Design and Development of Mobile Assisted Language Learning (MALL) application for English Language using Android Push Notification Services

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Abstract – The pervasive nature of the mobile devices and the wide array of mobile learning applications enables the acceptance of mobile devices as an indispensable component in the current pedagogical learner-centric mode of learning. The term mobile learning is used in different contexts by different researcher universally but this research paper is concerned with both the mobility of the learner and the mobile nature of the devices. Mobile learning applications specially addressed for Language learning typically featured with quizzes, tests, podcast, videocast, flashcards, surveys and polls etc. These features are built-in to the m-learning applications for enhancing the English Language skills of EFL students. The learning content and the exercises focussed on improvising EFL students grammar, pronunciation, listening, speaking, reading, writing and vocabulary skills. The students can be engaged with learning activities as long as they are updated with new lessons, exercises and learning objects like podcast and videocast. The generic existing model of mobile assisted language learning (MALL) applications are normally supported with 'pull' model where the learner has to make the request to the server for ensuring the availability of the new learning content, test results, new exercises, feedback, blogs, forum opinions, messages from the instructor and their fellow learners. This model decreases the motivation of the students in enhancing their language skills and the duration they spend for improvising these skills through mobile devices. This paper address the need for designing m-learning applications with 'push' model using Push Notifications by Android, iOS, Blackberry, Windows Phone and other mobile platforms. The evaluation of the MALL applications, built with the push notification, by a different group of students augments the theory that mobile devices as an enabler of enhanced, personalized and life-long learning paradigm.

Keywords: Android, Mobile Assisted Language Learning (MALL), Computer Assisted Language Learning CALL), Mobile Devices, Push Notifications, ESL, EFL, ELS, Language Learning, M-Learning

I. INTRODUCTION

Mobile Assisted Language Learning (MALL) applications has gained a universal acceptance in the learning context of improvising English language learning skills of English as a Foreign Language (EFL) students. Mobile devices plays a vital role in the emergence of pedagogical enhancement of teaching and learning process. The m-learning applications developed with the emphasis of constructivist, collaborative and learner-centric approach are gaining acceptance from the learners worldwide. The ownership of the mobile device by the learners and the ever growing functionality and features of the mobile device requires the attentions from instructional designers, language trainers to constantly modify the pedagogical concepts of delivery learning content via mobile devices. The technological innovation and enhancement in terms of user interface, gesture recognition capabilities, screen resolution, screen size, support for wide variety of file formats, browser capabilities, and mobile application life cycle warrants the MALL application developers and designers to re-conceptualize the application in terms of usability perspectives. The worldwide acceptance for social networking platforms and their enticing collaborative features requires the mobile applications in general necessitates the m-learning applications to include those features in MALL.

II. MOBILE LEARNING IN THE CONTEXT OF MALL
The increased penetration of mobile devices and the affordability by the learner gives the ownership of the mobile devices worldwide and particularly in developing countries like India. It increases the relevance of mobile devices in the classroom context apart from the consideration of using the devices for learning outside the classroom environment. The language learning skills are assuming prime importance in the case of higher educational institutions like colleges and universities. Students living in India and in worldwide where the English language is accepted as Second Language (ESL). The term mobile learning has been defined by various researchers in different notion and there is no universal definition. In general the m-learning or learning through mobile devices refers to the aspect of mobility of the learner and the mobile nature of the devices. The mobile assisted language learning is derived from the concepts of computer assisted language learning (CALL) with an enhanced support of learning in context and provides the EFL students a valuable learning tool. The successful design, development and implementation of MALL applications in the m-learning environment depends on three factors namely learning content or learning objects (LOs), learning activities and the communication & collaboration features.

Traxler (2007) suggested a designing of learning model which should include the three key aspects designing of content, designing of activities, designing of communication.

**Designing of Content**

The foremost requirement for designing of mobile learning applications revolves around the learning content in terms of their size, format, compliance and delivery aspects and should consider the following aspects:

- Open-endedness: if students are expected to construct some of the content as part of their learning, this could be done in various locations and can be facilitated by mobile devices.
- Personalization: mobile devices can cater to individual needs enabling learners to receive, assemble and carry around personally useful resources.
- Time-critical nature: content updates may be more easily delivered to mobile devices when learners are highly mobile.
- Portability: content such as portfolios might be best developed on mobile devices and physically owned and carried around by learners.
- Measured delivery: mobile devices can make it easier when content needs to be accessed by learners little by little over a period of time, mobile devices can make this easier.

- **Aural medium:** a personal listening device is often the best way to access it aural content.
- **Prioritizing medium:** when some content is made available for mobile devices, this can prioritize or reinforce it over other content, which may be a useful deliberate teaching strategy.
- **Alternative medium:** learners can appreciate having the option of mobile access to electronic learning materials and resources, even if they generally prefer desktop access.

**Designing of Learning Activities**

The second area to consider would be the design of learning activities. Naismith et al. (2004) have demonstrated that mobile technologies can relate to six different types of learning activities:

- For behaviourist-type activity, the quick feedback or reinforcement element is facilitated by mobile devices.
- For constructivist activity, immersive experiences are provided by mobile investigations or games.
- For situated activity, learners can take a mobile device out into an authentic context, or use it to access information while moving around an environment in a specially equipped location such as a museum.
- For collaborative learning, mobile devices provide a handy additional means of communication and a portable means of electronic information sharing.
- For informal and lifelong learning, mobile devices accompany users in their everyday experiences and become a convenient source of information or means of communication that assists with learning, or records it on the go for future consultation.
- Support, or coordination of learning and resources, can be improved by the availability of mobile technologies at all times for monitoring progress, checking schedules and dates, reviewing and managing- activities that teachers and learners engage in at various times during the day.

**Designing of Communication**

The last aspect of design for learning activities is often the most problematic, due to the concerns about the costs incurred by learners if communication and connectivity become additional financial burdens.
Within this constraint, mobile and wireless devices can support:

- Spontaneous communication and collaboration, e.g. one-to-one or one-to-many by texting on mobile phones, by sending a message to a forum or blog while travelling.
- Beaming of stored information from device to device and
- Portable sound-recording, voice-recording, photos and video clips that are used in communication

The prototype application designed and developed for MALL in this research paper has taken into the consideration of the designing aspects elaborated by Traxler (2007).

III. MOBILE LEARNING FRAMEWORK BASED ON WEB SERVICES

The mobile assisted language learning application (MALL) has been deployed on the m-learning framework developed [12]. This chapter discusses the methodology of implementing various prototype m-learning applications for evaluating the usability of the framework in various educational setting based on learning theories. The real-time implementation in higher education environment like colleges and universities is considered. The framework developed is based on pedagogical, technological and usability perspectives which is discussed below. The proposed m-learning framework consists of five components:

1) Mobile Devices (User Infrastructure)
2) Mobile Applications (Installed in the Mobile Device)
3) Mobile Middleware
4) Wireless Network Infrastructure (4G/3G / Wi-Fi)
5) Back End System (Hosting LMS Application and Services)

![M-Learning Framework for Ubiquitous Learning Environment using Web Services](image-url)
The framework is based on Service Oriented Approach using Web Services as its underlying implementation scenario. This framework is focusing on providing ubiquitous learning environment to the end user. The framework is built upon pedagogical, technological and social aspects. The framework is depicted in figure 1. The framework supports PC, Laptop and Mobile Devices. Owing to the proliferation of mobile devices, Smart Phones and Tablet PCs are considered as part of prototyping, developing and implementing the Mobile Applications. The mobile application installed on the mobile device presents a unique user interface for the learner to invoke and consume the various services associated with the mobile learning scenario. The prototype application is developed for Android platform considering its open architecture. The mobile middleware is the heart of the M-learning framework that is being developed as part of this research work. It operates on component model, interoperable with both the back end legacy LMS, database server and also with PC, Laptop, Tablet PC and other Mobile devices. The wired and wireless network infrastructure is used to connect the back end server through the middleware by the Mobile and other user devices. The user connects through mobile networks with varying network configuration and speed like 3G/4G. The typical backend systems employed in our scenario is Learning Management System and this back end systems may be integrate with other servers like mail server, social networking, video server or any other server which provides the requested data to the mobile clients through the mobile middleware as a service.

IV. MOBILE ASSISTED LANGUAGE LEARNING USING ANDROID PUSH NOTIFICATION

Google Cloud Messaging for Android

Google Cloud Messaging for Android (GCM) is a free service that helps developers send data from servers to their Android applications on Android devices, and upstream messages from the user's device back to the cloud.
This could be a lightweight message telling the Android application that there is new data to be fetched from the server (for instance, a movie uploaded by a friend), or it could be a message containing up to 4kb of payload data (so apps like instant messaging can consume the message directly). The GCM service handles all aspects of queuing of messages and delivery to the target Android application running on the target device. GCM is completely free no matter how big your messaging needs are, and there are no quotas.

1. First android device sends sender id, application id to GCM server for registration.
2. Upon successful registration GCM server issues registration id to android device.
3. After receiving registration id device will send it to our server.
4. Our server will store registration id in the database for later usage.

1. Whenever push notification is needed, our server sends a message to GCM server along with device registration id (which was stored in the database)
2. GCM server will deliver that message to the respective mobile devices using device registration id

**User Dashboard**

The dashboard consists of various menus related to mobile learning applications like courses, notifications, calendar for entering and viewing the academic and activity schedules, the media menu to browse, download and store the various media files like podcasts, videocast, animation and images associated with the course and lessons, the discussion menu for joining and discussing the various topics in the forum.

![User Dashboard](image)

**Fig 3. M-Learning Dashboard**

The focus here is on improving the English Language Skills for the non-native speaker (EFL students) or for L2 Language learner. Let us consider a situation where a student wishes to improving their English language skills (ELS), the learner logs into the MALL application, browses through the lesson content posted by their instructor. The course is listed with several lessons under broad category namely Grammar, Listening, Speaking, Reading, Writing and Vocabulary. The learner chooses the Grammar Module. It opens up a screen with the topics listed under the grammar lesson namely Noun, Pronoun, Tenses, Adjectives, and Adverbs etc. The user chooses the Tenses topic and browse through the contents. The user spends some time with the lesson and then clicks the Flashcard link given under the topic. The user flicks through the screen and clicks the various options given under the Word "Played" to select whether the word denotes the present tense, past
tense and future tense etc. Similarly he/she was posed with several words in the Flashcard and keeps choosing another word after answering for the images in the flashcard. It gives them an immediate feedback with a tactile sound whether they have answered it correctly or not. Out of the 10 images given under the flashcard the user was able to answer it correctly for 9 questions. The user ponders over the question which of them they have answered incorrectly.

The user again goes back to the grammar lesson and analyze why they have answered incorrectly and keeps note of it the mistake they have done. Having boosted by the morale the user was able to answer correctly nine out of ten questions then moves on to the Test arena and chooses the test topic given under the Grammar Menu. Having chosen the Menu it asks them to choose their various proficiency levels and the user chooses the Beginner level, the user skipped the Elementary level due to their confidence in answering the flashcard images correctly. The user was asked to choose number of questions they wishes to answer. Then the learner attempts the test but this time it does not give them immediate feedback and the answers are stored in the database and it displays the results finally after they finished answering all the questions. Now the user got all the questions answered correctly. Beamed with a smile they chose to attempt Intermediate level questions.

After some time to hone their listening skills they browse through the lessons given under Listening Menu. Various topics are listed and they were asked to choose one. Having chosen the topic, it immediately plays back the audio file attached with it. The user listens to the audio few times and then prepares for the assessment by clicking the test link attached at the end of the lesson. The user answers to the question they were posted with and it gives them the immediate feedback for the questions whether they answered it correctly or not. It tests their cognitive skills. The user answered correctly only for the five multiple choice questions out of the 10 questions they were asked. At the end of all the questions the screen flashes back them with the result and suggests the user to listen to the audio once again before they attempts the test again. It does not suggest the user which is the right answer for the questions and it simply says whether their answer choice for the question is right or wrong unlike in the case of Tense Flash Card exercise which they attempted few hours back. The idea behind this is on pedagogic principle to motivate them to listen to the audio clip once again to attempt the test. The user attempts the test once again after listening to the audio clip several times to achieve a good score in the test. This time the user got a better score and now at the end of the test it gives the feedback with reasoning for the right answer for the two questions that they answered incorrectly. This motivates their confidence and the user listens to the another podcasting exercise which was suggested at the end of the lesson and made an attempt for another test. This podcasting also marked with the difficulty level whether it is meant for Beginner, Intermediate or advanced etc.

Fig. 5 Tenses modules with listing
Fig. 6. Tenses Lesson
The screen shots are depicted for the Mobile Assisted Language Learning from figure 4 to 10. This application is built with the pedagogic principles and is intuitive in nature with no assistance or intervention from the teacher/instructor.
The analyze of this scenario with the m-learning application aligns with the broad objective that this application is suitable for Language Learning. The lessons are listed under the course module. Flash Card module contains various flash cards associated with the given lesson. The audio files are listed under Podcasting Menu. The various tests are listed with the proficiency level listings. The instant notifications featured by Android Push notification. A push notification, in simple terms, is when a message is forced to transmit at the time of sending. This is opposed to a ‘PULL’ scenario which requires a user to go and get it from the server. Push notifications are exemplary uses of mobile technology in the case of MALL applications.

V. RESULTS AND DISCUSSION

The mobile assisted language learning (MALL) application enabled with push notification services was installed on the android mobile devices of different undergraduate student groups belonging to computer science, physics, chemistry and mathematics. Their mobile devices were provided with the mobile networks connection on 3G speeds. Thirty students from each group have been invited to participate on a voluntary basis. The different learning groups have been assigned with a different tasks, one group was asked to practice grammar exercises, the other group was asked to work on vocabulary exercises etc. They were asked to share their feedback, their opinions, exchange ideas with the help of the communication and collaborative features of the applications. To evaluate the effectiveness of the push notification features only one group has been deployed with the MALL which does not include the push notification feature. The groups have been monitored by the tutors to observe their learning activities. Then each group has been provided with a questionnaire to give their feedback on the learning experience using MALL application. The questions were framed in such a way that to evaluate the learning interest, motivation and user experiences. The synthesis of the findings gives some valuable insights on the mobile learning application design, mobile application developed for language learning.

The finding suggested that the students shown a keen interest in learning through mobile devices and they were highly motivated on the unique experience of learning content which supports multimedia objects like images, audio, video, and animation used in the context of podcasting and videocasting for improvising the listening skills. The images listed with texts were used in the flashcards for augmenting the vocabulary learning activities. The students were thrilled to find the meaning of the words instantly when they presses the words on the touch-screen during the reading activities which has been linked with the built-in dictionary. The Notes taking feature helps the students to copy the words and sentences into his clipboard and save it for their future reference, sharing it with their peers etc. This considerably increases their interest in MALL and gives them personalized learning experience. The drag and drop of words in match the following exercises, re-arranging the sentences by dragging the words which are all built with web 2.0 principles and the ability to records their speech, taking pictures of the scenarios they desire, capturing video and sharing it with their peers enthuses them to spend their time with the MALL application. The push notification features which is the essential component of this application and our discussion epitomizes the success of employing MALL applications to enhance the learning interest and experience of the EFL and ESL students. The push notifications which gives the instant notifications to the students on their mobile devices, irrespective of whether they are using the MALL app on-line or off-line mode, as soon as the new learning content uploaded by the instructor, the test results and evaluation feedback from them, the messages, audio, video, blogs and forum discussion topics exchanged by their peers takes their learning experience beyond the content of the MALL. The objectives of attaining effective learning is realized only when the learner does the active role as opined by the constructivist theory. This mobile learning application was built on this intuitive approach.

CONCLUSION

The main goal of this paper is based on the research work of designing and developing an M-learning framework which supports the ubiquity principle of learning anytime, anywhere and through any device. The framework is built on the robust principle of service oriented open-architecture based on web services and to support pedagogical, technological and usability perspectives. The mobile enabled learning helps to build the platform on learner-centric approach and just-in-time learning environment. The mobile assisted language learning applications (MALL) or mobile enabled language learning (MELL) coined by Palalas (2011) implemented on this framework which is built on with Push Notifications enhances the learning experience of the EFL students by minimizing their effort in searching for the updated content, feedback and messages uploaded by the instructor and other users. The 'Push' model motivates the intuitive designing of the MALL
application where the learner is being instantly notified of new learning content, new exercises, feedback, test evaluation reports, instant messaging by their fellow learners. The empirical research survey findings based on the questionnaire administered to the participants, who have been asked to evaluate the MALL application learning experience built with Push Notification features, elicits the success of the initiatives taken to address the challenges aforementioned in the design of communication suggested by Traxler (2007). This 'Push' notification model saves the battery usage of the device, data accessing costs in terms of mobile network, minimized the 'Pull' effort of the learner and ultimately enhances the learning experience, improved learning with rich collaborative facilitation.

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