GUMSA Framework for the Development of Mobile Learning System of a Malay Language Using Near Field Communication

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Abstract

Discovering a city during vacation, a tourist might learn foreign language from a travel internet site on a home desktop computer, phone and interactive multimedia guide on the tourist information. The combination of these experiences constitutes mobile language learning. This paper present a mobile learning framework to develop a Malay language learning application using near field communication (NFC) technology. The proposed framework follow the lifelong mobile learning framework approach with some modification and added features; Mobile learning activity design which constitute Requirement and constraint analysis, technology environment design, mobile learning scenario and learning support services.

Keywords: Interactive teaching and learning, near field communication, Mobile learning, Mobile phone, Malay Language System (M-Lang)

1.   Introduction

Desire changes in behaviour of the individual result from passing a certain expertise is what is described as learning. Teaching helps an individual to learn.

Teaching is also described as the activities and operations carried out by the teacher to facilitate the learning process. To learn is to acquire knowledge and to teach is to impart knowledge or skills. Before the advent of technology the mode of learning is solely in classroom as mentioned by [2]. The emergence of technology learning content is delivered to end user(s).Technology helps knowledge acquisition even beyond learning in classroom. The advent of e-learning permits learning without the presence of a facilitator. Both the student(s) and the teacher are connected via network within a particular context. As such it is concluded that e-learning solves the drawback of traditional learning. But e-learning is restricted by learning within a certain allocated area (Context).Meanwhile the advent of mobile learning handles such restriction of the e-learning process.

Mobile learning is a process of learning across a multiple context through social and content interaction using personal electronic devices. Learner can learn anywhere at any time using mobile devices regardless of the location. [1] Assert that rapid development of information and communication technology can be applied to support teaching and learning process through e-learning environment. Learners are able to use portable devices to communicate with other devices directly or indirectly using technology mediated learning such as Near Field Communication (NFC).

NFC technology allows object to respond to the tap of mobile devices. The technology allows wireless communication over short distance. In practice, this means that a user brings an NFC enabled devices close to an object containing an NFC sensitive device (i.e. an NFC tag or another NFC enabled device).The users can retrieve information about the object and in some case they can share information by making the two devices close to each other.

1.1   Related Work

A Number of frameworks exist to assist the design and development of mobile learning system. [4] designed mobile learning framework; the framework was developed based on the reflection and result of action research from the Nokia mobiledu project [2]. Similar framework by [10] was developed by identifying the framework as an extension of e-learning. Moreover [3] proposed a framework based on four requirements; Generic mobile environment, Mobile learning context, learning experience and learning objectives. Beside these frameworks, another framework by [2] was developed base on lifelong learning. The frame work was developed by adjustments of the Parson's framework where four requirements are the platform of the lifelong learning framework with additional learning theories. These theories are found to be essential in the mobile learning frameworks as they play important role in designing instructional material and determine the direction of the design material and reflect the specific approach.

2.   Near Field Communication

NFC responds to the tap of a mobile device. NFC is an extension of RFID technology which allows fast and easy exchange of small amount of data between mobile devices, PCs, and smart objects. NFC depends on smart card technology standard ISO 14443 allowing wireless data transfers up to a range of 2 to 3 centimetres. Though NFC is emerging as the leading standard for the mobile payments, it has wider applications because of its "Touch to Exchange Information" capability [9]

Figure 2.1**:** Basic system of NFC technology

NFC mobile devices are typically composed of various integrated circuits, SEs and an NFC interface. Analog/digital front-end, NFC antenna and IC are contactless that are included in NFC interface. A mobile phone that supports NFC consists of at least one SE that connects to the NFC controller to perform secure proximity transactions with external NFC devices. Secured environment for programs and data are dynamically provided by the SE. User storage of valuable and private data together with execution of NFC enable services are secured. NFC controller can be connected with more than one SE directly. Single Wire Protocol (SWP) and NFC Wired Interface (NFC-WI) are the supported interfaces between SEs and NFC controller that are commonly known. There is possibility of accessing and controlling SE through the host controller internally or from the RF field externally. The heart of any mobile phone is the host controller. There is a bridge between NFC controller and host controller. The operating modes of the

NFC controller are set by the host controller through HCI. Connection is established between the NFC controller and the SE while the data being process are sent and received.

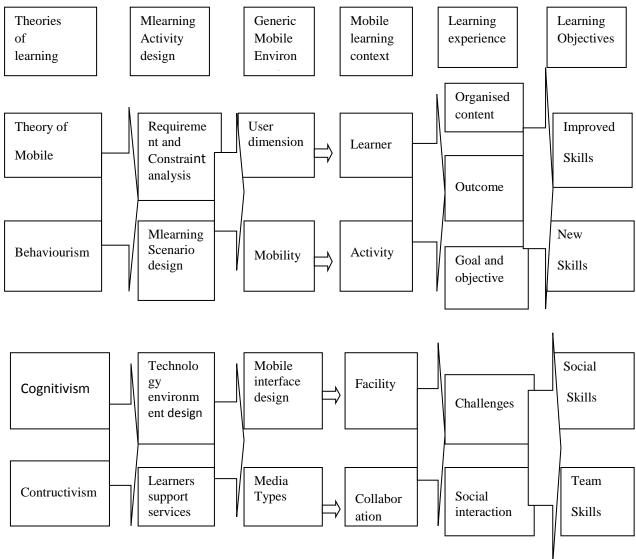## 3.   GUMSA Framework for mobile learning using NFC technology

Figure 3.1: GUMSA Mobile learning Framework

3.1   Theories of learning

[2] Mentioned in a research that design of instructional material requires the involvement of learning theories. These theories determine the direction of the design and reflect the specific approach used. The above mentioned statements make

learning theories to be involved in the framework learning material works with **Constructivism.** As such it will work with mobile learning activities. In most cases students construct knowledge from the information they retrieve from mobile content activities. In this respect, the interactive Malay mobile learning application will assist users who are considered as students to construct knowledge after retrieving the mobile contents. User of the system can be able to learn basic Malay language. Things to learn in the basic Malay language application include basic counting, greetings and food type. Even though mobile devices are bound to some restrictions as for screen resolution to mention but a few. Still mobile phones can be used for practice exercises and drills. As such [2] states that both drills and practice exercise are among the characteristics of **Behaviourism**. Student are motivated to learn much using their mobile devices when there is immediate feedback after the exercises or drills which encourage student to continue the remaining exercises. This Malay language application known as (M-Lang) involves characteristics of behaviourism as it contains quizzes that motivate the learner in using the application. Marks are awarded to encourage the user on the learning system. **Cognitive theory** in mobile learning is among the essential theories that student can recognise their problem and address the difficulty after they reflect what they have learnt in the class on the mobile device. Therefore, the students can recognise the Malay language learning problems and address the difficulty after they reflect what has been learned by the application in a face to face conversation

3.2 Mobile learning activity design

A. Requirement and constraint analysis

Mobile learning experience is not money making innovation. The aim of it is to satisfy learners using mobile devices. Certain demand is required by new mobile technologies. There is need to draw a clear image about these demands. According to Mobiledu two level of requirement analysis has been done. These are General concrete level.
General level: This analysis consists the following

I. Mobile learning common feature

This section analyses the distinctive attributes or aspect of mobile learning. The attributes are responsible to give a significant contribution to the overall learning scenario. [5] in a research described seven related features of mobile learning. These features are; ubiquitous, portable, private, blended, interactive, collaborative and instant information. Ubiquitous mobile learning is usually a context aware that allows user to learn anywhere at any time. However mobile device can be used to handle issues such as homework and project. Combining both classroom instructions and mobile learning in educational environment known as Blended learning, maximizes benefit of face-to-face learning and online

learning. Portability of mobile devices is an important feature that enhances learning at anywhere and at any time. Mobile device is a private device that a single user has access to in a specific time. Mobile can be used to generate collaboration between teacher and student in learning environment, as such this attribute enhances leaning via mobile device. In addition to the use of mobile device in learning it respond avidly to questions, learning content must reflect this requirement by providing material that enables a learner to quickly zone into information [5].If there is collaboration in learning process using mobile device, therefore it influences interactive learning.

II. Project team expectation and motivation

This section analyses what should be presented as the expected outcome of the project and what is expected to be produce by the project team. The present study is expected to develop a Malay language learning application that uses NFC technology. The system is simple to use and operate without having any knowledge on the used technology. This system will be of benefit to both children and adult with the intension of learning Malay language. What motivates the development of this learning system using NFC technology is the advent of research by [7] where interactive learning environment for children is developed. Similarly [8] developed a playful reading approach using NFC.

III. Potential end users and existing mobile learning application

The potential end users are those learners that are going to use the developed system. The Malay language learning system will be developed to suit those users with intension to learn at a basic level. Thus children and adult may be able to use the system in their learning approach. Similar application to learn Basic English vocabulary developed by [8] is in existence

IV. Current state and development trend of ICT in education

With the advent of technological development, the current state of education nowadays is developing. Before the involvement of ICT in education, learning is carried out using traditional system. Traditional Learning is carried out in class room which involve the present of a facilitator. The facilitator gives lessons and makes some drills and assignments using traditional way of learning such as using blackboard and chalks. ICT simplify ways of learning as teachers use projector in their teaching method. [11] Assert that multimedia technology can be used in teaching and learning. E-learning, learning management system such as Blackboard, WebCT and Moodle are now widely used to support classroom learning as well as distance education. The principle limitation with e-learning is the dependence on having access to a computer, almost always with an internet connection. Therefore, learning is still a dedicated activity that is location-based for most students; not always convenient and not integrated in to student's life. The advent of mobile learning clears all limitation to e-learning. Mobile learning

is currently used in educational environment. Due to its mobility, User can learn anywhere at any time without being in the learning environment. Students learn within their learning environment via network. Mobile Learning applications have been developed to enhance interactive teaching and learning.

Concrete level:

I. Influencing factor, environment and possible mobile learning factors

The advent of mobile learning enriches education as it put content of the learning material in the hand of student (learner) without considering the location. [12] conducted a research on factors influencing student intention to use mobile learning model is developed to investigate the prediction of behaviour intention to use mobile learning which is based on Unified theory of Acceptance and used technology (UTAUT).Quantitative approach is used by questioning student in UTM and the data was analysed using SPSS [12].Therefore mobile learning designers are to create learning activities that may match students preferences and perceptions. Technical standards are among the mobile learning factors. Environment where mobile devices are more standardized, e-learning is easier to deliver. Malaysia is among the countries whose environment is up to standard based on mobile device. Therefore, mobile learning is easier to deliver. In developing M-lang application learner's preference and perceptions is considered.

II. Potential user's learning characteristics

Potential users play an active and important role in achieving the required goal until the evaluation process is successful. [5] mentioned the learners characteristics or roles as follows; access information when they need ,responsible for own learning, Learning with their learning speed ,discover and use their learning styles, create and share new information or product ,study with their peers collaboratively ,evaluation themselves and other groups. Therefore these characteristics have been considered during the development of M-lang application.

III. User's attitude, skill, experience and use pattern towards mobile and wireless technology.

Among the analysis to be taken in to consideration before building any mobile learning application is to consider the user's thinking or feeling about the M-learning. Furthermore the skills of the intended user have to be analysed, as it is among the important consideration. User may not know about NFC technology but the intended user must be skill enough to use a mobile device in every respect together with wireless technology. Therefore the developer or designer must consider user's skill in the development process. Similarly, the experience of the user's patterning mobile usage and wireless technology need to be considered.

B. Mobile learning scenario design

Narrative story about a particular user, their environment and activities is described as scenario. Therefore, mobile learning scenario is described as how learners achieve their learning goal with certain characteristics where activities are carried out in certain settings. Mobile learning developers and designers make use of scenario in order to identify how and where the mobile learning and support technology work best. Scenario is a good starting point. In the present research, near field communication technology (NFC technology) is presented as the support technology. This proposed application will assist Malay language learning using mobile device. This system can be used anywhere at any time

C. Technology environment design:

Mobile learning activities is supported by technological environment such as content databases, learning tools, platform, and wireless network and near field communication technology. Figure 3.2 describe the structure of mobile learning technology environment using NFC technology
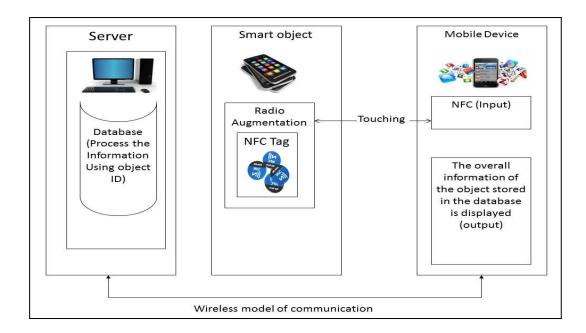

Figure 3.2:   Mobile learning Using NFC technology environment

The architecture demonstrates NFC mobile learning which includes the use of wireless communication between the remote server and the mobile device. Touching the object tag triggers the communication between the mobile device and server. The NFC presentation model illustrates the sequence of the proposed NFC Malay mobile learning architecture. The figure 3.3 illustrates the NFC presentation model and the sequence of the model.
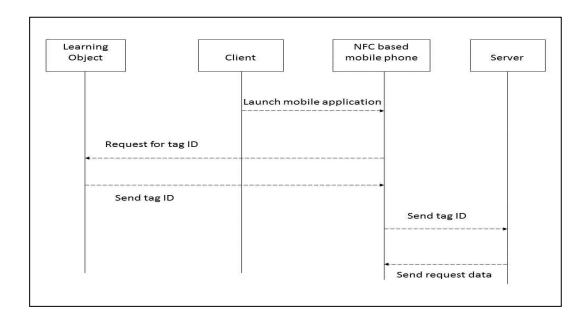
Figure 3.3: Sequence representation of NFC content presentation model

D. Learner support services design:

Leaner support is defined as range of services enabling learners to overcome difficulties, develop competencies and confidence in self regulated learning. Learning support services yield success to mobile learning following the practice of mobiledu project. Learner support services have great emphasis achieving the goal of mobile learning project to enhance sustainable development. The following are some of the component of learner support services:

I. Information consulting services

In this section of learner support services, learner makes use of WAP/website in order to fetch related information. The information comprises personal learning history. In relation to M-lang application with learning support services, the system uses wireless network in its communication between the server (Database) and the mobile device immediately when the tags are touched by the mobile user. The NFC tags triggered the communication between the mobile device and server (Database) via wireless network. The information to be displayed on the NFC mobile device screen is fetched from the server.

II. Blended learning services

This section describes learning activities that are fixed in the internet, mobile internet and even face to face.

III. Training services

In this process, learner is able to get feedback or leaning method, as such learners adapt to mobile learning patterns. Training services are embedded in this Malay

language learning application where drills or quiz is given to the respective user (learner) of the language after using the game like system to study basic Malay language, such as counting, greetings to mention a few . These drills are given in order to test the understanding of the user. In addition to the drills scores are assigned to the user after taking a short quiz as a feedback in order to motivate the user (learner) of the language using M-lang application.

IV. Community support services

Learners can obtain both academic and emotional support when online and mobile communities are built. As stated earlier that technical standard of the mobile learning environment enhances e-learning delivery, the same goes to the community support services. Internet facility is one of the major characteristics of e-learning. Online mobile communities are of important as they give support to learners in both academic and emotional environment. In most cases, this community assists the learner in learning context in discussions in order to collaborate.

3.3 Mobile generic environment

A. User dimension:

What is important in mobile learning environment is the user dimension that is user profile and their role in the use mobile technology. [2] assert that parties involved in the learning scenario are to produce demographic data. In addition, following the generic environment user dimension collect its data from identity and learner. Where for the identity of the user could be either core user or secondary user. In the present research user dimension collects the data from the learner only since identity usually used in learning environment where many mobile devices are connected to each other. In this present research user learn basic Malay using mobile device individually where the data is stored in communication server and can be fetched using wireless network. Similarly the database is stored again in the phone for cases where network is not available. User can collaborate and discuss during the study using a mobile device.

B. Mobility:

Among the important features of mobile environment is mobility .Mobility means looking at the role that mobile users play and the learners. This feature enables a user of a mobile device to be in contact outside the conventional communication space. The assessment of participant mobility and their gadget should be analysed [2].Mobility is what differentiate mobile learning and e-learning (using computer to learn via network).The system to be developed can be used anywhere without any restriction. All what is needed will be embedded inside mobile device to make the system function in a better way. The user of the system can learn anywhere at any time and drills can be given provided the NFC tag is within the environment. Therefore this shows that   the   system can be used even outside the conventional communication space.

C. Mobile interface design:

Mobile devices and even smart phone, iphone or personal digital assistant have small screen; they have restrictive input method and even the battery life is limited. When designing the interface, one has to consider this entire draw back. The mobile interface should not be overloaded with unnecessary complexity. As often described by [2], due to technological development, now interfaces are design for both small and large screens. This section of the generic mobile environment describes the interface design of M-Lang application. Moreover the design is among the phases of Mobile Development life cycle model (MDLC) which is used in M-lang development

D. Media:

Mobile application usually contains many media objects, among the characteristics of mobile learning content; it should be delivered in short information. The idea behind this is to be supported by different media types. In the development of the Malay language learning application, both the videos and sounds are not used, plain text and pictures are used to illustrate learning objects which is more easier for learner to understand and visualise without consuming much time

3.4   Mobile learning context

Due to technological development, the classroom experience has been complemented using mobile learning. As such mobile learning is made to be part of the traditional learning context. [2] reveal that traditional learning is different from mobile learning context as demonstrated by one of the mobile learning applications known as Ambient Wood Project. This project allows an integrated learning approach particularly in teaching science. Student collaborates extensively using their mobile devices. Student in there scientific research environment discuss, exchange notes, check facts and even elaborate using their mobile devices. Collaborative activities are between students, student and teachers or student and other sources as stated by [2]. In the present research using the application student can learn, discuss and exchange ideas more especially during the drills. They elaborate too but not using the mobile devices as learning is not suitable for multiple users within a context. The student and teacher collaborative activity is used, where the teacher is replaced by the server where the information is stored. Since the application will not be used by multiple users within the context, the need for identity is not necessary.

A. Learner:

Every learner has different psychological properties related to the learning experience. If the learner is highly motivated by using the system, probably the system will improve user's learning experience. Therefore, consideration should

be made on the user learning from the system. This research considers the psychological properties of Malay language learners. That is the reason of making the application simple to both respective users. The use of supported technology such as NFC technology and drills is what is assumed to motivate user (learner).It is quite sure that if the users are motivated, the application can improve Malay language learners' experience.

B. Activity:

Activities in mobile learning context are usually collaborative .But it is a good idea to address the individual learning activities in mobile learning. As such collaborative learning activities can take many forms. The collaboration is either within a class room or connected with a tutor via network.

C. Facility:

Before any Mobile interface is designed there is need to identify certain facility impact on it. Mobile learning environment currently makes use of standard mobile devices and most popular available service providers. Before the development of this application, a survey on equipment and tools to be used for this particular purpose was carried out. Below is the listed equipment that will be used

1. NFC Mobile device that support android 5.0 and support API 19.
2. NFC tags.
3. Xamarin studio.
4. Environment supported with wireless network capability

3.5 Learning Experience and objectives

Human being cannot live without learning activities, as such both the design and evaluation depends on learning experience. Touching on the issue of learning experience requires a revisit to user experience of usability [2].Usability is not the only objective that should be considered by the system designer, but also user experience goal like enjoyable, satisfying and motivating. [2] Use the six structural element of game base on Prensky's mobile learning system. To understand the usability, user's satisfaction, the evaluation is required to be carried out. The evaluation process is discussed where questionnaire are used in the process. The required analysis can be carried out using the SPSS software. The evaluation process is going to be carried out at Universiti Sultan Zainal Abidin and Universiti Malaysia Terengganu where international postgraduate students will be used as the target population.

A. Organised Content:

It is believed that delivery of the contents in an organised form is among the basic components of learning experience. Learning acquition can be promoted by organi-

sing content. In addition organise content enhance understanding as stated by [2]. Similarly it is necessary for organised content to be attached to Goal and objectives as it provides sense of direction. Organised learning content in developing a mobile learning application is among what motivate the potential user(s). In addition, the system usability will be enhanced also if the learning content are organised. In the present research, the application is designed and developed with organised content.

B. Goals and objectives:

Goal and objectives help learner to be in a sense of direction and to be engaged. Learners are motivated by achieving a task in learning environment. The fact proves when there is goal and objective there is possibility of obtaining feedback. In the developed application, the user's goal is to learn Malay language. The application is designed to learn basic Malay language such as; counting, greetings and food type of the three square mill. What is expected from the user is to learn basic content of the application. Quiz is giving to the user to test ability of the user learning experience.

C. Outcome and feedback:

In learning, feedback comes when something in the learning changes in response to what the learner does. The learner is informed on what have been learned immediately. If the content is organised in narrative form (story), learner will be directly involved in the learning if issues on personal basis are able to be explored. However this is an important aspect of learning experience as feedback generates user(s) motivation on usability and satisfaction. M-Lang application contain a quiz section, feedback is to be displayed as the result which motivate a user to continue in the learning process.

D. Challenge:

Learners are usually interested in activities that draw on conflict and possess competitive element. This factor can engage the learner, facilitating self-motivation and self-regulation.

3.6 Learning objectives:

Narrative (story or representation) in learning experience is a key factor for developing both new and improved skills. Among the important characteristics of narrative is that it can be complex and explorative. According to [2], narrative allow student to reflect on what they have learnt. The structure of knowledge is organised gradually after illuminating the process of learning. Social interaction can be described as group experience or creating some relevant collective learning. As such both social and team skills are developed.

4. Discussions

The present research modifies the mobile lifelong learning framework by introducing the four elements needed in the design of mobile learning as mentioned by [4].The M-lang application use NFC technology in the learning environment. Figure 4.2 shows a quiz form after touching the NFC Tag of the respective activity at the implementation process. However, the requirement and constraint analysis is an important element considered before any development process. M-lang Application considers the learning theories where quiz form at figure 4.2 is included in the system to test the users understanding ability on the learning process. As behaviourism is characterised by the drills and practice exercises. The Quiz form remains visible when the NFC tag is touched by the learner. Figure 4.1 show the home page of the Malay language learning system using NFC technology (M-lang) that specifies user interface of the system. The research is still under the development phase and the evaluation phase will be the final stage where the user(s) motivation will be assessed after analysing the result of the survey questionnaire among the postgraduate students of both University Sultan Zainal Abidin and University Malaysia Terengganu. SPPS will be used a tool for the evaluation phase. However the evaluation tests the learning experience of the user.
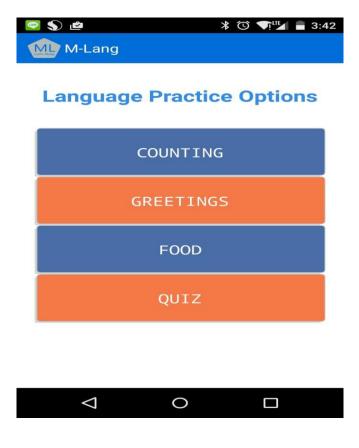

Figure 4.1: Home page

Figure 4.2: Quiz form

5. Conclusion

This paper discussed the design and development of Malay language learning mobile framework environment. The design is based on study of related literature on mobile learning frameworks by [4], [3], [2] and [10].Contribution is made to the lifelong learning framework by [2] by adding four factors of the mobile design activity which are essential for any mobile learning development. The developed application is design using the proposed framework. The system allows Malay language learning using mobile devices and NFC technology to achieve several learning theories such as Ubiquitous, immerse learning, context and tangible interface. Users learn the language using their mobile devices to enrich their learning process. NFC helps the learning process as it requires touch on tag or other NFC devices to work; therefore students interact with object directly.

In addition, NFC technology does not require much time in the learning process as the NFC mobile devices and tags are available. In future, the application will be evaluated to test the usability and functionality of the system; the evaluation will be carried out between International postgraduate student of Universiti Sultan Zainal Abidin and Universiti Malaysia Terengganu, using SPSS as a tool and a survey questionnaire for the data analysis

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