

Development of Mobile Learning Application to Promote World Heritage Site Preservation Awareness

Case of Luang Prabang, Lao PDR

Yew Siang Poong, Shinobu Yamaguchi, Jun-ichi Takada

Department of Transdisciplinary Science and Engineering
Tokyo Institute of Technology
Tokyo, Japan

Abstract—A world cultural heritage site is the legacy passed down by ancestors to all humanity of the world. It represents the masterpiece of the past with cultural significance. Given the increasing pressure between development and preservation, this paper proposes the development of mobile learning application to promote world heritage site preservation awareness in Luang Prabang, Lao PDR. The application was developed on Android platform as an appropriate technology solution, reflecting local context situation. Surveys and interviews were conducted with higher education students in Luang Prabang to measure the impact of the application users' perceptions, impact on users' understanding of preservation, as well as improvement areas. Findings indicate encouraging outcomes in using mobile learning application in promoting world heritage site preservation in a least developed country context.

Keywords—mobile learning; world heritage site; international development; user study

I. INTRODUCTION

Cultural heritage refers to monuments, groups of buildings, or sites which are culturally exceptional and significant for present and future generations. Cultural heritage is listed as a world heritage site by the United Nations Educational, Scientific and Cultural Organization (UNESCO), and is subject to evaluation and maintenance of the inscribed cultural values.

Located in Lao People's Democratic Republic (PDR), Luang Prabang is one of the most beautiful world heritage sites in South East Asia. It was inscribed as the world heritage site in 1997 due to its magnificent fusion of Lao traditional building architecture with colonial style building in a unique townscape. Since its inscription as a world heritage site, the number of tourists visiting Luang Prabang has been increasing rapidly. Tourism demand has led to cases of construction and modification of buildings which violates the inscribed architecture [1]. Without proper control on such activities, it is feared that Luang Prabang may slowly lose its uniqueness and culture as time goes by. Among the many proposed solutions to sustainably manage Luang Prabang, promoting preservation awareness among the residents is imperative [1].

Information and communication technologies (ICT) facilitate learning and provide access to information and knowledge needed to promote cultural heritage preservation

awareness [2]. Different kinds of ICT have been deployed to promote awareness, including traditional desktop computers to location-based mobile augmented reality. However, given contextual differences between countries and preservation requirements between world heritage sites, there is a need to customize applications in order to achieve intended outcome.

Lao PDR is a lower-middle income economy with a population of about 6.7 million and a GDP of 12 billion USD in 2014. As a reference, the United States' population was 320 million and GDP was 17 trillion USD in 2014. In addition, despite the fact that Lao PDR was ranked at 138 over 167 in ICT development index (IDI) in 2015, IDI report shows that there is an increasing trend of number of mobile cellular subscriptions from 62.6 per 100 inhabitants in 2010 to 67.0 per 100 inhabitants in 2014 [3]. This implies that mobile phone penetration rate is growing among the community of Lao PDR.

Past field survey indicates that mobile phone ownership is higher than personal computer in Luang Prabang [4]. However, high dependent on wireless network connection (WIFI) and mediocre mobile phones have rendered augmented reality not feasible. Based on the outcome of requirements study, mobile learning application with interactive quiz component is deemed appropriate as a means to promote world heritage site preservation awareness in Luang Prabang. Hence, the objective of this paper is to demonstrate the development of mobile learning application, known as *MoladokLP*, as an example of appropriate technology implementation, and to assess the usability of the application in promoting preservation awareness among residents in Luang Prabang.

This paper is organized as follows. In section II, literature review related to mobile learning and interactive quiz is presented. In section III, technical details of the mobile learning application is demonstrated, followed by experiment procedure. Section IV provides details on the results of survey and interview. Finally, conclusion is presented in section V.

II. LITERATURE REVIEW

A. Preserving World Heritage Site as Humanitarian Activities

The Director-General of UNESCO, Irina Bokova comments that:

Culture and heritage are not about stones and buildings – they are about identities and belongings. They carry values from the past that are important for the societies today and tomorrow. [...] We must safeguard the heritage because it is what brings us together as a community; it is what binds us within a shared destiny [5].

Preserving world heritage site is equivalent with conserving the heritage of humanity. A world heritage site does not belong to a particular community or a country. Instead, it belongs to the global community with the mission of passing to the future generation. World heritage site preservation bonds humanity together through several ways, including international assistance, research and training [6].

The world heritage site of Luang Prabang features unique blend of local and colonial cultures through building architectures and urban planning, including properly planned residential areas and streets. Furthermore, unlike monuments, what makes Luang Prabang unique is the fact that people practice their daily life in the world heritage site. However, preserving world heritage with inhabitants pose additional challenges, in particular to achieve a balance between preservation and the needs of inhabitants in development [7].

A world heritage site is subject to reactive monitoring to ensure active measures for the protection and conservation of the site. With increasing number of tourists and influence of modern cultures, the reactive monitoring team identified incidences of residential buildings which are not adhering to preservation plan in Luang Prabang [1]. The report urged the need to raise preservation awareness among local residents.

The Department of World Heritage of Luang Prabang (DPL) is a government agency responsible for the management of the world heritage site, including construction authorization, monitoring and awareness raising. Although multiple campaigns were organized to raise preservation awareness among local communities, human resources and costs hindered the campaigns to be held frequently [8]. As part of the international development project to apply information and communication technologies (ICT) to assist in the management of world heritage site of Luang Prabang, mobile learning was identified as a potential tool to supplement DPL's effort to raise awareness in the local communities [4].

B. Mobile Learning

Traxler [9] defines mobile learning as “any educational provision where the sole or dominant technologies are handheld or palmtop devices.” (p. 261). This definition includes smartphones and tablets, which are the main devices this research is targeting on. In comparison with traditional method of educational provision, mobile learning has advantage in terms of time, context, and support for non-formal learning [10]. Mobile learning allows users to access to learning content anytime and anywhere. This enables learning to take place in numerous environmental and social settings. Given unique characteristics of mobile phones, mobile learning for development has gained attention from the policy level and

implementation level. For instance, policies were discussed and implemented to increase access to basic education and learning opportunity in developing countries, raise health awareness, and increase environmental awareness [11, 12, 13].

Non-formal learning usually takes place outside educational institutions, and unlike formal education, learners are not normally given any recognition of achievement. However, non-formal learning has its importance in contributing to social and cultural development [14]. Based on previous arguments, it can be argued that the promotion of world heritage site preservation awareness fits under non-formal learning category, and the use of mobile learning is expected to be an appropriate mode to deliver learning content.

C. Interactive Quiz to Facilitate Learning

Having identified the mode of delivery is insufficient without considering how to present the learning content. One of the characteristics of mobile learning is spontaneity [6]. Although learning can take place spontaneously, anytime and anywhere, learning process can also be easily interrupted. Therefore, instant feedback or guidance is needed under spontaneous learning to minimize the impact of interruptions [15]. As a result, the role of interactivity becomes more prominent in the context of mobile learning. Evidence shows that interactive mobile-based learning content positively affect user's achievements [16]. Among the reasons cited include the design of interactive elements and the appropriateness of mobile devices in reinforcing learning activity [16]. Recent trend of mobile learning has extended to serious games, with 3D images and advanced manipulations [17]. However, serious games can only be deployed under the assumption that target users possess relatively high performance smartphones, which is not the case in Luang Prabang. Hence, in order to balance between the need to incorporate interactivity and target user's technology readiness level, this paper proposes the promotion of world heritage site preservation awareness through interactive mobile quiz application.

III. METHODOLOGY

A. Justification for Mobile Application Development

Prior to application development, factors determining mobile learning acceptance were investigated with 365 higher education students in Luang Prabang [18]. The finding showed that five factors affect mobile learning acceptance among the users. The factors include: perceived usefulness, perceived ease of use, perceived enjoyment, personal innovativeness and perceived facilitating resources. Among the five factors, the first three factors were directly related to mobile application development. The result suggested that designing application which increases knowledge on world heritage site, which is enjoyable to be used, and which requires less effort to use will increase application adoption rate. These factors were taken into consideration during application development process.

B. Prototype

A prototype was originally developed using jQuery Mobile web framework considering the HTML5 cross-platform

capability. In addition, the use of HTML was considered to promote easier maintenance for the local ICT team members in DPL. Fig 1 shows the main menu of the HTML5-based application.

Several issues, however, have rendered the redevelopment of the entire application. First, customizing font type was not an easy task. In this project, there is a need to include Lao font into the interface. Lao font was not displayed consistently throughout the interface using HTML5. Second, responsiveness was below expectation. The application was intended to be interactive. However, the slow prototype's response created challenges on staying in the flow from one state to another state. Part of the reasons could be the extensive use of Javascript to create logics during quiz game. Reflecting these issues, the application was redeveloped in Android, considering that the number of Android users was high during the period of application development.

C. Actual Application Architecture

As stated in the Introduction section, the name of the mobile learning application is known as *MoladokLP*, which is a combination of *Moladok*, which means “heritage” in Lao language, and *LP*, which stands for “Luang Prabang”. The application was developed using Android Studio. Android Studio is an official integrated development environment for Android-based application. Fig. 2 depicts *MoladokLP* architecture.

Reflecting the findings of the previous study, the application consists of four main views, namely main menu, level menu, quiz view and game over view, as labelled in



Figure 1: Prototype main menu (Source: Author)

numbers in Fig. 2. In the level menu, a user may choose the quiz level depends on his or her preference. The quiz level differs with each other from the number of quiz questions served and the time allocated for answering. A total of four levels are provided in the application, beginning from learning mode, easy, medium, hard and ultimate, in increasing number

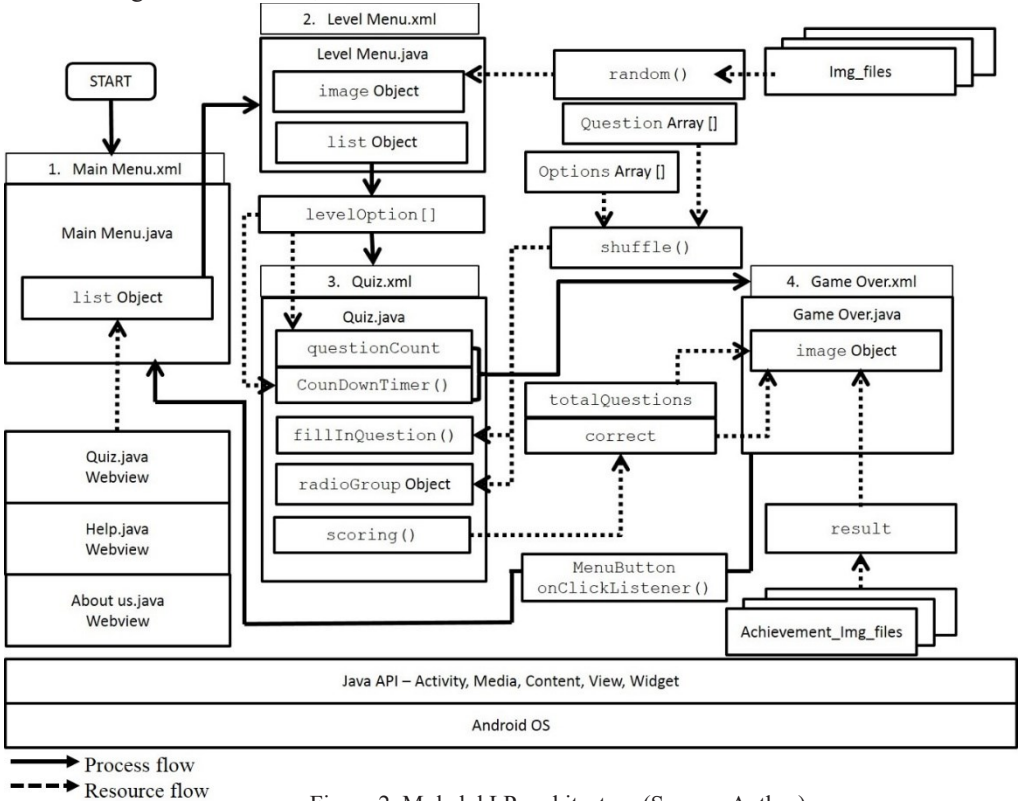


Figure 2. MoladokLP architecture (Source: Author)

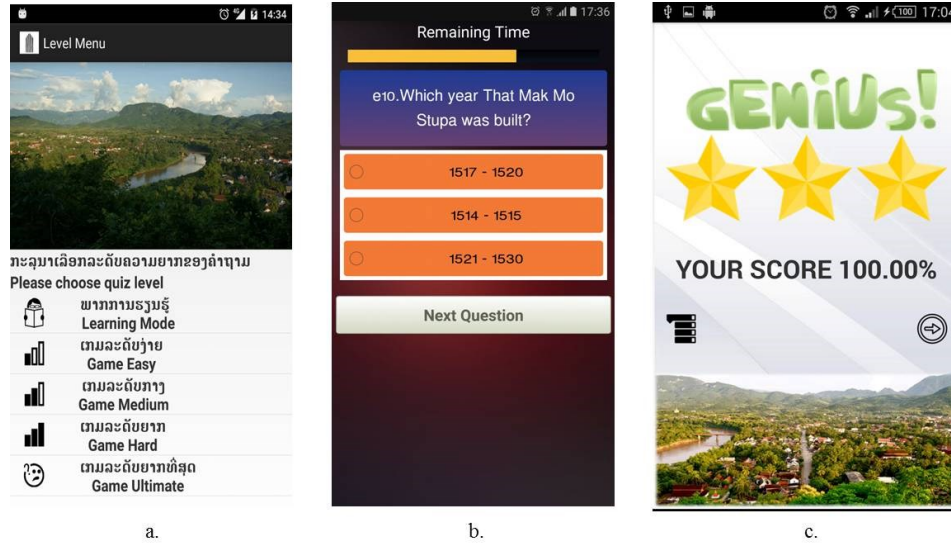


Figure 3. Interface of level menu, quiz view and game over view

Source: Author

of questions and lower lesser time allocated. Fig. 3a illustrates the interface for level selection and Fig. 3b depicts the interface for quiz view.

Quiz questions are randomized through a random question generator before serving to quiz view. In order to increase playability, the answer options are also shuffled. Both game level and random quiz generator were designed to reinforce perceived enjoyment, as supported by previous study and literature. In addition, the application was designed with simple to navigate interface and in two language options: English and Lao, to bolster perceived ease of use. The application ends based on two conditions: 1) all the served questions are answered; or 2) the allocated time has run out. Then user will be brought to game over view, which depicts the score obtained, as well as motivational elements to encourage users. Fig. 3c shows the game over view. The application is designed to be standalone, considering the difficulty of Internet connection in Luang Prabang.

D. Content Development with Quiz questions

A total of 30 quiz questions were included in the application, covering rules and regulations of building modification, history of Luang Prabang, and intangible heritage of Luang Prabang. Example questions related to each of the category is presented in Table I. The quiz questions were developed and authorized by DPL as important to raise the awareness of world heritage site preservation among the residents.

E. Data Collection Procedure

The application was uploaded to Google Play application store as a free application. Under the arrangement made by DPL, testing with 190 students and interviews were conducted with 15 students in two local higher education institutions in Luang Prabang. Literature identified the important evidence of knowledge spillover from students to family members in using

ICTs [19]. Although specific investigation may be needed in the context of Luang Prabang, similar tendency is expected among the young adults in Luang Prabang. Further, local discussion supports the importance of young generation as the leader to initiate effective preservation of the town. Testing was conducted using a pre and post-test approach. Students were given a questionnaire to answer before and after they experienced the application. The questionnaire aimed to measure students' perceptions on world heritage site, including perceived benefits of inscription, perceived response efficacy and perceived resident effectiveness. These perceptions were measured using a 7-point Likert scale, in which scale 1 indicates "strongly disagree", while scale 7 indicates "strongly agree". Definitions of each of the perception are given in Table II.

TABLE I. EXAMPLE QUESTIONS FOR EACH CATEGORY

Category	Sample Questions
Rules and regulations	i. Which material presents Luangprabang world heritage value? ii. How to sustainably preserve Luang Prabang as world heritage city?
History of Luang Prabang	i. Which year XiengThong Temple was built? ii. Who was the leader who built Vixun temple?
Intangible heritage	i. Which costume is unique of Lao Women? ii. Which month is Boat racing festival?

TABLE II. DEFINITIONS OF MEASURED PERCEPTIONS

Perception	Definition
Benefits of inscription	The positive factors associated with the inscription of world heritage site.
Response efficacy	An individual's beliefs as to whether the recommended action step will actually avoid the threat.
Resident effectiveness	A resident's belief that he or her efforts can make a difference in world heritage site preservation.

Students were then requested to download MoladokLP from Google Play. They were given sufficient time to explore the application until they were ready for the post test. During the post test, the same questionnaire was administrated.

The purpose of the interview was to supplement the results of the experiment by eliciting information about the following aspects:

- i. Impact on perception changes towards preserving Luang Prabang world heritage site before and after using the mobile application.
- ii. The challenges to increase the diffusion rate of the mobile application.
- iii. Suggestions to improve the application.

IV. RESULT

A. Pre and Post Test

Male and female respondents comprise of 56.3% (n=107) and 38.4% (n=73) respectively. A total of 131 respondents (68.9%) aged between 19 and 21 years old, followed by 41 respondents (21.6%) aged between 22 and 24 years old.

Fig. 4 shows the mean difference on perceived benefits of inscription (PBI), perceived response efficacy (RES) and perceived resident effectiveness (RED) before and after respondents used MoladokLP. Positive changes were observed after respondents used the application, as indicated by increased level of agreement for each of perceptions.

B. Interview Result

1) Impact of Application

Overall, results from the interviews do support a positive impact of mobile quiz application in promoting world heritage preservation awareness. First, interviewees stated that the use of mobile learning application improved their knowledge and understanding of the importance of preservation. For example, one of the interviewees indicated effectiveness of this application to motivate users to feel responsible for sustainable heritage site preservation.

Second, interviewees emphasized the appropriateness of the

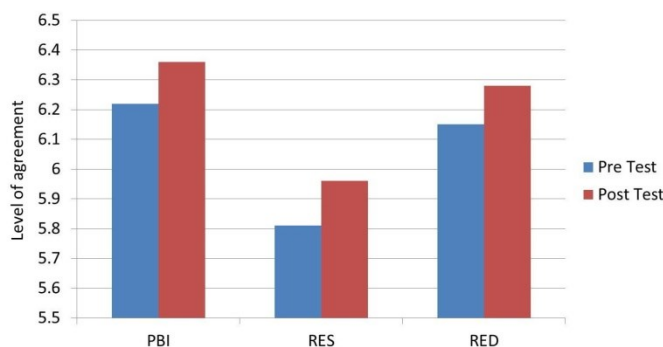


Figure 4. Pre and post-test results
Scale ranges from 1.0 to 7.0

application for young generation. Among the reasons cited include the high mobile phone adoption rate among the young adults, portability of mobile phone as well as their lifestyle of increasing use of mobile phone for communication. Third, interviewees were keen to use mobile phone to learn about world heritage site preservation. This can be observed from their request to increase more information in the application and development of iOS application to expand application reachability.

2) Challenges to Increase Adoption and Suggestions

Most of the interviewees agreed on the following limitations of promoting awareness through mobile application: 1) current application only supports devices running on Android operating system, which limits other interested users. 2) There is limited support of Lao font for some budget smartphones.

Several improvements were obtained during the interview, including creating additional information to be included into the application and designing more attractive interface. In addition, interviewees mentioned the need to develop the application in other platforms, such as iOS as more and more people

V. DISCUSSION

This paper presented a case of implementing appropriate technology in a least developed country context. In this study, a mobile quiz application was developed in response to the need to promote world heritage preservation awareness among the residents in Luang Prabang.

The application was developed on Android platform. Several functions were incorporated into the application to increase interactivity and playability, which include learning mode for instant feedback on right and wrong answers, variable timer and number of questions based on the difficulty level chosen by users. Motivating elements, such as images and scores, were included to encourage users to use the application. In order to measure the effectiveness of the application, a survey with 190 students and interview with 15 students in local higher education institutions were conducted.

Survey result indicates that there are positive perception changes after using the application on the following three aspects: perceived benefits of inscription, perceived response efficacy, and perceived resident effectiveness. First, the result implies that the application improves users' understanding of the benefits of world heritage site inscription for the local people. Second, it also suggests that the application affects users' perception on the recommended solution to preserve Luang Prabang world heritage site. Third, it further proposes that the perception on residents' efforts to preserve Luang Prabang was positively affected after using the application. In addition, interview findings show that the application indeed impacted students' awareness on the preservation of Luang Prabang. Moreover, users recognized the application was appropriate in targeting the young generation.

The findings of this study have provided valuable insights for future works, which requires increasing number of quiz questions, development of iOS version of the application and enriching application with other relevant functions and information, such as crowd-sourced reporting to enforcement authorities with regard to any damages related to the world heritage site. In addition, the sample used to assess the application may pose bias issue in the outcome of the effectiveness of the application. Future study will look into the possibilities to test the impact of the application on factors of world heritage site preservation based on users with different demographic backgrounds.

The past decade has seen ICTs being applied to assist the management of world heritage sites around the world. However, heritage management practices often suffered from sustainability and practical issues [20, 21]. This research project considers sustainable factors from the beginning of application development by understanding local needs. In addition, the fact that local community can download the application indicates that expansion scheme is in place. Finally, other countries with similar context and needs are expected to benefit from the findings and practices of this paper.

VI. CONCLUSION

A world heritage site belongs to all people in the world. Hence, the preservation of world heritage site is important to conserve the legacy of humanity, and to pass the legacy to future generations. As part of an international development project to implement ICT to assist world heritage site management, this study presented a case of development and implementation of mobile learning to promote world heritage site in Luang Prabang, Lao PDR. Findings show that interactive mobile learning is a feasible and practical technology to meet local development needs. Being one of the first initiatives in this research context, it is expected to provide academic and practical implications for the development of mobile application in world heritage site preservation and international development context.

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