The contribution of m-learning applications to improving the performance of training on the Moodle platform

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Abstract. *This paper presents a proposal for a mobile learning application called MySchool, which will be added to the e-learning platform Moodle and which contribute together with it to increase the efficiency of training on the platform.*

In the first part, analyzing the specialized studies, it was found that the main deficiencies reported in the case of e-learning platforms come mainly from the way the platform was designed and especially from the design of the training model when the beneficiaries and users are students in the pre-university course.

The paper proposes a mobile learning training system to be added to an existing e-learning platform in schools in Constanta County, Romania. The chosen platform was the Moodle platform which does not make such an application available to users.

The main features of the Moodle platform are further analyzed together with the didactic aspects of the application of the platform in the online training process of students. At the same time, the advantages of students who use mobile applications are presented, as well as the disadvantages of m-learning applications.

For the design of the proposed system, the ALDIE software design model was chosen together with the rapid prototyping method.

The functional and non-functional requirements of the MySchool system and its three-level architecture have been established (Fig. 7).

We also designed a learning network in a classroom with 25 students for the proposed system.

The conclusions of the paper highlight the usefulness and need for such a system attached to an e-learning platform.

Keywords: mobile learning, e-learning platform, m-learning system.

Introduction

New ITC technologies (Eadtu, 2015), (Eadtu, 2016), (Eadtu, 2017), related to the development of the Internet have revolutionized pedagogical methods leading to the emergence of e-learning. There are several forms of e-learning: 100% distance learning, blended learning, synchronous training (real-time platforms and virtual classroom systems), asynchronous training.

By the generic name of e-learning platforms (EC, 2019), a wide range of products are designated that support the learning process in different ways using electronic support. The advantages of e-learning systems are multiple such as: accessibility and mobility, flexibility (adapting the individual pace of students), adaptability (depending on the type of information transmitted, but also by the student), the use of various dynamic technologies, low costs, variety, organization by subjects, not by age, various pedagogical methods.

E-learning platforms were initially developed for different purposes. Some platforms are CMS (Content Management System) only with a focus on teaching or testing, others are LMS (Learning Management System) only, others are LCMS (Learning Content Management System).

Development of e-learning systems

In a sense, today's distance education (Batsila A., 2019) can be compared to early cinema. The first filmmakers made them as close as possible to the model of the plays - a static camera that was fixed on a stage. Over time, the directors realized that the camera could be moved, the scenes could be shot from different angles, and the time could be "solved" at the editing table.

The comparison applies and can be analyzed at all levels of material design and distance learning environment design. "Director-pedagogues" are beginning to exploit the potential of this type of training more and more profitably.

New digital technologies (Ermalai, 2010) and recent research in the field of visual design (visual design, screen design, eyetracking, etc.) significantly expand the scope of possibilities and hint at a future that leaves behind the "written history" distance learning.

Since 1970, research has shown that the quality of training is more important than communication in distance teaching and learning. This observation has shifted the focus of educators and researchers from the distribution of learning materials to the design of training programs and the design of teaching materials and the psychology of education.

Gradually, a theory was coined to support and direct educational practice, aimed at discovering the principles of effective learning according to printed material, audio or digital, supported by teacher-student interactions, in terms of developing independent study and distance collaboration. The communication environment will remain a support that is not unimportant, because it structures differently the teaching-learning process with a great importance on the development of effective educational situations.

Published comparative studies on students learning through IT technologies versus traditional classroom, on careful analysis, do not discriminate the type of training - mediated or face-to-face, but only if the training is well designed.

For distance learning, uploading support materials is an important function of the formative value of the educational message.

Moodle platform

The Moodle e-learning platform (Modular Object-Oriented Dynamic Learning Environment) is an open source software platform that allows the development of courses based on Internet connection, with very good security and administration systems and the development of which a large number of users participate. and developers (Moodle; 2020).

The platform was developed by Martin Dougiamas of Curtin University of Technology, and is currently used in universities, primary schools, non-profit organizations, private companies of teachers, but also by trainers and parents. It has been used in over 70 languages, including Romanian, integrating educational institutions into an international community with access to pedagogical and scientific experience. (Official Moodle Statistics, 2011).

Moodle is an e-learning platform focused on collaborative learning and includes several tools that facilitate this type of learning.

Conceptually, Moodle is a course management system that aims to help teachers develop online seams. The system is called a Virtual Learning Environment (VLE) or a Learning Management System (LMS). It is written in PHP and runs on Unix, Linux, Windows, MacOS X,

Netware platforms and is distributed under the GNU (General Public License), with customizable management functions for creating websites. The Moodle platform can use: MySQL and PostgreSQL databases which are the best supported, but it can also use Oracle, Access, Interbase, ODBC and others.

In addition to the basic features that are constantly being tested and improved, those interested can use the over 750 extensions developed by the Moodle community, with purposes ranging from different types of courses, to improved versions of the grade catalog, or to integration video conferencing systems. The open source nature allows anyone to use these software, as well as modify them according to the needs of each case.

Table 1. Moodle platform features

Evaluation	Grid tests, Questionnaires, Final evaluation
Resource planning	Efficient planning of resource (teachers, students, classrooms)
Creativity	Stimulating creativity and competition, individual and team work
Practical activities	Interactive lessons and virtual classroom utility
Database access,	Unlimited ,Free
Upgrading the operating system	Yes
Feedback	Waking Immediate feed-back and correlation of possible mistakes
Implemented lessons	Realization of portfolios, projects
Statistical reports	Yes

Romanian education is trying to distance itself from the classic teaching style, today's students being accessible and attractive modern teaching ways of working and focusing attention.

Moodle offers a new, modern paradigm adapted to current pedagogical principles that stimulate the creativity of students.

The EDU Moodle Romania network has been available since 2010 and turned 10 years old on November 25, 2020.

Analysis of the main didactic aspects of the application of the Moodle platform

Analyzing the Moodle platform in the teaching process I found the following:

- Moodle provides a training framework in the teaching-learning-assessment process;
- By using the Moodle platform, the time and space barriers between teacher and student are eliminated, thus ensuring the optimization of the learning process;
- Carrying out the educational activities through the Moodle platform represents a vision regarding the completion of the didactic approach that will inevitably contribute to the increase of the performances;
- The Moodle platform provides teachers with a set of teaching tools and resources that make it possible to teach-learn both online and offline.

Disadvantages:

There are no default materials. A unitary method of designing lessons is desired.

Design software model

The software model for such a system is the Client / Server model. This is a solution in which presentation, presentation logic, application logic, data manipulation, and data levels are distributed

between client computers and one or more servers. In the Client / Server model there are two other types of models known as Distributed Data (also called Two-Tier Architecture) and Multi-Tiered Architecture - Data and Application (called Three Tier Architecture Design or n-Tier Architecture Design).

Designing architecture on three levels means:

- Client level - This consists of the user interface and the data access levels for the system user. Access methods and graphic design are determined. The user accesses the system through the web browser.
- Application level - This level stores application logic, application security, and access methods. This level usually includes a web server (Apache, IIS and Tomcat) and the Application Logic Container (J2EE Container, PHP engine, ASP.net).
- Database level - This is probably the most critical aspect of the web application because it stores user data, operational data, and metadata for easy access and retrieval. At this level, the logic of the database and all the relationships between the entities will be defined. The three-tier architectural design includes the Apache web server, the MySQL database, and the PHP scripting engine.

In short, the client level consists of the operating system and its web browser; the application layer consists of the Apache web server and the PHP scripting engine, while MySQL is used to design the databases.

The conceptual model of an e-learning system is presented in Figure 1.

Figure 1. Conceptual model of an e-learning system (Picciano, 2017)

There are widely adopted standards that allow the description, assembly, delivery, and tracking of learning objects in a standardized way, regardless of the proposed shape, size, or purpose. A draft Learning Object Metadata (LOM) specification was developed by a group of researchers from several fields working together on the IEEE Learning Technology Standards Committee (LTSC, 2002).

The most widely used methodology for developing new training systems is called Instructional Systems Design (ISD). It is also known as Instructional Systems Design and Development (ISDD), Systems Approach to Training (SAT) or Instructional Design (ID).

One of the most widely used design models is the ADDIE model.

ADDIE model and rapid prototyping phase

There are over 100 different Instructional Systems Design (ISD) models, but almost all of them are based on the generic ADDIE model, which is Analysis, Design, Development, Implementation and Evaluation, as shown below. Each step has a result that feeds the next step.

Analysis -> Design -> Development-> Implementation -> Testing -> Evaluation (ADDIE).

For best results, a modified ADDIE model is used, adding aspects of the systemic approach. Specifically, a rapid prototype phase is inserted after, or as an extension of, the design phase. A rapid prototype is a fast assembled module that can be tested with the user at the beginning of the ISD process.

Determining learning objectives:

The first step in the design phase is to examine the requirements, tasks or subordinate objectives that have been listed in the analysis and from these a set of behavioral learning objectives is created. The appropriate learning objectives, specific and testable, can be written as the sentence: "After completing this course, students will be able to":

Five product characteristics are listed and an associated benefit is identified for each characteristic.

Outline: The accounts provide a lesson-by-lesson breakdown of topics, as well as a summary of the motivational strategies that will be used.

Practice activities indicated: The design document includes brief descriptions of simple query (multiple choice, true / false, or completion), simulations, instructional games, workplace application exercises, or situational analysis activities.

Technology and media: The design document officially identifies the available technology of the students, allowed in the organization.

The user interface and the creative treatment are determined: The graphical user interface is the critical link between the student and the content. The design document shows the buttons and navigation functions that will be available, what their labels or names will be, and where they will be placed on the screen.

Rapid prototyping for e-learning: At this stage of the project life cycle, an instructional software module is created for rapid testing on a sample of school audience. The rapid prototype creates an early iteration loop that provides valuable feedback on technical issues, creative treatment, and instructional effectiveness (Muller C., Stahl M., Alder M., Muller M-2018).

The design document itself is modified to reflect this feedback, and in some cases a new prototype is developed for further testing of refinements / iterations.

The value of a rapid prototype:

With the addition of the rapid prototype phase, the value of the ADDIE model for technology-based training is improved. The prototype goes beyond the traditional ADDIE approach in that it involves all team members earlier in the project cycle and allows both the teacher and students to provide early feedback. This early review process is essential for software development and can capture real errors as well as identify teacher preferences. A detailed design document and prototype are the best insurance policies against last minute changes.

MySchool software system

With the advent of m-learning, which is the philosophy of the four "O's" (anywhere-anytime-anytime-anything) of the information society, the "appetite" of the younger generation for these IT technologies has grown considerably.

There are many e-learning platforms in the world that offer or host mobile learning applications precisely to make training more flexible and more attractive. In the context of the COVID pandemic¹⁹, this approach has become almost mandatory.

The advantages of mobile learning

- Mobile devices with books, notes, etc. stored in electronic format are much easier to transport compared to printed materials on paper;
- Mobile devices can be used anywhere and anytime, anywhere, without being annoying;
- Gdgets allow recording and entering data externally, where desktop computers cannot be used;
- Students can interact with the teacher and with each other to carry out joint projects collaborating with each other. They can switch their device from one group to another, or "meet" virtually, using the PDA's Bluetooth feature, or a wireless network;
- If interactive multimedia, music, games and simulations are incorporated into teaching / learning materials, then the use of mobile devices can increase the attraction of students, making learning a fun activity;

Disadvantages of mobile learning

- There are no standards to unify the operation and presentation of the graphical interfaces of mobile devices and desktops. The different sizes of the screens and their resolutions pose major problems in the development of the content that will have to be available on all mobile devices;
- Mobile devices wear out very quickly;
- There are security issues with wireless access;
- In the case of a large number of users on wireless networks, the width of the communication band may degrade;
- Small screens limit the amount and type of information that can be displayed, especially on mobile phones or PDAs;
- Mobile devices have reduced storage capacity compared to desktop computers.

Advantages of students using portable devices:

1. Spontaneity – learning activities take place when the student feels ready, or can be used to fill "dead time";
2. Directness – learning becomes possible from the perspective of need, regardless of location.
3. Increasing access – learning resources can be accessed from the workplace, during travel, during classes and lectures;

Portability – communication with teachers and students, as well as capturing, storing and retrieving information in multimedia format, are possible from a device anywhere.

Due to the increasing use of mobile technologies in society by the younger generation, students will demand that course materials be delivered on mobile devices (tablets, mobile phones, smartphones) to be accessed from anywhere and anytime.

Mobile training must take into account the diversity of mobile devices that currently support m-learning platforms, currently available: iPhone, iPod Touch, and iPad (OS 4.x +) Android-based smartphones (OS 2.1 +).

In a definition given by O'Malley (2003) - Mobile Learning is “any way of learning, which the student uses when he is in a pre-established fixed position, or in a classroom, taking advantage of the opportunities offered by mobile learning technologies”, and the researcher Geddes (2004) added: “the acquisition of knowledge and skills through the use of mobile technologies, anywhere and anytime, which leads to behavior change”.

For a good regenerability of mobile applications, a hierarchical architecture of mobile applications based on modules is indicated, Figure 2.

Figure 2. Hierarchical structure of mobile learning applications

MySchool application requirements

The MySchool application I propose will be hosted by the Moodle platform and will have access to the platform's database. The user (student) will be able to download it to their mobile device.

The functional requirements of the system are as follows:

- Allow users to navigate through the app using tabs and screens;
- From each tab to allow the login, registration of a new account or recovery of the password by email in case of disconnection;
- To be able to share the application with friends through messages posted on Facebook and Twitter, but also by email;
- To be able to download teaching materials (video and text);
- To be notified (SMS or WhatsApp) when the teacher posts something.
- Data security.
- Data confidentiality.

Non-functional requirements

Non-functional requirements may be more critical than functional ones. If they are not met, the system may no longer be useful for the purpose for which it was developed.

- The performance of an application is reflected by the user's requirements. The proposed system will be quite fast for an application for mobile phones, the response time is short, which is why users will have a positive reaction in this regard. Problems can only occur with a bad internet connection, which can slow down the loading of data from the server. A standard internet connection allows an interactive running of the entire application, without waiting problems that irritate the user.
- Storage requirements. The system will have an acceptable size for an average phone in the range of those who use the Android operating system, falling below the size of 1Mb, so it will not create problems of occupying the internal space of the phone. However, if the device has an external

storage space, the user will be given the option to choose it to store the application, thus getting rid of the small inconvenience related to the size of the application.

- Reliability. Reliability is given by the probability that a software system will work without errors for a specified period of time, in a given environment. In this case the application will be relatively simple, tested in detail.
- Scalability. Scalability is the property of a system to successfully support its development as an application or increase the number of users. This application is organized in modules, which is why it can be scaled very easily by adding new modules and linking to existing ones.
- Usability. Usability is the ease with which a user can use the application. Even if it is a subjective measure, which depends on the type of user, this application can be used very easily by anyone who can use a mobile device. It will have a very interactive interface and a tabbed distribution with names suggestive of each other's features, which is why this application can be categorized as an application with a high degree of usability.
- Robustness. Robustness is represented by the probability of data corruption on error, as well as the restart time after the failure. In this case, in the worst case, when an error occurs, the application will give an untreated exception that will require its forced shutdown, but at the restart that will be done immediately everything will work in normal parameters. So robustness can also be seen as a quality of this application.

System architecture. This system is organized according to the Client-Server model. It is based on the division of tasks between the service provider called the server and the one who requested the services, namely the client. Communication between the two components is usually done through a communication network, but there are cases where this is not necessary, as both the server and the client will be located on the same system.

The client-server architecture uses smart terminals in that the processing is split between the two components, the client and the server.

The conceptual architecture of the application is presented in fig.3. Thus, the client (the mobile device that has the Android operating system installed) will connect to the server via the HTTP protocol. On the server side, PHP scripts will be used that will link to the MySQL database, and query a table.

Figure 3. The architecture of the MySchool system

It is noted that the system has two major components, namely: one is the platform and the other is the Android mobile component.

An application will run on the server through which the teacher-authenticated user will be able to add, modify or delete lessons, exercises, proposed problems, tests. He will also manage the students in his classes. In the case of a website, the architecture of the system will be the one in figure 4.

Figure 4. Website architecture in the MySchool system

The Android operating system comes with many requirements that produce complexity within the interface, in that it is a multi-processor system that supports multiple competing applications, supports multiple forms of data entry, is highly interactive and must be flexible enough to hold step with the growing number of devices in the field. Even though the interface is impressively rich and easy to use, it takes a lot of care to use it properly, without causing application failures and making it look inappropriate on some devices or causing system performance failures.

The Android development environment adds a new category of interfaces in the Java sphere, in addition to the established AWT, Swing or J2ME. It is a type of interface based on a single thread, oriented towards event management, built on a library of nested components.

The Android framework is organized around the Model-View-Controller architectural template (Figure 5). It provides the structure and tools for building the controller that handles user requests, such as pressing buttons or touching the screen, and a View that displays graphical information on the screen.

The controller is the core of the application. It makes the connection between the model and the view, between the user's actions and the decision part of the application. He also, depending on the area where the user is, calls the functions he needs.

Figure 5. Model-View-Controller architecture for Android

Design template for the MySchool system

The system we propose has 2 major components. One of them is the one developed on a mobile device with Android operating system, and the other on the server.

Thus, the client (the mobile device that has the Android operating system installed) will connect to the server via the HTTP protocol. On the server side, PHP scripts will be used that will link to the MySQL database, query a table (phone), and the result will be encoded in JSON language, which will eventually be decoded by the client and will be used further.

When designing content for mobile devices, there are a number of factors to consider:

1. Users expect an immediate answer on their mobile phone. Unlike e-learning platform that is accessed from a PC, users are not bothered by switching from one screen to another, with the possibility of uploading large media content, in m-learning are more likely to abandon mobile applications in when it takes more than five seconds to load such content. For example, for large content such as video images, the mobile device may allow users an option to download and view the content later, or lower the video resolution to download faster;
2. Too many functions can confuse the user. Most phone users mobile devices interact with their devices with one finger, or at most two, using both hands. It is therefore important to keep the design simple to operate by making the click area quite large;
3. Mobile phones are used frequently during the day, but only for periods short time in each case. This is in stark contrast to how most people use their PCs. The context design should be done in small "pieces" so that users can access them and easily go back to where they left off.

In general, mobile content falls into four main categories:

1. Information - organization and presentation of chronologies, dates, times and purpose;
2. Exploration - telling stories, inviting learning to explore further;
3. Collaboration - sharing and discussing concepts / ideas to reduce the gap between those with more knowledge / experience and newcomers;
4. Innovation - creating new experiences that lead to new points of view.

The proposed learning network for the MySchool system.

For the MySchool system, the learning network is illustrated in Figure 6. The number of relationships between users in a class with a number of 25 students will be $UT = 300$.

Figure 6. My School Learning Network

The modular conceptual solution of the MySchool system

The proposed system will be organized on three levels of access and will have 4 modules as shown in Figure 7:

Level 0

It will contain only the Main Mode - Authentication, which will allow the student access to the system.

Level 1

It will have two modules: the Student Module and the Lesson Module. The Student module will manage each student through the Android application that he will download on his own phone. He will also allow access to any of the lessons taught in his class, interact with the teacher and be able to access the discussion forum.

Figure 7. The modular conceptual architecture of the MySchool system

Level 2

It will only contain the Forum Module. The Forum module will have tasks according to its name and will be accessible to all users.

The software solution described above is version 0 (a prototype) and is not intended to be definitive, and may be subject to change and adaptation when implemented and tested.

Conclusions

M-learning technology requires a distance learning system, which should include access to training materials and services on various mobile devices, as well as the availability of web-access. The aim is to create flexible teaching solutions that will allow access to information with all kinds of devices, as well as to produce flexible material in a variety of situations. Mobile technology is just the beginning to take the first steps in teaching and learning.

M-learning must be perceived as a tool of learning activity. M-learning is a complementary form that enriches, and varies the conventional lessons or courses, which have emerged as a result of the evolution of technology and the change of our way of life and which has the role of helping us in the learning process through adaptable solutions. our time.

This paper contains the main directions and objectives that have been pursued in the research. The m-learning technology is presented in relation to e-learning and in detail the particularities of mobile learning systems. The advantages and disadvantages of such systems (contributions) have been identified.

The “Proposed Software System” section contains:

- The proposed software solution;
- General system architecture;
- The modular conceptual architecture of the MySchool system;
- MySchool learning network.

All this is an attempt to improve the facilities and efficiency of the Moodle platform for its use in the online training of pre-university students.

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