

# A Case Study on Mobile Learning Implementation in Basic Education

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**Abstract**—Recent years has seen an incremental amount of mobile learning experiments for the purpose of implementing mobile ICTs into mainstream education. However, the adoption of mobile learning in basic education—primary and secondary schools, is still disappointingly slow, rather than exponential. This case study portrays a unique and novel education concept derived from the Chinese mobile learning industry, in which Noah Education Holding Co., Ltd (Noah) acts as a premier provider of mobile learning services and devices. In China, mobile learning has already formed a booming market. In 2008, 6 million educational electronic devices are predicted to be sold which digital learning devices (DLDs) appear to be leading the trend. Astonishingly, these devices are not mobile phones and the vast majority of them can't even connect to wireless networks. However, they embrace a wide range of new technologies and are widely accepted by students and teachers in particular. As a result, the success of Noah challenges the popular understanding of mobile learning and offers an alternative to implement mobile ICTs into the basic education.

**Keywords**—mobile learning; mobile technology; online learning; basic education; pedagogy; blended learning;

## I. INTRODUCTION

Even if it is widely praised as a new conduit for training and learning, the adoption of mobile learning is still slow, rather than exponential. Despite a rapid development of mobile technology and widespread enthusiasm, it is a fact that mobile learning has not yet seriously impacted education and the projects addressing the adoption of mobile ICTs in schools can still be regarded as spearheads [1, 2]. In higher education, the pedagogical use of mobile devices is not widespread [3] while in basic education mobile learning largely remains on the periphery of planning of most primary and secondary schools. Thus far there is little evidence to show any wide-scale adoption of mobile learning in schools.

In this study we portray the unique and novel education concept initiated by Noah, a leading provider of new educational electronic devices, learning materials and software in China, which offers an innovative mobile learning solution and challenges the traditional mobile learning concept popular in current mobile learning applications. The paper attempts to demonstrate the implications of Noah's education concept in terms of an extreme emphasis on educational use, from devices design to built-in ICTs selection and development, from learning materials generation to learning support.

Field observations play a central role in this case study. However, the data collection process is slightly different from the typical procedure in case study research, as the second author, Miss Jun Liu, is the Deputy Team Leader of China's 11th Five-Year Plan on educational technology projects—'a portable network learning system'. This ongoing project is undertaken by Noah and Beijing Normal University, and digital learning devices are one of the key research objectives.

The paper is structured as follows: After a brief literature review, the unique education concept of Noah is introduced, after which conclusion is made. Finally, limitations and future research are specified.

## II. LITERATURE REVIEW

Adoption of innovations have been intensively investigated by researchers and practitioners of many disciplines, in which the technology acceptance model (TAM) appears to be one of most widely accepted and applied models [4]. TAM originates from the theory of reasoned action (TRA), and postulates that two beliefs (perceived ease of use and perceived usefulness) determine the attitude toward using the system and that attitude, together with perceived usefulness, determines use intention. Perceived ease of use refers to the degree to which a user believes that using a particular service would be free of effort while perceived usefulness is defined as the degree to which an individual perceives that using a particular system would enhance his or her job performance [4]. An extensive body of research has demonstrated the robustness and explanatory power of TAM in predicting use of various information technologies. In particular in the context of mobile services, the basic structure of TAM has been extended and examined in a diversity of areas as well, such as mobile chat [5], mobile credit card [6], mobile parking [7], B2C mobile commerce [8] and mobile ticketing [9]. With regard to the field of education, TAM is also used to investigate antecedents affecting people's behavioral intention in the context of for instance multimedia learning environments [10], electronic learning [11, 12], and mobile learning in particular [13, 14, 15]. In this light, it is reasonable to examine the attributes of DLDS from the viewpoints of ease of use and usefulness, which are in line with the basic beliefs of TAM.

## III. NOAH'S SOLUTION FOR MOBILE LEARNING

Despite widespread enthusiasm, the current reality is that mobile learning is used occasionally and in a supplemental

manner in education [2], and very few mobile learning solutions— even on a global scale— indicates that there is no capability to enable a large scale adoption. Guidelines and experiences for implementing mobile learning in basic education are in short supply. With this, Noah's mobile learning solution is on a large scale generated from constant experimenting and testing. Currently, Noah is becoming a chief provider of digital learning devices, software, and interactive, multimedia educational materials in China. In order for DLDs to be acceptable for users, great efforts have been made by Noah in a wide spectrum of domains.

#### A. Making mobile learning easy to use

With different advantages and disadvantages, handheld devices currently available for mobile learning are many and varied in relation to the different handheld technologies embedded, such as iPod, PDA, smart phone and laptop [16]. These technologies and handheld devices have one thing in common as they are largely developed for business or entertainment purposes rather than for educational use and usability issues are frequently reported [17]. With this, a new device specifically designed for mobile learning is necessary. It is reported that there is at present no successful case and guidelines widely acknowledged on how to develop a best device for mobile learning. As a result, based upon a selective utilization of mobile technologies presently available and an independent development of new handheld educational technologies, a series of DLDs has been developed in order to make mobile learning services easy to use. Here, similarities among the devices developed are summarized as follows:

##### 1) Layout design

A series of DLDs have been designed with a price largely ranging from 90 to 170 €, of which a big screen size appears to be a basic feature, such as  $320 \times 240$  dot matrix in both NP1100 and NP1200. The screen is designed in a way similar to a TV set or laptop instead of the typical portrait layout of smart phones. Handwriting support or a keyboard with more or less 64 keys, or both of them is used as input method. In addition, computer keyboard and mouse can now connect to recent products, such as NP1200 as shown in Figure 1. Also, NP1200, as a leading product, enables a connection to projector and displays courseware in various types of file formats. This new function purposely assists teachers to give lectures in multimedia while building on the content from DLD.

##### 2) System design

The system is designed for the purpose of a more comfortable and easier learning and operating experience. Increasingly, DLDs are utilizing a Linux and WinCE-based proprietary NP-iTECH software platform with rechargeable large-capacity lithium-ion battery, high-frequency chip, extended memory support, external loudspeakers, built-in pronunciation and dual-channel headphones. New functions, such as camera, are now embedded in recent DLDs as well.



Figure 1. The layout of NP1200

##### 3) Interface and learning materials design

Interface and learning materials are displayed with a full screen presentation, in which interactive, multimedia material appear to be the mainstream. Regarding English language study, Text-to-speech (TTS) technology is widely embedded. Further, various types of file formats, such as text, MP3, MP4, MIDI, MPEG4 etc. can be displayed in DLDs alike.

#### B. Making mobile learning useful

A wide spectrum of services and technologies is developed to offer a useful mobile learning experience. Over 30,000 multimedia courseware titles, 8,000 animations for English learning, a wide range of language dictionaries, such as English, Chinese, French, Japanese etc. and an animation dictionary with animated illustrations of 9000 commonly used words are offered. The learning material developed is mainly to complement prescribed textbooks used in China's primary and secondary school curriculum, covering English, Chinese, mathematics, physics, chemistry, biology, geography, political science and history. DLD posits to be a useful tool for students, as the general research group's statistics have shown that to varying degrees it enables to improve students' academic achievements [18].

In addition, a wide range of learning support and management functions are provided to help students arrange their studies as well as daily lives, including schedule, calendar, name card, class schedule, memo, appointment management, personal finances and many more. In addition, Noah devotes itself to a constant development of new and useful mobile learning technologies and services. Among all the new handheld educational technologies developed, the three most important ones are introduced here, which are NP-iTECH, Question Search Function, and Graphic Calculator Technology.

##### 1) NP-iTECH

NP-iTECH is short for 'Handheld Network Multimedia Integrated Technology'. It is the basic software platform for the Noah DLDs, and was introduced as the 'world's first network-aided learning player to combine animation and a time synchronous integration of reading, listening and learning tasks' [19], holding five domestic patents, eight domestic and one international patent applications until June 2007. Based on network processor technology, this technology supports and integrates mainstream multimedia formats, and enables content

developers to efficiently design and assemble multimedia content elements. Many new technology solutions are integrated in NP-iTECH, such as NMAIL, NFlashMX, DLSprite, NTrack and Nmessage technologies.

a) *NMAIL*: This is a multimedia mail sending and receiving software, enabling students to write and read nMail on DLDs. Once Internet connection is available, DLDs will send and receive the nMail automatically.

b) *nFlashMX*: nFlashMX is a visual design tool used to design cartoons, MTV, Electronic Album and courseware. It is easy to understand for both teachers and students. This software is introduced by Noah as to ‘you can make a cartoon if you can use a mouse; you can make courseware if you can use a computer.’ With this, teachers are capable to make courseware for their classes on their own terms.

c) *DLSprite*: Integrated with a ‘One-key download function’, DLSprite is used for fast updating and downloading of learning material from Internet to DLDs. DLSprite also offers students an easy and fast way to delete, transfer and edit the files inside DLDs.

d) *NTrack and Nmessage*: NTrack is a technology used to support the learning track record and intelligent analysis system. It records the learning process of students and then transmits the record to the remote database of Noah. The final analysis of records will be sent to parents or students by Noah.

### 2) Question Search Function

In July 2007, Noah launched its question search function on DLDs, as shown in Figure 2. The question search function is a powerful vertical search engine developed for the common educational user. With this portable search engine, students are able to search the database for the answer to their questions anytime and anywhere. These questions initially focus on the subjects of mathematics, physics and chemistry, and now extend to other topics such as Chinese, English, history, political science, geography and biology. The search is built on questions, books, encyclopedia, English words and phrases. As for the encyclopedia, more than 200,000 titles are available, covering the subjects of astronomy, geography, science and nature. Meanwhile, nearly 10,000 outstanding ancient and modern books are also offered referring to popular science, biography, philosophy, the humanities, modern economy, and so on. Further, both the question search engine and NP-iTECH software are scalable and have the potential to be used on a variety of platforms.

### 3) Graphic Calculator Technology

This technology is China’s first handheld graphic calculator technology (GCT), which integrates five basic functions namely: math sketch pad, algebra calculus, mathematical functions and programming, geometric dictionary, and classic courseware. The technology is particularly useful for mathematics teaching, as it converts abstract mathematical concepts and theory to form comprehensible images in an intuitive and dynamic way. GCT is launched on DLDs at the end of 2007, and is currently available in NP1100 and NP1200.

### C. Motivating students intrinsically

Intrinsic motivation is an important factor affecting user adoption of mobile services, as indicated by a number of studies [20, 21]. With regard to mobile learning, intrinsic motivation appears to be of especial importance, as education does not always bring a sense of gratification but also pressures.

In this light, many fashionable edutainment solutions are initiated in DLDs, like MP3, E-books, My Blog, Electronic Album, RPG games etc. In addition, three kinds of well-organized digital magazines are offered monthly referring to extra-curricular learning, entertainment information, friends making, and Flash development skills. These magazines are increasingly downloaded by students. From different resources, thousands of E-books, such as ancient and modern masterpieces, are now available and downloadable via Internet. Also, Noah initiates four RPG games downloadable for DLDs, in which knowledge is learned in a lighthearted learning environment. As a result, the availability of various edutainment products accommodating varied learning interests in turn motivates students intrinsically.

Further, Noah offers different learning solutions according to the level of learners and engages students with personalized learning materials. A new textbook, ‘Mobile Mind English’, is offered in concert with the use of DLDs, in which new pedagogy theories are being researched [22]. In addition, a range of new learning and teaching methods are embedded in this textbook to order to inspire students.

### D. Facilitating a continuous use of mobile learning

A constant provision of updated learning material is a popular challenge for education organizations. It is well understood that it is impossible for a few teachers and researchers to create all the learning materials needed for the students due to a lack of necessary resources. Nevertheless, an in-time updating is a basic requirement in order for students to continuously use mobile learning services. To this, Noah now offers an alternative.

DLDs package a wide spectrum of learning content once being sold, while new learning content can be subsequently downloaded at over 8,500 points of sale, approximately 2,000 download centers, or via its website: [www.noahedu.com](http://www.noahedu.com). As both computers and Internet are becoming popular in China, updating the DLDs appears to be much easier for students today. Further, new learning materials are continuously produced and sold to students, in turn forming a good cycle for



Figure 2. One of main interfaces of NP1200

learning materials production. The learning content produced actually includes the topics covering nearly all walks of student's lives, making it to arouse and retain the learning enthusiasm for a longer time.

Unlike most mobile learning services available at present, DLDs and learning materials are not public goods. The devices are largely purchased by parents, and new learning content will be sold subsequently. In the Fiscal Quarter Ended March 31, 2008 for instance, Noah has generated net revenues of US\$26.3 million [23]. The revenue generated in turn supports a further updating and development of new products.

In order to consistently supply high-quality education resources, Noah attempts to collect the knowledge of well-known teachers and professors in China. It established a "Teacher's Alliance" which consists of over 250 experienced teachers and 17 education experts from more than 100 top schools in 15 provinces throughout China. A team of approximately 100 full-time and more than 400 part-time producers, editors and graphic artists is organized to constantly produce learning materials adaptive to DLDs. On the other hand, Noah is actively seeking partners for developing high-quality education resources. Hitherto, Noah has gained copyright from many national and international publishing companies for new content, such as Longman Publish, Oxford University Publish, People's Education Press and Translation Publishing house etc. Riverdeep Fun Mathematics is brought to students largely based on the original Riverdeep textbooks. All of these efforts in turn give Noah a capability to constantly supply high-quality learning materials.

#### *E. Integration with classroom learning and online learning*

Misuse of mobile devices in class has been reported to be one of the main challenges when employing mobile learning in basic education [24, 25]. By an exclusive use of high-quality learning material stored in devices, Noah makes its devices acceptable for a majority of teachers and successfully alleviates the disrupting effect of mobile learning. Further, as learning materials are largely developed in accordance with the prescribed textbook, teachers gain an opportunity to utilize DLDs in teaching. Consequently, a wide adoption of DLDs not only promotes the use of ICTs in education, but also supports and initiates a new learning environment, resulting in a harmonious integration of classroom teaching and mobile learning.

In addition, Noah offers a new method to take advantage of online learning. Online learning appears to be advantageous in terms of fast connection and operating speed, high bandwidth and ease to operate. A high dropout rate however is frequently found in online courses, in which a sense of isolation, lack of personal contact and immediate instructor feedback are widely acknowledged to be the Achilles heel when offering education to distance learners [26]. In Noah, after-school tutoring programs have been provided online since July 2007, in which students can log-on and post questions regarding their homework. Video is used for experienced teachers of Noah to answer these questions everyday. In addition to this, online community, chat rooms and bulletin boards are opened to facilitate interaction among students, teachers as well as

parents, where an incremental amount of users across different schools and provinces make the forum booming and effective.

#### IV. CONCLUSION

Noah believes that the success of DLDs contributes to its capability to 'present traditional education content in an engaging multimedia format at a pace and in the order selected by each individual student, creating a more tailored and more enjoyable teaching and learning environment' [27]. While a vast majority of current mobile learning projects is heavily depending on the use of mobile devices mainly developed for business or entertainment use, Noah initiates an innovative mobile learning solution by intensively utilizing and developing handheld technologies to accommodate education, not by making education accommodate technologies. From the DLD design to built-in ICTs selection and development, from learning content provision to learning support, education is always the focus and target, resulting in a new device which is easy to use and useful for students and accepted by teachers and parents in particular.

In order for learners to accept the physical restrictions of portable devices and changing environments, interactive and multimedia learning materials are required. To some extent, the attractiveness of learning material displayed in the digital devices tends to retain students' attention for the long term and therefore facilitates the adoption of ICTs packaged as a whole. Also, a provision of various learning materials stored in DLDs reduces the requirements on the wireless network as well as the efforts needed to access education.

If leveraged appropriately, an ICT-implementation in mobile learning can be used in a 'natural' way without destructively disrupting the learning environment in class. Noah offers a success case in which the application of mobile learning will accommodate current pedagogy theories; however, it also shows a potential to facilitate a transformation and evolution of pedagogy. With this, mobile learning tends to be more acceptable for teachers who are always important stakeholders when it comes to the adoption of mobile learning methods in schools.

Education technologies, including mobile learning, online learning and conventional fact-to-face learning, are integrated in accordance with respective advantages, in which mobile learning appears to be a bridge and therefore forms a new style of blended learning. Online learning complements DLD-based mobile learning by offering relatively high bandwidth for learning material and system updating, and by providing essential connectivity, such as sending NMAIL to peers or teachers, visiting a forum and receiving after-school tutoring.

Advertisement and marketing campaigns are continuously launched by Noah as well as its competitors to persuade parents to purchase educational electronic devices for their children. The business-oriented model enables Noah to develop and market new DLDs and learning materials so as to further explore the potential of the mobile learning market.

Currently, the mobile learning industry is booming in the Chinese market and the DLD is apparently a high-end product leading the trend of educational electronic devices

development. According to the prediction of SINO Ltd (2006), 3.39 million educational electronic devices from both Noah and its competitors were sold in 2006, which would increase to 4.6 million in 2007 [28]. The figure is expected to reach 6 million in 2008 [29]. A series of studies on DLDs are being carried out in a number of schools across several provinces in China, which is included in China's "11th Five-Year Plan" as a key research subject on educational technology, and is led by Beijing Normal University and Noah. It can be expected that DLDs as well as mobile learning will be increasingly popular and embedded in the student's lives. In this regard, the success of Noah actually offers a possible 'killer app' in basic education.

## V. LIMITATION AND FUTURE RESEARCH

The field of mobile learning is still in its infancy [30]. To date limited understanding has been achieved on how mobile learning could be implemented in basic education. As the research and application of DLDs is in an initial stage and a series of research and experimenting are still projects in process, the empirical data support from a learner's perspective is relatively limited. In relation to this, future research will exert more efforts to investigate how DLDs could improve academic performance as well as factors affecting users' intention to use mobile learning in basic education.

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