iLiad e-book devices in our experiments as it is currently one of the most popular types of e-readers. We installed the Minimo web browser into the e-book device for loading a small footprint Internet-based chat application. In this project, we explored the use of two types of wireless technologies commonly found on mobile devices: Bluetooth and WiFi. We investigated techniques for iLiad to communicate with Bluetooth-enabled phones such as Sony Ericsson K610i using a Bluetooth USB dongle; and

to the newer generation of WiFi-enabled phones such as Nokia N95 using iLiad's built-in WiFi connectivity in ad-hoc mode. In turn, this allows iLiad to access the phone's 3G Internet connection. We used a Nokia N95 (Nokia, 2009) as a 'walking hotspot' for Internet connection depending on the experiment scenarios. Before the experiment, the principal investigator explained the tasks and demonstrated all the necessary steps in operating the e-book device to the students.

4.1 Procedures

Once the students were ready for the experiment, they were separated into different rooms to simulate the peer-to-peer learning environment. The tasks for the participants include activating the e-book system, make a WIFI connection with the 3G walking hot spot, launch the Minimo browser, launch the text chat application and communicate with peer, read the database problem on the paper provided, discuss the database problem with peer using the chat application, switch to scribble application, construct a solution with the scribble application using a blank.bmp template and provide a file name, switch to Minimo browser, use the chat application to upload the solution to peer, identify file location, receive solution from peer, read solution, and end chat communication.

4.2 First Experiment

The first scenario as depicted in Figure 1 was described to the students as follow:
"*You are in a remote area. There is no wireless hotspot for you to make an Internet connection. However you have an assignment due and you need to discuss the assignment with your peer as you have pre-arranged. Your friend is out of reach of telephone communication but is holding an e-reader that is connected to the Internet and waiting for you to start the chat. Luckily you have a 3G mobile phone that is equipped with a walking hot-spot solution and an e-book device. You activate the walking hot-spot and make an Internet connection and chat with your peer to discuss the problem.*"

4.2.1 Observations

For this scenario, the investigator observed several problems with the system such as difficulty navigating from one application to another smoothly and successfully, tabbing the stylus more than once as there was no immediate response from the e-book

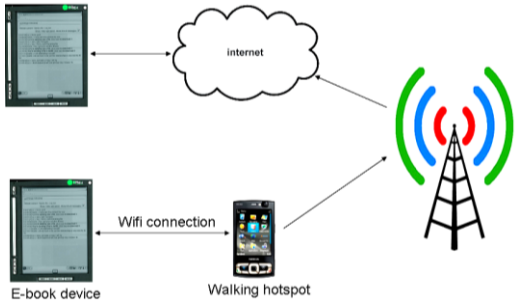

Figure 1: Scenario for Experiment 1.

device, no feedback on the current status, unable to close the scribble application with the "x" menu due to sensitivity issues of the e-book device and stylus, difficulty finding the required interface to tab for enlarging the font size, produced slanted writing with the stylus, frequently tabbed to refresh the chat program due to very slow responses from the e-book device, uploading files through the chat program frequently caused an "internal server error" problem. Further it took about five minutes to draw the ERD diagram and upload the file and battery consumption was rather fast for the N95 device equipped with a "walking hotspot". This will have implications for the mobility of the user and the duration of the mobile application.

4.2.2 Summary of Focus Group 1

Participants commented that navigation was a major problem. They could not switch smoothly from one application to another application. There were multiple steps needed and they were not intuitive. The response from the e-book device was very slow. They commented the response speed of a mobile phone was even faster than the e-book device response. In addition, participants felt that it was rather time consuming to switch from one application to the other without a clear view of the application and its status. Participants commented that downloading and uploading files from the chat application was acceptable as it was similar to other chat applications with which they were familiar. No major problems were encountered. The steps for uploading were quite simple and speed was acceptable depending on file size. The "send" file feature was very useful under such a scenario. Participants commented that the chat application was simple and easy to use however they tended to manually refresh the page very often as the auto refresh was rather slow. The application response could be slow at times. Participants felt that the chat text input was rather quick but there was some delay

displaying the text on screen. However it was faster than expected. Participants felt that the e-book device connection to WiFi was very quick and easy to establish and they did not encounter any major problems with the WiFi connection. Participants agreed that the chat application was useful in drawing the solution and upload. The peer-to-peer system was very useful. Drawing using stylus was very easy and useful compared to one on a PC using a mouse but it lacks an annotation feature that would be helpful in order to avoid creating many files. Participants felt that using the chat application was a similar experience to sending text messages. They felt very close and able to communicate with someone. Emotionally they felt that the other party was quite close and in the vicinity while using the system. Participants commented that the mono color display is a bit dull but it did not hurt their eyes. However it is preferable to have a color display if there is a need to send pictures. One participant however commented that a black and white screen can be seen as a formal setting for the discussion of an assignment or business. Given the scenario, all the participants agreed they are likely to adopt the system. However they commented on the urgent need to have a better e-book system that has more intuitive navigation. The ability to use Task bar to switch and search applications would be useful. The file upload feature along with the ability to use voice communication will be ideal.

4.3 Second Experiment

For the second experiment as depicted in Figure 2, the participants were given the following similar scenario:

"*You are in a remote area. There is no wireless hotspot for you to make an Internet connection. However you have an assignment due and you need to discuss the assignment with your peer as you have pre-arranged. You can communicate with your friend using a mobile phone and chat with him via an e-book device that is connected to the Internet. He is waiting for you to start the discussion. Luckily you have a 3G mobile phone that is equipped with a walking hot spot solution and an e-book device. You activate the walking hot spot and make an Internet connection and communicate with him to discuss the problem.*"

The tasks involved in the second experiment were similar to the previous experiment. The participants were given a run down on the steps to perform each task. The investigator explained the e-book device and the 3G-WiFi ad-hoc connection to the participants. They were allowed to use the 3G phone for direct voice communication or text chat communication during the experiment.

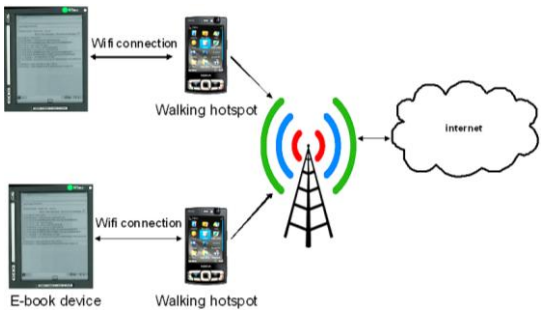

Figure 2: Scenario for Experiment 2.

4.3.1 Observations

For this scenario, the investigator observed major problems such as frequent tabbing with the stylus which caused further response problems and opened up multiple browsers, fail to send a file, frequent "internal server errors" while trying to send a file. During voice communication participants could not use the chat application as it was suspended and when voice communication was terminated, the chat communication resumed. However it would be risky to assume that chat communication will always resume as the session time may have expired. If that is the case then users may need to re-activate the chat application. This is not a good experience for users.

4.3.2 Summary of Focus Group 2

Participant M felt that navigating through the e-book device was easy once the steps were given. Participant M had no problem establishing the WiFi connection to the N95 device. With respect to folder organization within the e-book device, participant M felt that the ability to identify the correct paths and folder was crucial in identify the correct file to be send to peer. Participant M encountered frequent "Internet server errors" while sending the file. He re-created another file to resolve the problem. It was not clear what caused the "Internet server error". It might have been due to the file itself. Participant M felt that voice communication was quicker and had less delay than text chats. Emotionally he felt that he needed to get answer quickly and voice communication can achieve that better than text chat where he needed to wait. Participants preferred to use voice for more complex tasks and text chat for easy tasks. They would not hesitate to use voice communication even if they do not know the other party. Participant M commented that if he had

unresolved problem using text chat he would revert to the phone. They felt that the distance between participants was nearer while using voice communication than that of text chat. However, participant M felt that text chat allowed him to draw the ERD diagram and upload the file and was more effective than voice communication. Both parties could check the files to view the solution. They recommended using voice communication to discuss how to do it but not to actually doing it while it is clearer to explain using mobile voice communication. Both participants acknowledged that the scribble application was easy to use and no major problems were encountered. Participants felt that a main barrier to using the system was that the system was not very responsive. There were no instant feedbacks when tabbing with stylus. They needed to wait and refresh to see what happening. Otherwise the system was rather easy to use and easy to understand. Participants acknowledged that they would adopt the system as it is very handy to have and able to communicate ideas and drawing to peers. They suggested other useful features to enhance the system such as word processing software emailing, colour display and faster response.

4.4 Discussion

In evaluating the Peer-to-Peer Collaborative Learning with E-book Devices over a 3G-WiFi Ad-hoc Network, we looked at three perspectives namely from usability heuristics approach (Nielson, 1994), technology acceptance model (Davis, 1989) and mobile and educational affordances (Norman, 1998; Kirschner, 2002) to answer the research questions. The usability heuristics principles could explain some of our findings rather well. For example the principle of *Visibility of system status* explains the lack of appropriate feedback of our system. The principle of *Error prevention* explains our system was error-prone and errors were not well prevented. File upload and switching application were not based on the principle of *Recognition*. There is also a lack of *Accelerator* principle where no short cuts were available to expert users. Some of these issues identified can be overlapped with Technology Acceptance Model (TAM) which has been widely adopted as the basic framework to examine various adoptions of technologies. In TAM Perceived usefulness (PU) defined the degree to which a person believes that using a particular system would enhance his or her job performance. Perceived ease-of-use (PEOU) defined the degree to which a person believes that using a particular system would be free from effort. A summary of issues mapped with adoption factors we identified in our evaluation is show in Table 1.

Lastly, the concept of affordance (Norman, 1988) can also explain some of our findings. Norman described affordances as "*the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used*". Based on this concept, we identify some affordance factors in Table 2.

Table 1: Summary of adoption factors.

Observed issues	Adoption factors
Navigation interface of the e-book device	PU
Responsiveness of the e-book device	External
Sensitivity and accuracy of the stylus	PEOU
Overall System performance	External
Text chat application	PU
3G voice communication – direct and responsive	PU
Scribble application – file exchange	PU
Lacking Feedback	External
System stability and error tolerance	PU
Ease of connecting to wifi	PEOU
Expectations of the system performance	PU

Table 2: Affordance factors.

Items observed	Affordance factors
e-book system is light weight and small and allow ease of set up	Mobility
e-ink display allow sustainable interaction	Sustainability
e-book is easily connected with WiFi and Bluetooth for Internet access	Connectivity
Browser – a major interface to other learning environment to obtain learning resources	Accessibility
Scribble and text chat application – provide information exchange, storage and record	Communication
The system provide group work and discussion	Collaboration
e-book system allows resource to be obtained when needed	Immediacy
e-book with voice communication	Responsiveness and proximity

5 CONCLUSIONS

The e-book device based peer-to-peer learning system with a 3G-WiFi ad-hoc network was viewed

favourably by the participants. The potential adoption of such a system is very likely. While some of the findings are similar to previous studies (Shieh, 2009) several major issues needed to be resolved before such a system can be widely adopted to compete with netbook. These issues are the navigation interface of the e-book device, the speed, response and feedback of the e-book device and the sensitivity of the stylus. Moreover, the e-book device must include a proper browser with clear features for file saving, font size adjustment, navigation history and favourites. The advent of colored e-ink display from Pixel Qi may provide some solutions. In addition, this project has enabled us to gain an insight into the current technical features of iLiad, such as its processor speed, battery energy consumption, touch-sensitive e-ink display, and wireless connectivity. It has also demonstrated the possibility of using our everyday mobile phones as a wireless gateway for iLiad to access the Internet anytime anywhere. This in turn allows us to adapt current web-based learning applications for iLiad to achieve our goal of a mobile peer-to-peer learning experience. With respect to theory, the three perspectives namely usability heuristics approach (Nielson, 1994), technology acceptance model (Davis, 1989) and mobile and educational affordances (Norman, 1998; Kirschner, 2002) explain well with our findings and potentially useful to provide a primary conceptual model for future studies on the adoption of ebook devices using quantitative and structure modelling approach.

REFERENCES

Barkley, E. F., Cross, K. P., and Major, C. H. (2005). Collaborative Learning Techniques, Jossey-Bass (Wiley), San Francisco, 2005.

Burk, R. (2001). E-book devices and the marketplace: in search of customers. Library Hi Tech, vol. 19, no. 4, pp. 325-331.

Clark, D. T., Goodwin, S.P., Samuelson, T., & Coker, C. (2008). Qualitative Assessment of the Kindle E-Book: Results from Early Focus Groups. Performance Measurement and Metrics: The International Journal for Library and Information Services, 9 (2).

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13, 319–340.

E-Book. (2009). E-book Reader Matrix. Retrieved on 24 October 2009 from http://wiki.mobileread.com/wiki/E-book_Reader_Matrix.

IRex (2009). iLiad Retrieved on 24 October 2009 from http://www.irextechnologies.com/products/iliad/.

Kirschner, P. (2002). Can we support CSCL? Educational, social and technological affordances for learning. In P. Kirschner (Ed.), Three worlds of CSCL: Can we support CSCL (pp. 7-47). Heerlen: Open University of the Netherlands.

Looi, C. K. (2005). Exploring the affordances of online chat for learning. Int. J. Learning Technology, Vol. 1, No. 3, pp.322–338.

Nielsen, J. (1994). Heuristic evaluation. In Nielsen, J., and Mack, R.L. (Eds.), Usability Inspection Methods, John Wiley & Sons, New York, NY.

Nokia (2009). N95 Retrieved on 24 October 2009 from http://www.nokia.co.nz/A4715502.

Norman, D.A. (1988). The Psychology of Everyday Things. New York: Basic Books.

Resta, P. and Laferriere, T. (2007). Technology in Support of Collaborative Learning, Educational Psychology Review, Springer Netherlands, vol. 19, no. 1, 2007.

Sallnäs, E-L. (2002). Collaboration in multimodal virtual worlds: Comparing touch, text, voice and video. In Schroeder, R. (editor), The Social Life of Avatars, Springer-Verlag, pp. 172-187.

Shieh, D. (2009). Northwest Missouri State U. Tries E-Book Readers With Mixed Results. The Chronicle of Higher Education, January 13, 2009.

Waycott, J. (2002) An Evaluation of the Use of PDAs for Reading Course Materials. Paper presented at the IEEE International Workshop on Wireless and Mobile Technologies in Education (WMTE 2002), August 29-30, 2002, Växjö, Sweden.

Wilson, R. and Landoni, M. (2003). Evaluating the Usability of Portable Electronic Books. Proceedings of the 2003 ACM Symposium on Applied Computing (SAC), March 9-12, 2003, Melbourne, FL, USA. ACM: pp. 564-568.