INTEGRATING JAVA CODING INTO PROJECT BASED LEARNING IN M-LEARNING ENVIRONMENT

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ABSTRACT

The widespread use of mobile phones among students supposes possibility to develop mobile learning tools. This paper discusses the design and development of a mobile courseware using project-based learning approach. The aim of designing the courseware is to study how feasible it is to adopt the learning pedagogies based on projects for mobile learning environments designed for technology and computing students. Java Programming is the basis of the case study, while the framework on which the courseware implements is M-Learning. PBL environment is used for depicting mobile learning's learning objects delivery and design.

Keywords: *Learning based on Projects, M-Learning, M-Learning Framework, Java Programming*,

1.0 INTRODUCTION

The revolutionizing of mobile computing resulted in placing of computing into people's pockets instead of their offices throughout the globe, and we expect to see the same rate of growth to continue [Rebelsky and Flynt, 2000]. While growing up with mobile phones, students finds it easy to accept the transitions to smart phone. They are enthusiastic in mastering the applications and user interfaces of smart phones, and thus it is natural for anyone interested in programming to be happy to learn and master any programming language using smart mobile phones. Harnessing this enthusiasm, we hereby present course designed for learning of Java Programing for the sophomores using the mobile learning. Through this we foresee potential improvement in the learning of topics related to core computing along with improving the students' preparedness for the professional market for jobs ahead.

Through the course offered in the study, we aim to teach the newly enrolled FCIT (Faculty of Computing and Information Technology) students Java language using Project-Based Learning (PBL) methodology in m-learning environment. We presume that the paper would accrue benefits in three ways. First, it presents a course that teaches Java using m-learning, secondly we have tried to integrate it with project-based learning and lastly we have discussed the architecture for imparting this course in m-learning environment.

2.0 PROJECT-BASED LEARNING

The pedagogy of PBL is learner-centered and is commonly acknowledged to be a learning methodology that is effective on the basis of the present day learning concepts of situated learning, social constructivism & constructivism, and is known to bring improvement in the learner's metacognition knowledge. PBL aims to actuate profound learning through permitting learners to utilize a method of exploration to deal with subjects and problems which are plentiful, real and related to the issue being surveyed. It is planned to be utilized towards complicated topics that need learners to explore so as to comprehend [Baron, 1998]. Collaboration in PBL mentions the execution of operating in accordance with usually corresponded targets and probable manners, substitute for operating individually in contest. There are various methods in PBL which vary in number of group students, project period, and in the mode the members collaborate [Mikko, et al, 2011]. In summary, several advantages of PBL are included in the previous researches, for example, the probability of raising motive, linking learning with actuality, or enhancing problem-solving and teamwork, among others [Ruth, 2011].

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 A true PBL challenges students to acquire deeper knowledge of a concept by establishing connections outside their classroom [Chang, et al, 2011]. According to the research on PBL [Thomas, 2000], the main tenets are to:

- create real world connections,
- develop critical thinking skills,
- foster structured collaboration,
- motivate student driven work, and
- enable a multifaceted approach,

It is important to consider the potential of applying the challenges of coding to the proven successful tenets of PBL. Similarly, coding applies all of these core tenets of PBL as programs require logical thinking, team work, a variety of tools, and – most importantly – perseverance on the part of the student. Problems, which are in alignment to the objectives of the course, about real life & complex situations are presented to the students. It leads to enhancement of thinking process at expert level, analytic thinking, collaborative & communicative and problem-solving skills of the students [Esko, et al, 2005].

Project based learning begins with an inquiry into a real-world problem. Problems are not meant for testing the skills, rather they are aimed at assisting the development of the very skills being utilized in solving the problem. The problems presented have minimal information and are ill-structured. It takes many iterations to gather information, perceive the problem and develop the solution. Research into the authentic problem involves going beyond the textbook, and involves activities such as interviews, web searches, and discussion with peer groups. Learning often takes place in collaborative groups, where students build a sense of community, with coaches and teachers acting just as mere facilitators who provide guidelines on how to possibly approach the problem only. While the assessment is performance based and authentic [ChanLin, 2008].

3.0 RELATED WORKS

Project based learning promotes analytical thinking of students leading to solution of real life problems [Esko, et al, 2005]. In addition, the probability of raising motive, linking learning with actuality, or enhancing problem-solving and teamwork are other advantages of PBL [Ruth, 2011]. Sensing the need of PBL in coding based problems, many researchers have proposed methods that combine various aspects of learning coding using PBL. The various methods suggested for integrating PBL in solving coding based problems vary in number of group of students, project duration, and in the mode the team members collaborate with each other [Mikko, et al, 2011].

The ever increasing trend of handset culture requires integration of PBL approach in the environment of mobile learning [Trifonova and Ronchetti, 2003]. This led to strong shift in paradigm of delivering and disseminating literature, course material, pedagogical content. Such education has brought about learning via smart mobile phones/devices. The m-learning transition from e-learning has been marked by many researchers [Sharma and Kitchens 2004; Evgeniya et al. 2005; Nyiri 2005] to make learning ubiquitous. Considering the choice of learners using smart phones for learning, Jumaat and Tasir (2013) proposed a framework for integrating PBL with m-learning in real life situation of higher educational institutions like universities and colleges. In this paper, we have proposed a framework for integrating PBL in teaching Java programming language in m-learning environment.

4.0 COURSE DESIGN

An introductory course on Java was prepared to teach CPCS-202 (Programming-I), which is mandatory requirement for all students enrolled in the Faculty of Computing and Information Technology (FCIT). This course helps students develop basic problem-solving skills using the Java programming language. The topics included are Algorithm, Flowchart, API, IDE, and JDK, Numerical Data, Primitive Data type, Short hand operators , Cast value of one type to another type, Selection statements, Switch statements, Break and Continue statements , Relational operators, Logical operators, Logical expressions, Boolean variable, Boolean expressions, Repetition statements, Nested loops, Methods, Pass arguments to a method, Method overloading, Method abstraction, use of methods in the math class, arrays, common array operations, methods with array arguments and return value, search and sort operations on array, etc.

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The courseware has been divided into six units. Each unit comprises of basic learning contents related to that unit, followed by various types of assessments like Fill in the blanks, True/False, MCQs, Predict the output, Short Questions, Small programming exercises and Creativity Problems. A graded sheet of real-world problems have been designed for the students to solve. Instructor's support and group interaction help the students in solving the problems. The instructor plays the role of facilitator who is responsible for enabling practice of self-questioning, encouraging the process of learning, being a mentor to learning, and helping to understand the problem via diagnosis of needs. Additionally, he also assesses the process and provides instructions, models inquiries, monitors the engagement and manages the workgroup for managing the process of learning.

In the PBL environments, learner enrolled for CPCS-202 is placed in a group of six, with a facilitator assigned to each group. The final aim of this courseware is to impart skill using which the students could assimilate his coding skill to solve a specific problem using Java. We start learning with providing the students the content related to the concerned unit of Java Programming course. The students are made to practice this content and self-assess the level of learning achieved by them through means of various assessments like tests and quizzes, etc. When confident of their learning process they are finally asked to solve the problem they were initially presented with.

The task is clearly presented to the student, who then attempts at solving the problem on an individual basis first before he goes ahead with discussing the approach and ideas with his peers in the group for finding the best possible solution to the issue. This leads to the learner taking ownership of the problem and presenting it in his perspective to the others. This way the student is faced with the challenge of realizing the complexity of the task that needs to be resolved so that the acquired learning is applied in conjunction to the cognitive skill of the student.

The role of the facilitator is challenging the thinking of the learner rather than systemizing or dictating that thinking. All kinds of LOs (Learning Objects) – instructional materials and learning resources are to be used by the learner as the source of their information. The materials are aimed at supporting the performance or inquiry of the learner rather than teaching them. Collaborative learning experiences are promoted by the structure of the groups in which the students work for solving the problem. The students are required to present (via a presentation) their approach on solving the problem and based on the learning outcome they are evaluated and provided feedback. The next section discusses the framework of mobile learning applications that is developed in order to implement this methodology.

5.0 M-LEARNING

The ever increasing penetration of smart mobile devices in everyday life of people coupled with rapid development of wireless infrastructure have resulted in transition of e-learning towards mobile learning (m-learning) [Trifonova and Ronchetti, 2003]. Real collaborative experiences are delivered along with facilitating a knowledge sharing interaction between learners & instructors through the smart mobile devices that help distribute educational content based on multimedia [Rebelsky and Flynt, 2000].

A paradigm shift is promoted to a learning process that is learner-centric instead of being teacher-centric due to the advancement in mobile technology. Student's active participation is to be ensured by the instructor through different collaborative activities such as social bookmarking and wikis, group activity by use of tools similar to blogs and discussions. The adoption and proliferation of mobile technology requires integration of PBL approach in the environment of mobile learning.

In the light of above developments, the proposed m-learning tool could have a potential to add-value on the existing learning system if it is leveraged properly and help in realizing the objectives of m-learning. In addition, learning of programming course can be made more exciting and learners are able to learn enjoyably and more effectively. This is anticipated to enhance their interest and performance.

The following characteristics were proposed by Herrington A., et.al in 2009 for amalgamating the learning environments of higher education with m-learning:

1. Relevance (Real World Situations): Authentic real world situations to use mobile learning environments.
2. Contexts: Mobile learning to be used in contexts/situations where the students are on the move.
3. Exploration: Time to be provided for exploring the mobile technology.

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4. Blending: Blending of non-mobile and mobile technologies to be done.
5. Whenever: Spontaneous using of the environment of mobile learning.
6. Wherever: Non Traditional environments of learning to be used for mobile learning.
7. Whomsoever: Collaborative and individual use of environment of mobile learning.
8. Affordable: Exploiting the possibility of making mobile technologies affordable.
9. Personalizing: Making the use of the mobile device of the learner.
10. Mediation: Knowledge construction to be mediated by mobile learning.
11. Produce & Use: Producing and consuming knowledge through the environment of mobile learning.

The next section discusses the proposed m-learning that utilizes the above-mentioned principles of design in its development [Zafar, 2012]. We would consider the real life situation of higher educational institutions like universities and colleges in integrating PBL with m-learning [Jumaat and Tasir 2013].

5.1 Overview of M-Learning Framework

The proposed m-learning framework is based on pedagogical, technological and usability perspectives. We propose to establish an open ended architecture to delivery and cross platform based learning environment both for mobile and PCs.

The proposed m-learning platform allows courseware delivery both in m-learning (online and offline) and e-learning methodology. It also has the provision to deliver course content and mixed variety of modules for wide variety of device delivery - like smart-phones, Tablets/iPads, PDAs, feature phones (with GSM-GPRS) and also for PCs and Desktops as e-learning courseware (Fig.1). The courses may be rendered over mobile devices both in online and offline mode with limited connectivity. In the limited connectivity environment the courses and their modules are delivered on the devices. The modules will be delivered for users to work with mobile devices with limited connectivity and their performance is captured and updated on first available connectivity scenario. The online delivery of courseware is delivered over browser based rendering of courseware where chunked and offline courses are delivered through mobile based classroom application designed with built in Offline Course Management Toolkit, User performance tracking, P2P connect, and online Sync of Device Data and Course Content (over Devices) on first found connectivity basis. As the proposed solution also provides facilities to compose and compile java programs using mobile phone, we integrate mobile applications (on Smart Phones) with Open Java IDEs for mobile level code composition and compilation and also integrate with cloud based Open IDEs for online learning environments for browser based delivery on mobiles and e-learning delivery over Internet on PCs and Desktops. A Peer-2-Peer compilation or Cloud based compilation is created for user with feature or low-end devices like Nokia S-40 and S-60 series for code compilation and running using peer devices or cloud based compilation environment.
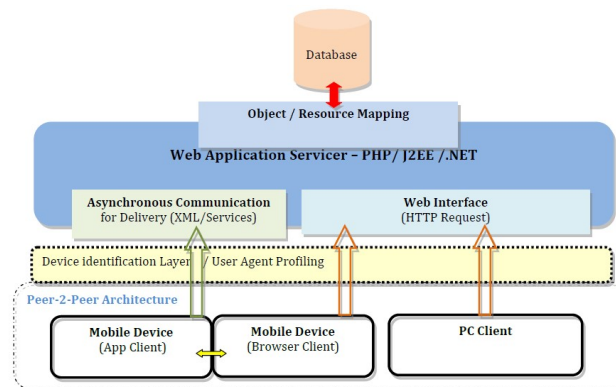

Fig. 1: System Architecture

The administrators have access to develop course content using variety of multimedia components like, Image objects, Video objects, Simulations, Animations, Info-Graphics and Texts. The learning objects are stored in learning objects repository managed by the *Learning Resource Management Module* of the platform. The Course

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can be developed by the Course Developers/Administrators using the *Course Authoring Module* of the platform. The learning objects of the platform will be made available for cross sharing on the LMS/CMS.

In our design of the *graphical user interface* (GUI), we took care of designing a system that is user-friendly and to be used by a variety of users. Hence the text to be proposed should not occupy the whole screen of the mobile handset. Moreover, the user should be able to view a learning object in the screen along with hyperlinks to other LOs and control keys with no (or minimum) scroll down. The Course is delivered both as *Asynchronous and Synchronous methods* over the air. For PC and browser based mobile delivery the GUI is designed as responsive design to fit the mobile screen and the content and the components of the courseware are delivered on runtime.

The mode of access is *HTTP connection* using WiFi /DSL/broadband. In Case of mobile devices with limited connectivity, the courseware is delivered asynchronously using *Socket Connection* over GPRS or 2G or 3G connectivity. Here the courses components are downloaded on mobile devices (SD-ROMs) and a local database is created to deliver content and capture usage and performance (Fig.2). The local database syncs with the server end database on first connectivity basis thereby updating the user tracker, user performance and related information.
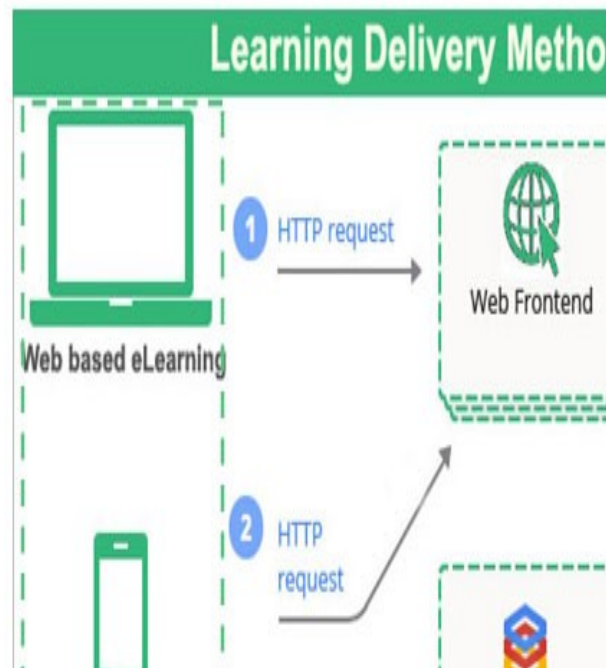

Fig. 2: Delivery Methods

As the m-learning platform is developed for students of FCIT in the classroom like environment, we proposed to establish two new components:

- **Peer-2-Peer Connect Ring Framework**: This framework is developed for the students to share content and information. This is designed like a social media component as information exchange within the students' networks. Here the students can share their Projects, LOs, and Test Performances and also use the P2P connect for communication.

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- **Code Compilation and Run Module**: As the platform is developed for students of programming and computer science, it is important that they are able to compile, run and test programming scripts. Also this layer will be available in 3 different modes for 4 different types of device access, namely Synchronous Web based for PCs, Synchronous Mobile based for Browser based learning, Asynchronous Mobile application Base Delivery, Asynchronous Low-resource Devices Code Compilation (Fig.3).

The 3 ways of integrating Code Compilers and Runners are:

- **Establishing Cloud based Open-IDE** for code compilation and running for web based and mobile browser-based users.

- **Integrating Open-Mobile IDEs** for code compilation, running and testing on the device. This is done by integrating the Mobile App with Open–IDEs for mobile like JM-Mobile and AIDE - Android Integrated Development Environment, Ada - Android Integrated Development Environment.

- **Peer-2-Peer Code Runner Method** – We propose special code compilation interface for low-end devices like S-40 and S-60 series and run the code on Peer-2-Peer network devices (type B or type A). Here the code will be sent to a peer device or to the cloud and response of the runner is received with output of the code snippets. This is done specially for low-end and low-resource devices which do not support possibilities of establishing code compilation IDEs at device level.
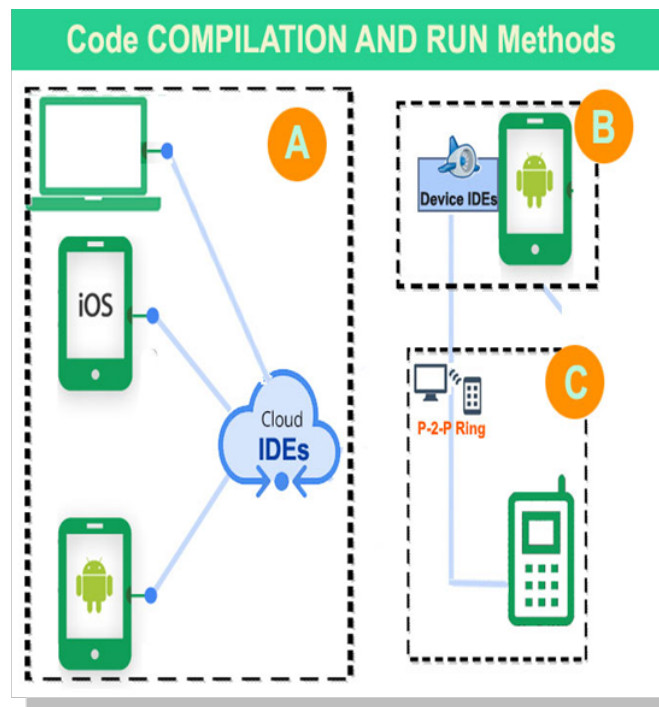

Fig. 3: Compilation and Run Module

The m-learning platform comprises of variety of backend and frontend tools. Backend Authoring, Content Management System and Administrative Modules is developed in PHP/ MySQL and using Jscript, Jason and XML technologies. The front end tool is developed using HTML5/ Java Script/ Jason and XML for universal App for large variety of mobile devices. The native m-learning application is developed for variety of mobile device delivery

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like using Java for android phones and Tabs, Java VC or C# application for Windows Mobile or Objective-C for iPhones and iPads, Java/J2ME for Low end Java devices.

6.0 CONCLUSION

This study proposes a method that combines aspects of learning java programming that attempts to solve real world problems using PBL in m-learning environment. Firstly, we have presented a course that teaches Java using m-learning. Secondly, we have tried to integrate it with project-based learning in such a way that the design conforms to the tenets of PBL. Lastly, we have discussed the architecture for imparting this course in PBL mode in m-learning environment.

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