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DEVELOPING EDUCATIONAL MATERIALS TO INSTRUCT IN THE JAVA PROGRAMMING LANGUAGE

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Abstract: This paper discusses the process of developing educational materials for instructing in the Java programming language. With the increasing demand for computer science education and the widespread adoption of Java as a foundational language, the need for effective teaching resources is paramount. The paper outlines various strategies and considerations for creating educational materials that cater to different learning styles and proficiency levels. It explores the importance of clarity, interactivity, and hands-on practice in engaging learners and promoting comprehension. Additionally, the paper discusses the integration of real-world examples, exercises, and assessments to reinforce learning objectives and foster practical skills.

Keywords: *Java programming language, educational materials, instructional design, computer science education, learning styles, interactivity, hands-on practice, real-world examples, exercises, assessments, pedagogical theories, learner engagement, instructional resources.*

INTRODUCTION:

The advent of mobile computing has transformed the accessibility of computing worldwide, moving it from offices to people's pockets [Rebelsky and Flynt, 2000]. This trend is expected to persist, with the rapid adoption of smartphones by students who grew up with mobile technology. These students eagerly embrace smartphone applications and interfaces, making them natural candidates for learning programming languages on mobile devices. Leveraging this enthusiasm, we introduce a course specifically designed for sophomores to learn Java Programming through mobile learning. We anticipate that this approach will not only enhance students'

understanding of core computing concepts but also better prepare them for future employment opportunities. By capitalizing on students' familiarity with mobile technology, we aim to foster a deeper engagement with programming and facilitate a smoother transition to the professional job market.

The study aims to instruct newly enrolled FCIT (Faculty of Computing and Information Technology) students in Java language via Project-Based Learning (PBL) methodology within a mobile learning (m-learning) framework. The paper anticipates three main advantages. Firstly, it introduces a course that educates on Java through m-learning. Secondly, it integrates this approach with project-based learning. Lastly, it outlines the architecture for delivering this course within an m-learning environment.

LEARNING. The increasing prevalence of smart mobile devices in daily life, alongside advancements in wireless infrastructure, has led to a shift from e-learning to mobile learning (m-learning) [Trifonova and Ronchetti, 2003]. Through smart mobile devices, m-learning enables real collaborative experiences and facilitates knowledge sharing between learners and instructors through multimedia-based educational content distribution [Rebelsky and Flynt, 2000].

This transition promotes a learner-centric approach to education, diverging from the traditional teacher-centric model, thanks to the advancements in mobile technology. Instructors aim to ensure active student participation through various collaborative activities, including social bookmarking, wikis, and group activities utilizing tools like blogs and discussions.

The integration of a Project-Based Learning (PBL) approach is essential in the mobile learning environment to accommodate the widespread adoption of mobile technology.

Given these advancements, the proposed m-learning tool has the potential to enhance the current learning system if effectively leveraged, aligning with the objectives of m-learning. Moreover, integrating programming courses into this environment can make learning more engaging and effective for learners, potentially increasing their interest and performanceThe 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.
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].

Learning Framework

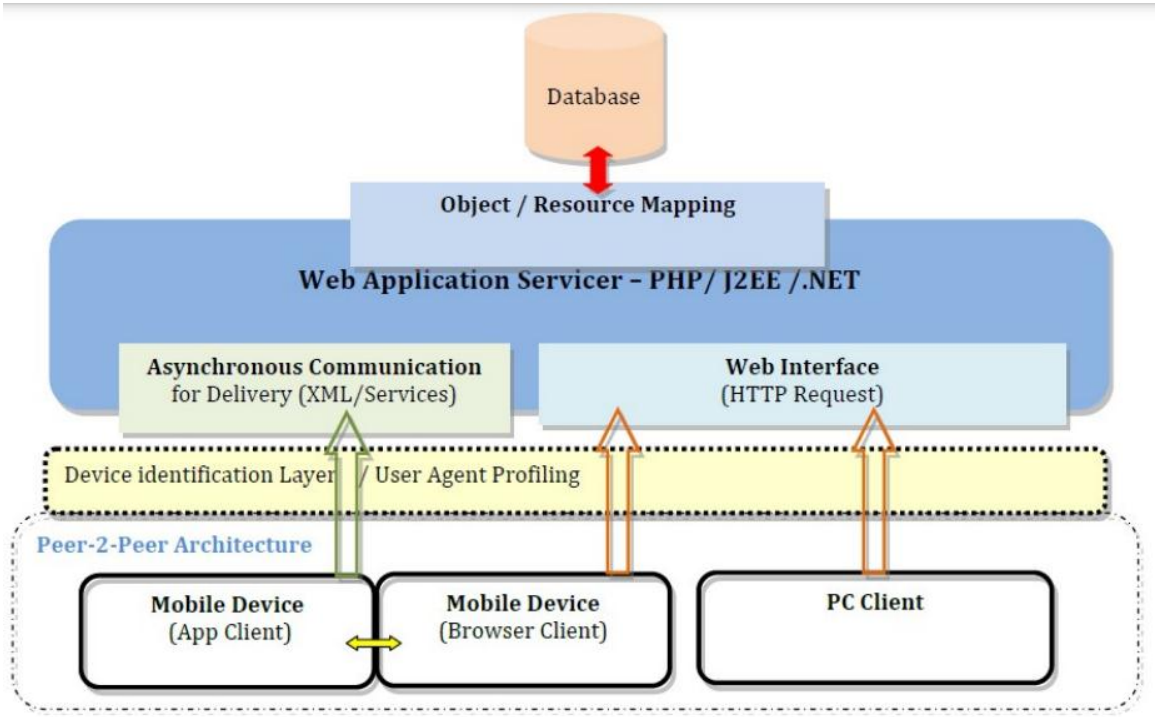
The proposed m-learning framework encompasses pedagogical, technological, and usability considerations, advocating for an open-ended architecture to deliver cross-platform learning experiences for both mobile devices and PCs.

This m-learning platform facilitates courseware delivery in both m-learning (online and offline) and e-learning methodologies, catering to a wide range of devices including smartphones, tablets/iPads, PDAs, feature phones (with GSM-GPRS), PCs, and desktops (Fig.1). Courses can be accessed online or offline with limited connectivity, with modules delivered directly to devices for offline use. User performance is tracked and updated once connectivity is restored.

Online courseware delivery utilizes browser-based rendering, while offline courses are managed through a mobile-based classroom application equipped with an Offline Course Management Toolkit, User performance tracking, P2P connect, and online sync of Device Data and Course Content upon connectivity restoration.

Additionally, the framework enables Java program composition and compilation on mobile devices through integration with Open Java IDEs, both locally on smartphones and via cloud-based IDEs for online learning environments accessible on mobiles, PCs, and desktops. For users with feature or low-end devices like Nokia S-40 and S-60 series, a Peer-2-Peer or Cloud-based compilation system is implemented for code compilation and execution, leveraging peer devices or cloud resources.

Overall, this comprehensive framework facilitates seamless and flexible learning experiences across various devices, catering to different connectivity scenarios and device capabilities.

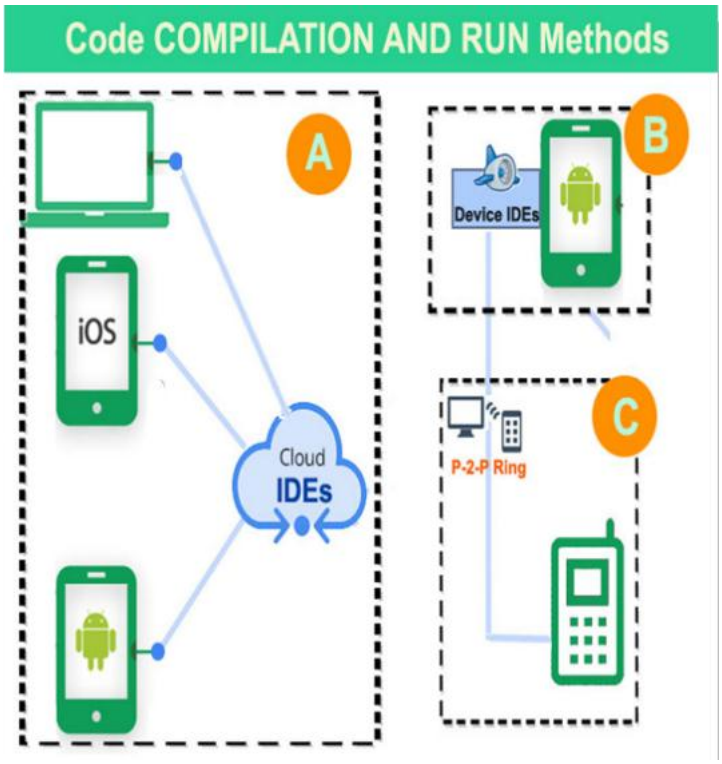


Administrators can create course content using a range of multimedia components such as images, videos, simulations, animations, infographics, and text. These learning objects are stored in a repository managed by the Learning Resource Management Module of the platform. Course Developers/Administrators can use the Course Authoring Module to develop courses. The learning objects within the platform are accessible for sharing across Learning Management Systems (LMS) and Content Management Systems (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.

In designing the graphical user interface (GUI), we prioritized user-friendliness for a diverse range of users. Text should not overwhelm the mobile screen, allowing users to view learning objects alongside hyperlinks to other objects and control keys without excessive scrolling. The course is delivered asynchronously and synchronously over the air. For PC and browser-based mobile delivery, the GUI utilizes responsive design to adapt to mobile screens, delivering course content and components dynamically at runtime.

Access is via HTTP connection, utilizing WiFi, DSL, or broadband. For mobile devices with limited connectivity, courseware is delivered asynchronously using Socket Connection over GPRS, 2G, or 3G. Course components are downloaded to mobile devices (SD-ROMs), establishing a local database for content delivery and performance tracking (Fig.2). The local database synchronizes with the server-end database upon first connectivity, updating user tracking, performance metrics, and related information.



The m-learning platform consists of a range of backend and frontend tools. Backend functionalities, including Authoring, Content Management System, and Administrative Modules, are developed using PHP/MySQL, along with Jscript, JSON, and XML technologies. On the frontend, the tool is built using HTML5, Java Script, JSON, and XML to create a universal app compatible with a wide range of mobile devices.

For native mobile application development, various technologies are employed to cater to different device ecosystems. Java is used for Android phones and tablets, while Java VC or C#

applications are utilized for Windows Mobile devices. Objective-C is chosen for iPhones and iPads, and Java/J2ME is employed for low-end Java devices. This diverse approach ensures compatibility and optimized performance across various mobile platforms..

Conclusion. This research introduces an approach merging elements of learning Java programming with problem-solving in real-world scenarios through Project-Based Learning (PBL) within an m-learning setting. Firstly, our study outlines a course structured to educate on Java programming via m-learning. Secondly, we endeavor to blend this approach with project-based learning principles, ensuring alignment with PBL guidelines. Lastly, we explore the framework for implementing this course in PBL mode within an m-learning environment.

The proposed method represents a novel integration of educational strategies, leveraging the benefits of both m-learning and PBL to enhance students' understanding and application of Java programming. By incorporating real-world problem-solving tasks into the curriculum, learners are not only exposed to theoretical concepts but also challenged to apply their knowledge in practical contexts, fostering deeper comprehension and skill development.

The course design emphasizes active engagement and collaboration, mirroring real-world scenarios where programmers often work in teams to tackle complex challenges. Through project-based learning activities, students have the opportunity to develop critical thinking, problem-solving, and teamwork skills, essential for success in the field of software development.

Furthermore, the architecture discussed in this study outlines the framework for effectively delivering the course content in PBL mode within an m-learning environment. This includes considerations for technological infrastructure, instructional design, assessment strategies, and support mechanisms to facilitate a seamless learning experience for students.

Overall, this method offers a comprehensive approach to teaching Java programming, enriching the learning process by integrating m-learning and PBL methodologies to prepare students for the demands of the modern computing industry.

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