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Research Article

Mobile Learning System for Egyptian Higher Education Using Agile-Based Approach

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Nowadays, due to easiness and expansion in property of smart mobile devices, it is becoming inevitable for mobile applications to have an important role in higher education systems. The Egyptian public universities are facing the problem of students' large number enrolled in each year. Thus, we lack proper communication between educators and learners. Mobile learning can solve that problem, and it enables adjustment of the curriculum to meet students' learning time and life situations. It provides different solutions better than traditional educational methods. Students and professors could exchange educational material or information even if they are not in the same class. Furthermore, the cost of universities' materials reduced, as all course materials can be found online through mobile applications. This paper proposes a mobile learning system named "Easy-Edu." The proposed system intended to make the learning process easier, focus on students' needs, and encourage communication and collaboration between students and professors and supports collaborative scenario-based learning for university students. Unlike other traditional systems, the proposed "Easy-Edu" was built using an Agile-based approach that delivers sustainable and high-quality mobile learning system. In addition, it eliminates the chances of absolute system failure and detects and fixes issues faster. Summarily, everything related to the design and implementation of "Easy-Edu" is discussed.

1. Introduction

Higher education plays a major role in the economic development of society. Egypt's public universities and educational institutes received around 2230314 million enrolled students, in the academic year of 2017-2018 according to the Egyptian Central Agency for Public Mobilization and Statistics [1]. Such problem caused a lack of communication, interaction, and direct engagement between educators and learners. It is hard for educators to pay attention to hundreds of students and students who cannot ask questions or give feedback in the lecture time. Therefore, mobile learning is now a new trend in such education. Because of its expansion and ease of use everywhere, the network provides quick access to different fields of interest. Because of the resilience of mobile learning applications, universities and institutions are trying to develop different mobile learning solutions to support their different courses [2, 3]. Mobile learning improves students' interest and motivation in learning new courses. In addition, it is able to make a pedagogical shift from classroom-based learning to collaborative and constructivist learning [4]. Besides, mobile devices and wireless networks technologies are improving continuously with time. The evolution of these technologies helped e-learning to extend to mobile learning [5].

The Agile model was used to build a new mobile learning system "Easy-Edu" that will be used in Egyptian higher education. Using the Agile model in building the mobile learning system can ensure that the system is reliable, sustainable, and of high-quality. It can enhance the user interface (UI) design and the user experience (UX), increase the sustainability of system usage, create an opportunity to continually reprioritize, and refine the system features to suit students' needs. In addition, it eliminates any chances of system failure, test, and fixes issues.

The major challenge that motivated us to develop "Easy-Edu" system is a lack of communication between educators and learners because of the large number of students in the classes. The huge number of students has caused different problems such as weaker contacts between students and educators, insufficient management of learning curriculums, lack of motivation to learn new subjects, and restricted opportunities for students' feedback.

Our research has contributed to the mobile learning in higher education; the system helps students to study courses' materials and solve problems that are aligned with the course objectives. This enhances their problem-solving skills, collaborative and communicative skills, and analytic thinking process. In addition, the system takes into account the learners' intelligence by moving the learners from lower level to a higher level while solving the questions to adapt to their knowledge. The learners can share different ideas and questions with each other using group discussion module, suggest the problem solutions, and collaborate with each other. Also, they can participate in the educational process by sending their questions to the professor to be added to the questions bank, and then the professor adds four different answers to the question to be used in the exams. The professor's role is to mentor the learning, enable the self-questioning practices, manage the learning process, monitor the engagement, and provide instructions and important announcements.

The Easy-Edu application is intended to support educators and students in large populated classes, to ease using mobile devices in the learning of university courses.

The purpose of this paper is to discuss the design and implementation of Easy-Edu mobile learning system. We are going to pursue this goal by answering the following research questions:

(1) How to make the students participate in the educational process and exam development?

(2) How to make the educators communicate with the students and vice versa?

(3) How to change questions' level in the test and adapt according to the learners' intelligence?

(4) How to make students ask questions easily and collaborate with each other?

The rest of the paper is organized as follows: Section 2 presents the current state of mobile learning, mobile learning, collaborative learning, scenario-based learning, and mobile learning solutions for higher education from the literature review. Then, Section 3 explains the proposed system, design and development, Agile information system, and using the Agile approach in developing Easy-Edu as well as in the implementation of the system. Section 4 presents Easy-Edu capabilities against other systems, while Section 5 shows the potential impact and the preliminary results of Easy-Edu system. Lastly, the final conclusion and future work are presented in Section 6.

2. The Current State of Mobile Learning

2.1. Mobile Learning. Mobile learning, or M-learning, can be any educational interaction delivered through mobile technology. Early definitions saw that mobile learning is simply using hand-held devices to support learning [6]. Other mobile learning definitions have been reported by former researchers [7]. M-learning can be defined as the application installed on the mobile devices to check different types of learning resources, communicate, share learning experiences with other students, and collaborate together in solving problems. Mobile learning is not about using mobile devices to support learning only, but it also includes all the actions that could happen between educators, students, environments, theories of learning, anyone, anywhere, and anytime learning [8]. The core benefits of learning using mobile devices are that it allows students to be in a suitable place at a suitable time, so they can gain experience in an authentic learning environment, wherever that is. M-learning is identified by three elements that are all important to the educators and students: *(1) Convenience and usability. (2) Expediency and efficacy. (3) Immediacy.* More details can be found in [9].

2.2. Collaborative Learning. Collaborative learning is a type of learning where two or more students learn something together [10, 11]; unlike individual learning, students work together in collaborative learning depending on one another's skills and resources (asking one another for information, monitoring one another's work, evaluating each other's ideas, etc.) [12, 13]. Specifically, collaborative learning is based on the idea that knowledge can be created within a large number of individuals where members interact actively by sharing experiences and ideas [14]. Collaborative learning refers to environments and methodologies in which students engage together in a common task. Discussion boards can be an example of collaborative learning because students are forced to read other answers and opinions and respond carefully. Through the back-and-forth engagement and interaction with each other, they can expand their personal knowledge and share points-of-view, insights, and perspectives.

2.3. Scenario-Based Learning. Scenario-based learning blends e-learning and problem-based learning together. Knowledge cannot be developed and understood completely especially in courses that need practical applications [15]. It allows students to imagine themselves in realistic situations requiring them to apply and develop their knowledge and problem-solving skills. Good scenarios can help students imagine the practical applications of knowledge and concepts they have studied. The focus is on the student exploring many ways to find a solution and try to learn from their own mistakes. Scenario-based learning places students at the center of the learning environment. Students can get in many different activities in the scenario [16]. This allows them to understand the problems that they may face in the industry and real life. It gives students options to explore and imagine a realistic situation. Students can control their own learning process as they see the consequences of their decisions and choices when exploring the scenario.

2.4. Mobile Learning Solutions in Higher Education. Mobile learning solutions for higher education should support meaningful learning and provide motivation to students to study [17]. Leinonen et al. [18] found that mobile apps that are designed for learning are in short supply. A survey of M-learning trends in computer science education showed that M-learning can increase students' affective traits [19]. There are already different kinds of M-learning solutions including the commercial ones in higher education. Some examples from the literature were chosen to mention here as they are designed and developed by the researcher, for free, applied in higher education, and used in computer science, information technology, and engineering classes. These literature examples have inspired the work of "Easy-Edu" system. Mbogo et al. [20] proposed an android mobile learning application developed according to five-level scaffolding framework to support the learning of Java programming. This work was developed in the African context. They found that mobile learning as a new method could offer opportunities to minimize the difficulty faced in learning programming. However, the drawbacks are that it is an application for a specific programming language and do not support other programming languages. It does not support collaboration between learners, and it is considered as self-learning application. It lacks the communication between professors and students.

Boticki et al. [21] have developed an Android app to support sorting algorithms learning. They found that students are encouraged using mobile devices for learning. As another example, Wen and Zhang [22] implemented a microlecture system on mobile. The mobile system helps students to see videos and other microlecture resources. The idea was so encouraged and has many advantages. However, it lacks the collaboration activities between learners. Besides, there are no quizzes for students to test their skills after studying through the microlectures.

Moreira and Ferreira [23] developed an application to assist the teaching of requirement engineering using the Lucidchart application on mobile devices for UML systems modeling. Shanmugapriya and Tamilarasi [24] designed and developed mobile courseware for information and communications technology students using a problem-based learning approach. The course is designed to check the problem-based learning in a mobile learning environment. "RoboRun" mobile learning game was developed by Vinay et al. [25]. The platform allows touch input devices for coding and learning conditional programming and algorithm sequence ordering.

Prenner et al. [26] designed a mobile medium for the teaching of algorithms and data structure courses to students. This work created NetLuke, a visualization tool for interactive algorithms and data structures. The NetLuke assists in direct data input by the user, the loading of visualization samples, and dynamic animations. Potts et al. [27] proposed an M-learning application for iOS and Android operating systems. It is used in two electrical engineering courses at the University of Tennessee at Martin, ENG 231 Digital Logic and ENGR 361 Digital Signal Processing. This application is quiz-style and offers the user a multitouch interface to answer the relevant questions related to electric engineering courses.

The quizzes have a large range of covered topics, including digital logic gate analysis, discrete signal evolution, and digital filter design. After concluding each work, the score results are sent to the instructors via e-mail. Two evaluations using 18 students from both courses were conducted to measure its effect on them. The application should have integrated a discussion and collaboration module to make the learning process more attractive to the learners. Tamhane et al. [28] presented the design and development of mobile learning application on the Android platform using Java programming language to help students in computer courses at the Computer Engineering Department. The approach was to merge between multimedia concept and command language to create a new learning environment using the mobile learning application. The aim of the mobile learning application was to complement the traditional learning and e-learning systems.

Lim [29] presented the design and implementation of a mobile-based interactive teaching model with in-class and off-class components aided by Socrative online response system to improve the engagement of the students in a Malaysian university. Table 1 summarizes the research-based mobile learning systems from the literature and their limitations.

This could be a step to support learning but might not be completely continual and efficient considering a large number of students in Egyptian universities. However, the previous implementation and application of M-learning to various computer science courses have been successful; our solution would work on the issue of teaching large students in the classes, using collaborative scenario-based learning approach. It is important to design a new all-inclusive M-learning system built using a scientifically proven methodology like Agile.

3. The Proposed System

The main practical requirement for "Easy-Edu" system is the ability to support learning and engagement of a large number of learners at any time. One way to boost learners' engagement in mobile learning is to use mobile communication functions, such as discussion forums, announcements, notifications, and self-practice materials. All these functions are available on Easy-Edu, creating on-demand access to information. Easy-Edu system supports the uploading of lecture materials. Thus, Easy-Edu helps learners to access learning materials in different formats such as PDFs, e-books, and videos. View announcements, enter discussions forums, solve adaptive scenario-based quizzes, and receive notifications. Figure 1 shows the proposed framework which uses different web services. The framework focuses on providing collaborative scenario-based learning to the students. It is built upon educational, technological, and social aspects.

The proposed mobile learning framework consists of five components: (i) mobile devices (user infrastructure), (ii) mobile applications (which is installed on the mobile

Table 1: Summary of some of the research-based mobile learning systems.

Researchers	Year	App name	The Solution	Main limitations
Lim [29]	2017	N/A	Mobile-based interactive teaching model based on the Socrative online system.	Need implementation of peer discussion and assistance tools.
Moreira and Ferreira [23]	2016	N/A	iOS application that helps engineering students to learn UML.by adopting the Lucidchart application on mobile devices.	It is only for learning UML course. But will not help in other courses. No activates between students.
Wen and Zhang [22]	2015	N/A	The microlecture mobile learning system.	No collaboration between students and engagement with professors.
Tamhane et al. [28]	2015	N/A	Mobile learning application on Android to help computer engineering students in computer courses.	Need game based module and quizzes module.
Prenner et al. [26]	2014	NetLuke	"NetLuke" is a mobile environment teaching algorithms and data structures courses.	Does not support other courses. Need collaboration module between students. Need to be supported by popular platforms like android and iOS.
Vinay et al. [25]	2013	RoboRun	"RoboRun" mobile learning game.	Need to support collaboration activities and to support other platforms.
Boticki et al. [21]	2013	Sortko	"Sortko" Android-based application to help to master sorting algorithms by leveraging the existing body of knowledge dealing with the use of animation in teaching and learning.	Need to support other platforms like iOS and Windows phone.
Mbogo et al. [20]	2013	N/A	Android mobile learning application to help to learn to programme using the scaffolding technique.	Need to support other platforms to gain more audience. Should be possible to load a saved program in order to reuse it.
Shanmugapriya and Tamilarasi [24]	2013	N/A	Android mobile courseware for ICT students.	Need to support other platforms like iOS and Windows phone.

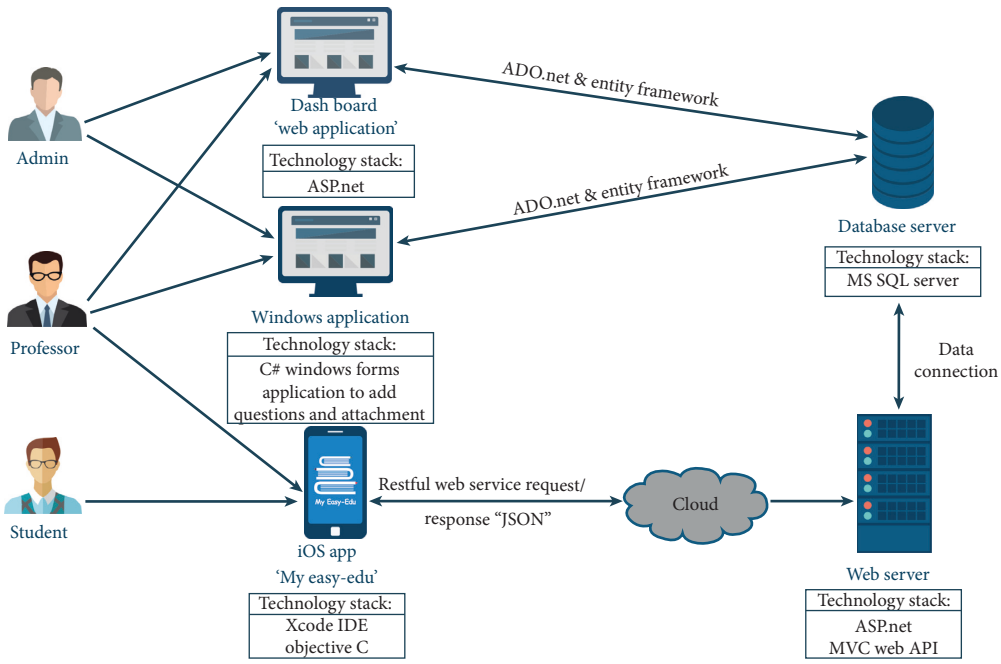

Figure 1: The proposed framework.

device), (iii) mobile middleware, (iv) wireless network infrastructure (4G/3G/Wi-Fi), and (v) back-end system "database server" and "web server" (hosting users database, courses database, material, questions database, and services).

User Infrastructure. The framework supports mobile devices like iPhones and iPads, in addition to PCs or laptops to access the web application system connected to the mobile learning system.

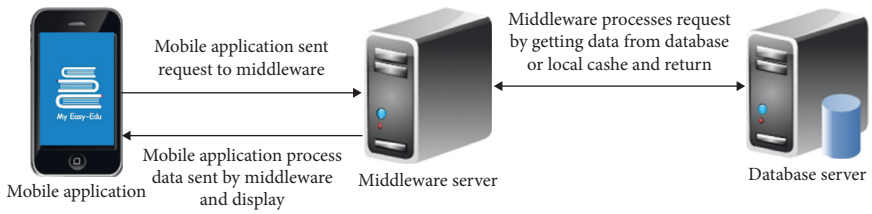

Figure 2: The middleware connection.

Mobile Application. The mobile application installed on the mobile device has an eye-catching and unique user interface for the learner to help in invoking the different services that are associated with the mobile learning scenario. The application is developed for the iOS platform. The application is developed to work on "online" mode and it is connected to the back-end server through the wireless network like Wi-Fi or through a mobile network like 3G/4G. The application is designed upon the modular structure and each module works with other modules in order to provide the required functionalities. The application is to support a wide variety of data like audio/video, e-books, PDFs files, and other file formats.

Mobile Middleware. The middleware is built with http://ASP.net and model view controller (MVC) web API for providing web services using JavaScript object notation (JSON). It accepts the request from the mobile client and translates this request as a web service to get the content from the back-end servers through Internet connections. The raw data that are collected from the back-end servers are formatted according to mobile device profile which requested it and then the formatted content is sent back to the mobile devices in a presentable manner to the mobile applications which invoked it, as shown in Figure 2.

Network Infrastructure. Mobile devices mostly use the wireless connection in a home network or in the university. The students send request from their mobile devices through the Wi-Fi connection. When the students are not at home or in the classroom, they can connect through 3G/4G mobile networks.

Back-End System. Back-end systems may integrate with other servers like authentication server, video server, mail server, or any other server which provides the requested data to the mobile users using the middleware as a service.

3.1. Design and Development. Easy-Edu utilizes a web and database server to share data and resources among all mobile devices as well as an administration subsystem where all activities for collaborative learning and scenario-based questions are carried out.

The physical structure of "Easy-Edu" consists of the learning center "mobile app," web application "dashboard," desktop application, and the server. The learning center is counted as the core of the proposed system as it represents the central unit that connects all system components. It is consisted of 4 main modules to achieve different functionalities as shown in Figure 3. *Content* supports various courses and all the materials such as PDFs, videos, and e-books. *Scenario-based questions* give access to different smart adaptive levels of questions in the shape of a quiz with a scenario. *Ask questions* supports collaborative discussion between students and professor; students can share ideas or questions where other students can answer and reply to each other. Professor can help them or choose the correct answer from students' replies and mark it, so other students know the right answer. Also, a student can raise a flag to the professor if they want to add their question to the question pool. This option can help in making students participate in the educational process and let them engage with professors in developing the exams. *Announcements* module provide updates on upcoming activities and events.

3.1.1. Agile Information Systems and Software Development. Agile information systems and software development (ISD) attracted the researchers because it is an approach that deals with changing and hardly controllable elements of ISD. Agile is based on an iterative and incremental approach. Instead of planning deeply at the beginning of the project, Agile methodologies are open to requirements changing and gets feedback from the end user and the stakeholders [30]. Each iteration's goal is to produce a prototype that works correctly.

Agile refers to any process that aligns with the concepts of the Agile Manifesto. 17 software developers met together to discuss methods of lightweight development, in 2001 [31]. Then, the Manifesto for Agile Software Development was published, which covered "better ways of software development by doing it and helping others do it."

Illustrated in Figure 4, the phases of the Agile development cycle which followed our proposed system are as follows [32]: (1) planning, (2) requirements analysis, (3) design, (4) implementation, coding, or development, (5) testing, and (6) deployment.

3.1.2. Using the Agile Approach in Developing Easy-Edu System. The Agile model was chosen as the appropriate approach for managing and building Easy-Edu system. Using the Agile model in building the mobile learning system guarantees delivering high-quality, reliable, and sustainable mobile learning system. Agile helps in improving the performance and features of the system. It also helps in eliminating the system failure, by the continuous testing and issues fixing.

Working with an Agile approach made it easy to respond to stakeholders' requirement changes. The requirements were not well-defined and were evolving continuously. There were many requirements and ideas that appear in every meeting with the

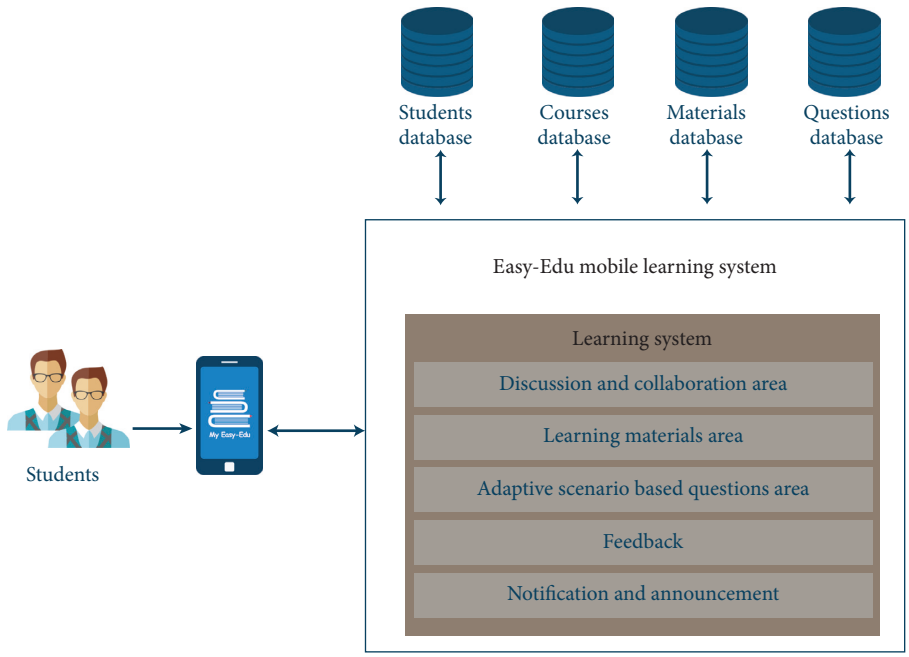

Figure 3: The structure and functions of Easy-Edu system.

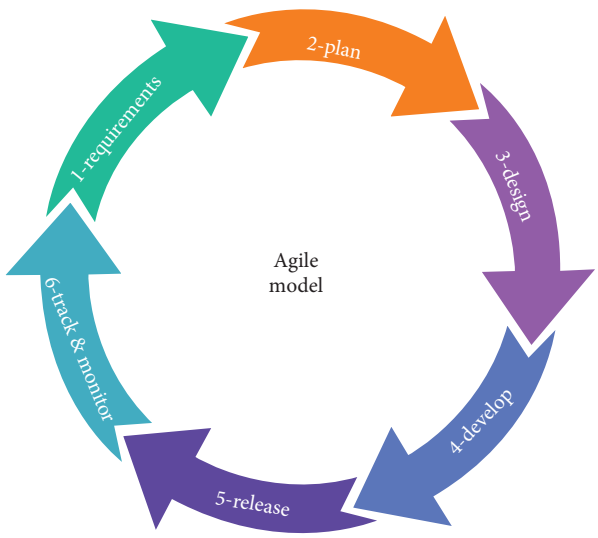

Figure 4: The Agile model.

stakeholders at the university. Agile depends on iterations; in each iteration, a prototype is built and tested [33]. It is proved in many studies that fixing a defect/issue found in final production stages is more expensive than fixing it when found in earlier stages of the project [34]. Thus, Agile approaches aim at fixing issues as early as possible when detected [35].

Scrum is an Agile framework that has been used in Easy-Edu system building, and it has been used widely for software project management as an Agile approach. By using Scrum, team members can deliver software to the customer faster. Transparency, focus, and energy will be added to the planning and implementation of the project [36].

Figure 5 shows implementing the Agile approach in Easy-Edu system and how the skilled functional teams work things out together; requirements are changing through the iterations. The fast feedback is very important to help the team to think about the outcomes and provide solutions. Testing allows continuous improvements in the releases of the deployable prototype.

3.2. Implementation of the Proposed System. Our iOS-based mobile learning system, as described in the framework section, consists of the clients, web application, desktop application, database, and the server. To ensure system portability, efficiency, and maintainability, each subsystem using different software technology is constructed. These subsystems were later connected using a dynamic link library. After developing the application, we ran it several times on the simulator and actual devices to confirm the functionality of the different units. Then, we installed the application on a real mobile device for debugging. The testing was done on iPhone 6 mobile phone. The system was implemented according to stakeholder's requirement specifications. Rigorous fine-tuning and iterative features of Agile were used. The first version of the app was developed for iOS operating system users. Easy-Edu app is released on Apple App Store. Obtaining Easy-Edu is free and requires registration by users.

Figures 6 and 7 show snapshots of the *home* screen in professor view and the student view. The Easy-Edu system administrator is responsible for setting up the courses and managing users. The professor, after signing up as a new user and securing authentication, can set his/her profile and select his/her course. Afterward, the professor through windows forms application can upload learning resources and also can add questions and answers to the questions pool which is used at scenario-based questions. Through the dashboard web application, the professor can write and send announcements, see student's grades in the quizzes, approve

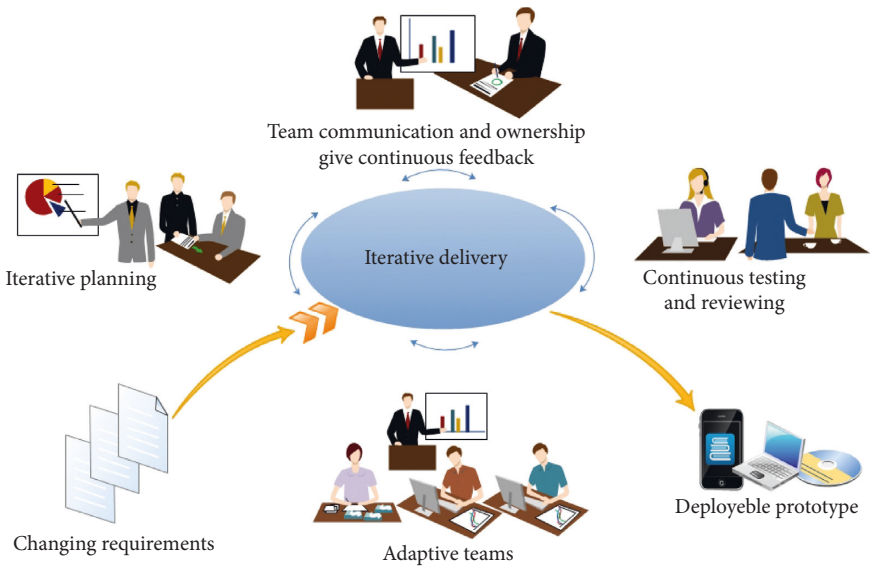

Figure 5: Implementing the Agile approach in Easy-Edu.

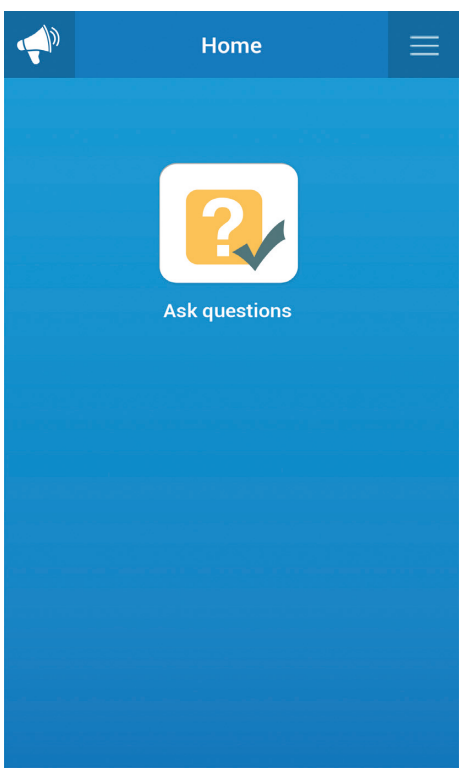

Figure 6: Home screen (professor view).

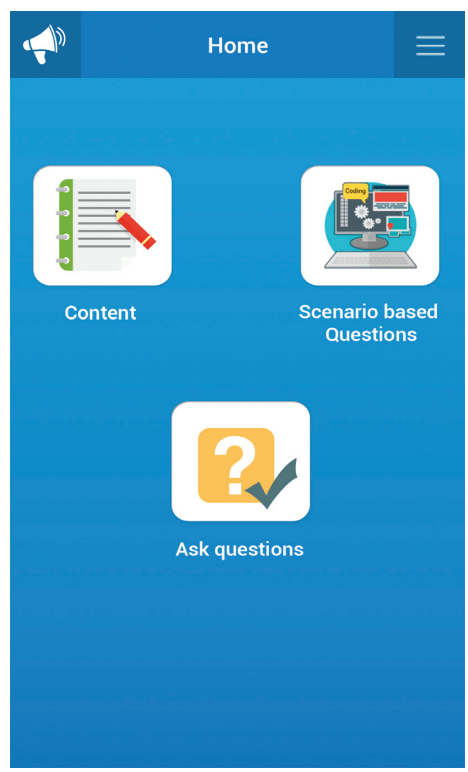

Figure 7: Home screen (student view).

questions from students to be added to the community, and read feedback messages from students. Through the mobile app "Easy-Edu," the professor is able to engage with the students by choosing correct answers of questions added to the community and also can see flags from students who want their questions to be added to the questions pool, and if the professor sees a new unique question, it can be added to the questions pool by adding 4 answers and sending it to the questions pool. Thus, that answers our first and second research questions.

The students would similarly need to obtain authentication and then access the mobile learning platform. Authentication is mandatory to protect the professor and student works, copyrights, privacy, and the identification of students [37]. Users are able to change their own password to log into the system.

Scenario-based questions module supports a student with two scenarios and each scenario with three different adaptive levels of difficulty. The first scenario: the student imagines that he/she finished the course and wants to test

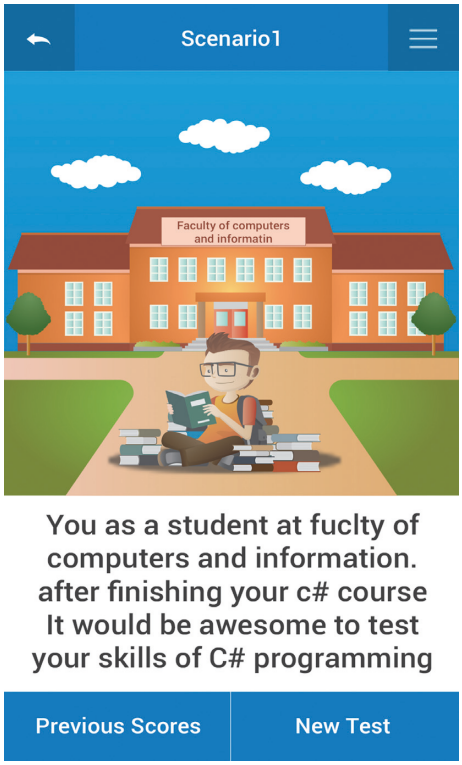

Figure 8: Scenario storytelling.

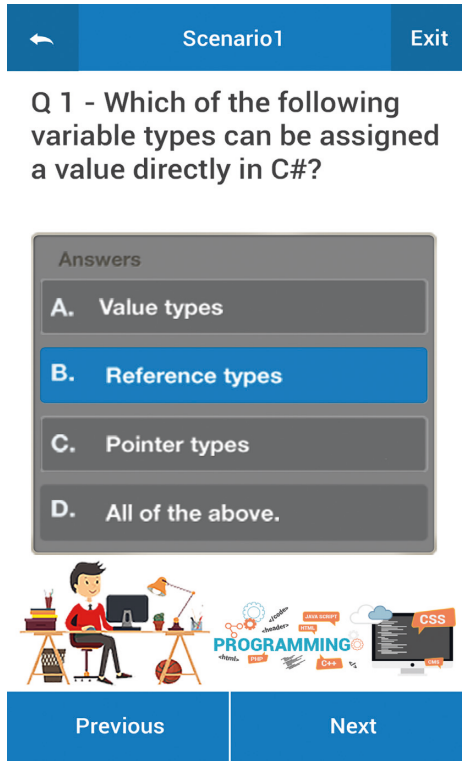

Figure 9: Multiple choice questions.

his/her own skills; the second scenario: the student imagines him/herself as a job seeker so he/she will go and answer interview questions to see if he/she can join a company. These scenarios help the student achieve better learning outcomes and place them in the learning environment center.

Figure 8 shows the screen of the first scenario storytelling so the student feels him/herself inside the scenario and answer the questions. As shown in Figure 9, the questions screen, the student answers the scenario questions for the level that was chosen. Each level consists of 10 multiple choice questions type which comes randomly from the questions pool.

The proposed system is adaptive enough to sense the students' skills. It could automatically transient students to higher levels once the student answers most questions correctly. In fact, adding this feature would be attractive to many motivated learners who may feel bored with low levels. Therefore, in our system, if the student correctly answered the first five questions and in that case, a pop-up message appears to the student and asks if he/she wants to go to the higher level or stay at the same level. Finally, results with percentage are shown to students with a human face that feels happy/sad according to their answers as shown in Figure 10. Also, he/she can check back the answers to learn from his/her mistakes in the future. Thus, this answers our third research question which is: *how to change questions' level in the test and adapt according to the learners' intelligence?*

Through *the Content* module, the students can choose the course and then see the professors' teaching materials,

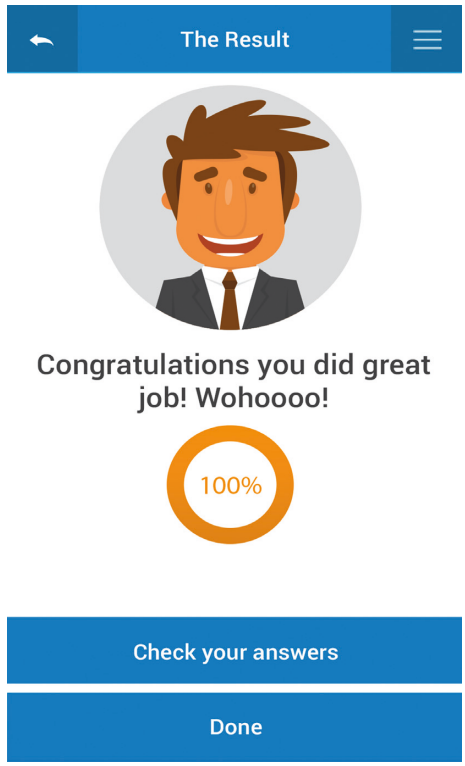

Figure 10: Results of the test.

such as PDFs, videos, and e-books. Students can access these materials on the go easily as shown in Figures 11–13, respectively. To answer the fourth research question on how

Figure 11: Different courses.

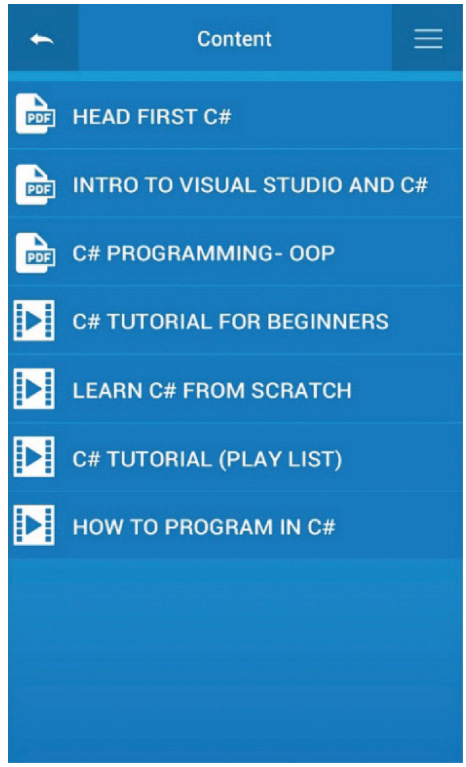

Figure 12: Course material.

students ask questions easily and collaborate with each other, *Ask Questions* module was made to support students' teamwork and collaboration, where each student can ask the question, other students can answer, and the professor interacts with them and check the correct answer and mark it as correct so the rest of students know the right answer. Students' questions cannot be added directly to the community; it needs professor's approval first. Professor receives and views the questions at the dashboard web application and then he/she has the right to add or discard a question when it is not an appropriate one. The *Announcement* module is to pass information about course activities, lecture time, and other news. The Easy-Edu system is an all-inclusive system that supports collaborative and blended learning for a large number of students.

4. Easy-Edu Capabilities against Other Systems

Mobile learning apps can be criticized by their availability, science content, and type. The availability of the mobile apps is explored through several factors, including the app developer, whether it was publicly accessible, and whether the platform recent or not. Mobile apps developed for older platforms, such as PDAs or hand-held/pocket PCs, are no longer being used by the general public. However, more recent platforms such as smartphones, tablets, and iPods are developed. Most apps are either directly included content for science learning or provided in a customizable template that was enriched with science content. Four broad categories of apps, including place-based data collection tools, games and/or simulations, learning management systems (LMS), and productivity tools are listed in Table 2. Table 2 presents the general characteristics and application features of a number of surveyed mobile apps compared with our proposed system.

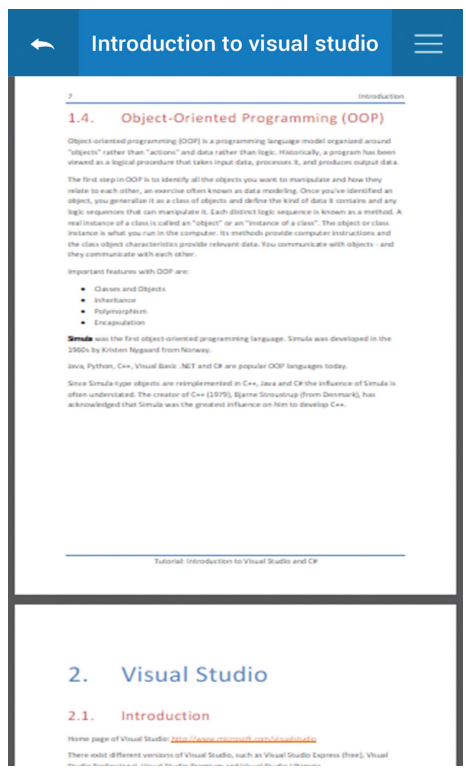

Figure 13: PDF book.

Table 2: General characteristics and features of mobile apps.

Researchers	Developed by researchers	Publicly accessible	Recent platform	App type	Offer learning content	Provide attractive UI	Discussion collaborative forum	Adaptive questions and quizzes	Professors involve with students	Notification and announcement	Checking previous scores	Send feedback to the professor	Has control panel
Lim [29]	✓	✗	✓	LMS	✓	✗	✗	✗	✓	✗	✗	✗	✗
Moreira and Ferreira [23]	✓	✓	✓	LMS	✓	✓	✗	✗	✗	✗	✗	✗	✗
Wen and Zhang [22]	✓	✗	✓	LMS	✗	✗	✗	✗	✗	✗	✗	✗	✗
Tamhane et al. [28]	✓	✓	✓	LMS	✓	✓	✗	✗	✗	✗	✗	✗	✗
Prenner et al. [26]	✓	✗	✗	S	✓	✗	✗	✗	✗	✗	✗	✗	✗
Vinay et al. [25]	✓	✗	✗	G	✗	✗	✗	✗	✗	✗	✓	✗	✗
Boticki et al. [21]	✓	✓	✓	Pr	✓	✓	✗	✗	✓	✗	✗	✗	✗
Mbogo et al. [20]	NS	✗	✓	LMS	✗	✗	✗	✗	✗	✗	✗	✗	✗
Shanmugapriya and Tamilarasi [24]	✓	✗	✓	LMS	✓	✗	✗	✗	✗	✗	✗	✗	✗
Proposed Easy-Edu	✓	✓	✓	LMS/ Pr	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note. S= simulation; G = game; LMS = learning management system; Pr = productivity; NS = not specified.

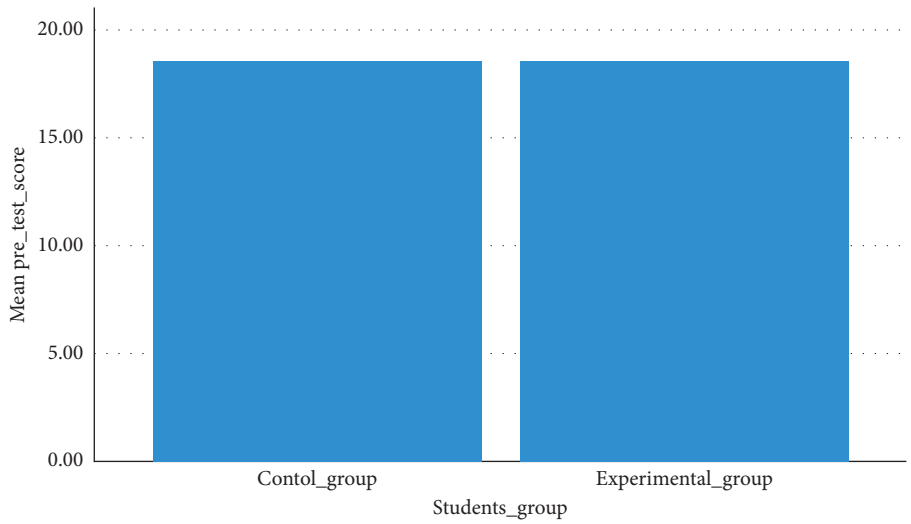

Figure 14: Pretest results.

These common features, which are considered important for mobile apps, either addressed a common issue with mobile learning, such as reducing potential cognitive overload, or took advantage of the affordability of mobile technology.

5. Potential Impact and Preliminary Results of the Proposed System

The proposed system is expected to help students communicate with each other and with their educators, make it easy to access the learning materials, help the students to participate in the exam development and the educational process, adapt to the learners' intelligence by changing the difficulty of questions in the quizzes, and collaborate in solving questions and problems through the discussion module.

To evaluate the impact of using the Easy-Edu, we conducted an experiment on students participating in the C# programming course at the Information Technology Institute (ITI), Mansoura University, Egypt. "Easy-Edu" was used as a technology tool for administering the course, supporting students' learning experience and engagement.

The participants of this study were 100 students taught by the same professor. After studying the basic knowledge of programming in a C# programming course, these participants were randomly assigned into two groups to participate separately in two different teaching methods. The participants of the experimental group used Easy-Edu mobile learning system and the control group depending on the traditional face-to-face learning. To check if there is an improvement in students' learning achievement after using Easy-Edu, first, the pre- and posttest data were analyzed. Pretest examined the level of basic knowledge about C# programming in each group by independent t-test; some preliminary results showed that the two groups are equivalent. The pretest mean and standard deviation for the experimental group were ($M = 18.5600$, SD = 1.76311) and the control group were ($M = 18.6000$, SD = 1.60357). There was no significant difference in the reported pretest results for students who are in the control group and the experimental group (T (98) = 0.119, $P = 0.906, P > 0.05$). This means that the two groups have the same level of knowledge at the beginning of the course, as shown in Figure 14.

From the posttest scores, we found that the experimental group's average learning performance and achievement are significantly better than students in the control group (the experimental group ($M = 48.1200$, SD = 1.66157); the control group ($M = 43.5600$, SD = 3.08492)). This shows that the use of Easy-Edu has helped to improve students' learning achievement (Figure 15).

The detailed study will be continued in the next research paper to describe the learning achievement, perceptions, and pedagogical experiences of learners using "Easy-Edu" system. Experimental data will be collected and analyzed from interviews and a questionnaire which will be given to the students.

6. Conclusion and Future Work

Developing multiobjective mobile learning applications is a big challenge. In this paper, a mobile learning application named "Easy-Edu" that would serve in Egyptian higher education has been presented. The development process of Easy-Edu system, an iOS version of the M-learning application, has been reported. It would be a solution to a large number of students in Egyptian universities. Based on Agile methodology, the first version of Easy-Edu app has been designed and implemented. Easy-Edu supports blended and collaborative learning with different functions that help learners to interact with course materials easily, effectively, and efficiently. This proposed system is evaluated by computer science students at the Information Technology Institute, Mansoura University.

To answer the first research question "How to make the students participate in the educational process and exam development?" students can ask questions in the

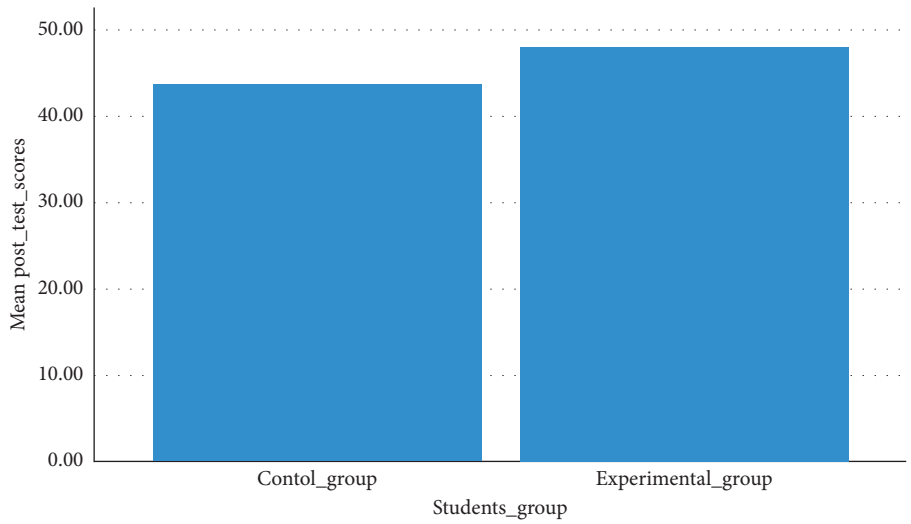

Figure 15: Posttest results.

discussion module and raise a flag so the professor can see the flags from students who want their questions to be added to the questions pool which the exam comes from. If the professor sees a unique question, he/she can add 4 different answers to that question and send it to the questions pool. That helps students participate in developing exam questions and to have that ability to share ideas with their educators.

To answer the second research question "How to make the educators communicate with the students and vice versa?" students can ask different questions in the discussion module while others can answer; professor's rule is to check the answers of the students and mark the correct answer with a right sign, so students can see which is the right answer. Also, students can send the professors a message with their feedback about the subject they are studying.

To answer the third research question "How to change questions' level in the test and adapt according to the learners' intelligence?" Easy-Edu is adaptive according to the students' skills. It could automatically move students from lower level to a higher level once the student answers most questions correctly. It is attractive to many motivated learners who may feel bored with low levels.

To answer the fourth research question "How to make students ask questions easily and collaborate with each other?" discussion module was made to support students' teamwork and collaboration, where each student can ask the question easily, other students can answer, and the professor can help them mark the correct answer, so the rest of students know the right answer.

Since the Agile process is based on iterations, the future work will include the improvement and refinement of the system. The future work will include improving the content of the system by adding more modules and other question types like fill in the blank or true/false questions. Additionally, the system will be cross-platform so it can work across multiple types of platforms/operating system environments such as Android and Windows phone.

Data Availability

The data supporting this research and that used to build the system are from previously reported studies and datasets, which have been cited.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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