Use of a Mobile Application to Promote Scientific Discovery Learning: Students’ Perceptions towards and Practical Adoption of a Mobile Application

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ABSTRACT

This paper examines what students think about the use of a mobile application as a learning support tool and describes how a mobile application helps students improve scientific discovery learning outside of school. To meet the needs of conveniently saving and retrieving student’s learning, the customized mobile application eBookMaker was developed for our two studies. This application enables students to quickly create mobile documents offering media-rich functionalities. Thirty-two fourth- and fifth-grade students in a public school participated in the studies. Each student was given an Android-powered Motorola smart phone pre-loaded with eBookMaker. In the first study, students were asked to make a mobile document about what they learned in class and fill out a survey form for their feedback about the use of a mobile application. In the second study, students were required to individually explore the scientific phenomena from their daily life, record their investigations, and create mobile documents using eBookMaker for two weeks outside of school. Based on the findings from these two studies, we can suppose that students have a positive attitude (80% of the students replied that they were mostly satisfied with a mobile application, eBookMaker) towards the use of a mobile application as an educational tool. Furthermore, a majority of students (86%) could figure out their own topics, search relevant information from a variety of sources (i.e., Textbooks or websites), and come to their own conclusion, which is a basic scientific discovery learning process, and even 24% of the students could design an experiment, conduct the experiment and draw a conclusion from the experiment, which is a more advanced scientific discovery learning process.

Categories and Subject Descriptors

K.3.2 [Computers and Education]: Computer and Information Science Education –Curriculum

General Terms

Documentation, experimentation, design

Keywords

Mobile application, scientific discovery learning, mobile document, constructivism

1. INTRODUCTION

Today, one of the widely accepted claims in science education community is a constructivist idea that discovery learning is the best way to gain deep and lasting understanding of scientific phenomena and procedures for young children [2]. Constructivism claims that knowledge is actively constructed by the student, not passively delivered by the instructor or absorbed from textbooks and lectures. Each student will develop his or her own knowledge because the construction builds recursively on knowledge that the student already has [5]. Scientific discovery learning can be defined as a highly self directed and constructivist form of learning according to de Jong and Van Joolingen [14], which may refer to the instructional model that engages learners in the learning process through discovery. Thus, offering the opportunity to directly explore scientific phenomena to the student may be a practical approach to promote student learning in science education.

Many studies have pointed out the distinct benefits of mobile devices as educational tools ([3, 4, 9, 15]). The rapid advances (i.e., increase in processing power, memory, and connectivity) in information and communication technology (ICT) have made mobile devices more interactive and media-rich than before [12], offering a fun and engaging context to learners. Moreover, mobile devices require less infrastructure and electricity, which may give educational advantages over traditional computers [8]. In particular, the affordances of mobile phones can present a valuable opportunity to re-integrate student self-investigation into the discovery learning both inside of and outside of school. More specifically, students are already actively using their mobile phones ([1, 6, 10, 11]), so there is an opportunity to apply mobile phones into the real learning environment as a way to promote scientific discovery learning. Considering the current trend toward the consolidation of open-source mobile operating system platforms [1] and that mobile phone ownership among children has increased by 68% in the past five years [7], this is the perfect time to take advantage of these benefits of mobile devices [13]. Therefore, use of mobile devices (or mobile learning) may play an essential role in promoting student learning, in particular scientific discovery learning offering the opportunity to directly explore the scientific phenomena in the real world.
This paper introduces the use of a mobile application “eBookMaker” as a learning support tool in science education. This application enables students to summarize their previous learning and share their summaries with peers in real time. Students can freely add images to their mobile document from the image gallery on the mobile phone or take a picture of their surroundings. Moreover, students can add their voices to give more detailed explanations about their mobile documents. Created mobile documents can also be shared with other students using Bluetooth, which is an open wireless technology standard for exchanging data over short distances. These features of eBookMaker may provide a particularly effective means of promoting student scientific discovery learning both inside of and outside of school.

The remainder of the paper is organized as follows. Section 2 describes basic functionalities of eBookMaker and section 3 describes purposes, participants, and procedures of two studies. And section 4 discusses the results from the studies and finally section 5 outlines brief conclusion and direction for future studies.

2. EBOOKMAKER

The customized mobile application eBookMaker was developed by a developer at Stanford University. eBookMaker, an android based mobile application, enables students to create their own mobile documents. This application was designed to help students add images and sounds as well as texts. There are two reasons to develop the application on the Android platform. First, Android is an open-source platform, which enables everyone to freely and conveniently develop mobile applications, upload them to their own mobile devices, and share them with other people. By simplifying the complicated steps to publish mobile applications, amateur developers can design and develop mobile application for their own research. Second, Android based mobile applications can be readily installed on any wireless Android devices unlike iPhone or iPad.

Figure 1 shows the main functionalities of eBookMaker. Upon opening the eBookMaker application, students can create a new mobile document that is a summary of what they learned in class (Figure 1a). This application provides students with three functions: create (edit), read, and send or receive (Figure 1b). After making a mobile document, students can edit and add new contents to it (Figure 1c). The application allows students to take pictures or download images from the embedded image gallery on the phone, and insert the images into the pages of their mobile documents (Figure 1d). Students can also record audio or insert audio files in the same way (Figure 1e). After students have finished creating a mobile document, it is automatically uploaded to the mobile document library of eBookMaker on the phone and then students can read any mobile documents of the library (Figure 1a and Figure 1f). Moreover, students can send (Figure 1g) and receive (Figure 1h) their mobile documents to their peers using Bluetooth technology, a local communication network (Figure 1g). All functionalities of this application are not difficult, a 15-minute overview on how to use this application would be introduced to the students and they can perform the task of creating their own mobile documents.

3. STUDY I & STUDY II

3.1 Purpose

The purpose of the first study was to investigate students’ perception of the use of a mobile application, eBookMaker, as a learning support tool in a classroom setting. The purpose of the second study was to examine if the use of a mobile application has a positive effect on improving students’ individual scientific discovery learning in their daily life.

3.2 Participants

The participants in these studies were 32 fourth- and fifth graders (16 female, 50%) from a public school in California. The class was a hybrid composed of 14 high-achieving fourth grade students and 18 fifth grade students.
3.3 Method: Study I
Each student received one Motorola Android smart phone preloaded with the eBookMaker application regardless of whether or not he or she already owned a phone. The students would listened to a 15-minute explanation of the application’s basic functionality as well as what they are supposed to perform during the activity session. Figure 2 shows photographs of the students completing each of the required activities during the activity session. Students typed what they summarized based on their previous learning (Figure 2a), took a picture of materials that are related to their prior learning (Figure 2b), and recorded an audio explanation about their summary (Figure 2c). After creating a mobile document, students read the newly created mobile document (Figure 2d), shared them with their peers (Figure 2e), and then completed a survey that asked what they thought about using a mobile application in their learning process (Figure 2f).

3.4 Method: Study II
All students have experienced how to use a mobile application, eBookMaker, to create a mobile document about their previous learning through study I. One month later, they took part in the second study using the same mobile application. Unlike the first study, they were asked to individually explore the scientific phenomena from their daily life using the mobile application, eBookMaker. All activities the students participated in during study II are shown in Figure 3. First, students were asked to share their thoughts about scientific phenomena that can be discovered from their daily life, and the instructor encouraged them to decide and select their own topics (Figure 3a). At that time, the instructor gave several examples to the students in order to help them figure out their own selection. At this point, the instructor let the students decide their topics of discovery scientific phenomena and explore how to use various functionalities offered by the mobile application, eBookMaker (Figure 3b). For the next two weeks, students were required to explore everyday life, discovery scientific phenomena, and figure out what is happening in the real world based on their topics. After two weeks, students got together and presented their own discoveries using a document camera (Figure 3c). Each student was given 90 seconds to report the topic of their investigation, how they chose to explore the scientific phenomena, the most interesting thing they had learned in the discovery learning process, and the conclusion on the findings of their own investigation (Figure 3c).

4. RESULTS & DISCUSSION
4.1 Students’ Perceptions
4.1.1 Overall Student Satisfaction
After completing the required actions, students were asked to indicate how satisfied they were with the use of eBookMaker on a four-point Likert scale: Very satisfied, mostly satisfied, somewhat satisfied and not satisfied. As shown in Figure 4 below, 67% of respondents were very satisfied and 0% of students replied that they were not satisfied.

4.1.2 Student Perception of the Use of eBookMaker
In order to evaluate student perception of the use of eBookMaker in depth, the following questions were offered to the students:
(Q1) What do you like about eBookMaker?
(Q2) What do you not like about eBookMaker?
(Q3) How does eBookMaker help you learn?
(Q4) What features do you want to add to eBookMaker?
(Q5) What was the best thing about eBookMaker?
Students’ responses to each of these questions are discussed in the sections that follow.

Q1. What do you like about eBookMaker?
Students’ responses to Q1 were coded and then categorized into six response types, which are displayed in Figure 5. 67% of the students replied that they liked to make their own documents with eBookMaker. For example, one student responded, “What I liked about this application is that using my imagination to write a
story.” Another mentioned, “I like that I can record my voice and take pictures.”

Figure 5. What students liked about eBookMaker

Q2. What do you not like about eBookMaker?
Students’ responses to Q2 were coded and categorized into five types, which are displayed in Figure 6. A majority of students (70%) replied, “Nothing.” 13% of students indicated they experienced technical problems: long loading time and accidental data loss. Another responded, “I don’t want others read my story.” In addition, 7% of students said that it is difficult to type with the small keyboard.

Figure 6. What student did not like about eBookMaker

Q3. How does eBookMaker help you learn?
Students’ responses to Q3 were coded and categorized into five response types, which are displayed in Figure 7. 57% of students responded that eBookMaker enabled them to learn by writing their own summary about what they learned. Moreover, 20% of students indicated that reading others’ documents helped them learn. In addition, remembering facts and looking at pictures that were collected as ways to learn with eBookMaker. Lastly, only one student (3%) replied that eBookMaker didn’t help him to learn.

Figure 7. What students thoughts they could learn with eBookMaker

Q4. What features do you want to add to eBookMaker?
Students’ responses to this question were coded and categorized into two types, which are shown in Figure 8. 77% of students responded that there is nothing to be added to eBookMaker. One student said, “Nothing. It is really perfect by itself.” The rest of students (23%) gave a variety of responses: spell checker, dictionary, music, video, and more bright colors.

Figure 8. What features students wanted to add to eBookMaker

Q5. What was the best thing about eBookMaker?
Lastly, their responses to this question were coded and categorized into six types, which are displayed in Figure 9.

Figure 9. What students liked best about eBookMaker
Similar to Q1, 47% of students replied they liked to make their own stories. For example, one student responded, “It was so awesome and fun. It can help me write better.” 17% of the students responded that they loved everything about eBookMaker. Besides these responses, reading stories, taking pictures, and voice recording were also mentioned as the best thing about eBookMaker.

4.2 Practical Adoption

In the study II, 29 of the 32 students had completed the task and submitted their scientific mobile documents. The collected students’ mobile documents average 4.48 pages, 3.73 pictures and 352.17 words. More detailed evaluations about the collected mobile documents will be described in the following sections.

4.2.1 Types of Images Used in Mobile Document

The images collected from student-created mobile document came from a variety of sources, including photos of images from their computer screen (Figure 10a), photos of images from textbooks (Figure 10b), photos of their own drawings (Figure 10c), downloaded images from the internet onto their phones (Figure 10d), and photos taken in a real environment with the mobile application (Figure 10e). This information may demonstrate that students with a mobile application can freely collect any images from their surroundings that are related to their own topics.

4.2.2 Research Method Used in Mobile Document

The collected student-created mobile documents were categorized into three types of research method based on how to explore scientific phenomena and conclude from their investigations (See Figure 11). Method I is to collect information relating to their research topics and summarize their collections. Method II is to gather information regarding their chosen topics and conclude from their investigations in their own words. Method III is to come up with a question, design the experiment, conduct the experiment, analyze the results from the experiment and conclude based on their findings.

4.3 Practical Adoption

A majority of students (86%) collect information regarding their topics, analyze their collections and conclude based on them. Furthermore, 24% of the students designed the experiment to investigate their topics, and conducted the experiment, which is typical learning process in discovery learning. Figure 12 demonstrate one student’s mobile document using Method III. This student researched relevant information about soap (Figure 12a) and designed his/her own experiment about what will happen with and without soap (Figure 12b) and concluded in his/her own words (Figure 12c). While conducting the experiment, he/she took a picture of the experiment and add it to the mobile document (Figure 12a). The findings from this study suggest that various functionalities of the mobile application, eBookMaker, stimulate students to actively explore scientific phenomena in everyday life and figure out what it is through discovery and even experimentation.

5. CONCLUSION & FUTURE STUDY

This paper describes what students think about the use of a mobile application, in particular eBookMaker, for their learning and how the use of a mobile application affects scientific discovery learning outside of school. Preliminary findings from the study I indicated that 67% of students were very satisfied with the use of a mobile application, eBookMaker, in their learning process. Also, a majority of the students (77%) responded that they learned by writing summary what they have learned and reading others’ summaries. These results can suppose that students see the positive benefits of using a mobile application in the learning environment. Furthermore, the study II demonstrated that students experienced the scientific discovery learning process with a mobile application by coming up with their own research
question, designing the experiment, and drawing conclusion in their own words. To summarize, it can be said that the use of a mobile application in the learning process helps students build logical and scientific argumentation skill. Furthermore, the obtained findings from this study suggest that mobile publishing can be a new learning competency of the 21st century.

Based on these positive findings about the use of a mobile application in the learning environment, we will design science curriculum using a mobile application and apply that to more learning settings in the next studies.

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7. REFERENCES