

Improvement of the quality of development process of E-learning and M-learning systems

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Abstract

Electronic Learning (E-learning) has become one of the most important axes in the development of any institution. The large demand of universities on a complete e-learning platform makes concurrence between developers of those systems. As a consequence, the improvement and development of these platforms become more challenging for both institutions and industry. In this paper, we propose a new method to improve the quality of an e-learning platform. This new methodology can be integrated in the process of development in both e-learning and m-learning systems. It is based on integration of Model Driven Architecture with quality methodologies and practices.

Keywords: E-learning, MDA, Development process, ADDIE model, Platform.

Introduction

Integration of Information and Communication Technologies (ICT) in learning has become paramount since both students and teachers are more familiarized with new technologies and mobile devices. This situation carries out us to think how to benefit from the large advantages of the integration of new technologies in the field of learning / teaching. However, needs of students and teachers of flexibility and the increase of internet users make the development and improvement of the quality of a learning platform in challenge. Consequently, the huge demand on adequate learning platforms is increasing year after year. To achieve this goal, learning using an e-learning platform must offer the same quality of learning as in ordinary class. This quality depends on different factors: human factors (resistance on use of e-learning platforms), content (of an e-learning course for example), and the flexibility and the quality of the learning system. In this article we are focused on the last factor, and we will propose a methodology to improve the quality of development of an e-learning system, based on MDA and application of XP quality approach. The proposed methodology can be applied on both e-learning and mobile learning systems.

From E-learning to M-learning

E-learning

Electronic Learning is the way of learning using electronic devices in order to diffuse the content via internet, CD-ROM,

radio, interactive TV, or satellite broadcast [1]. Using an e-learning system [2], users can share content by uploading / downloading files have a tool for synchronous and asynchronous communication. Management of a system users and content is done using a Learning Management System (LMS). It is a tool that simplifies the administration of learning/training programs within an organization [3]. Furthermore, LMS must be able to manage learners, deliver content, ensure synchronous and asynchronous connection, provide reports, etc. Regarding its significant role, LMS must offer a big flexibility and intuitiveness in use. Generally, we find LMS as a web based application. This characteristic helps users to have access to the LMS everywhere using devices connected to Internet for online LMSs, and without connection for offline ones.

M-learning

Many definitions have been given to m-learning in different communities; however, the characteristic of mobility is common between all these definitions.

According to [4], m-learning is learning that happens when using mobile devices regardless of location in time or space. [5] Defines m-learning as a kind of learning that happens when the learner is not bound to a fixed or predetermined location while taking advantage of mobile technologies for learning. [6] Requires in the process of m-learning the use of handheld devices for learning. [7] Introduced the concept of D-learning (distance learning) in e-learning (electronic learning) while considering the mobility with m-learning and ubiquity with ubiquitous learning (U-learning, ubiquitous learning).

State of the Art

Actually, we find many Learning Management systems offered in the market. According to e-learning industry website [8], we find 150 e-learning systems. In 2015, the most popular LMS in terms of users is Moodle [9], followed by Edmodo [10] and Blackboard [11], those statistics were given by capterra website [12].

The quality of a learning system depends on many factors. First, the quality of the content in a system has a significant role. When a course is well explained with maximum essential elements, the task of learning in the side of students will be more efficient. Also, the organization of the content in a platform is important in the learning process, and here we

distinguish two elements responsible of the quality of this axe: the human factor and the quality of interfaces in the system. Our work is focalized on this axe and aims to improve the quality of the final product in a learning management system development process.

Related Works

LMS Development Process

As any Information System (IS), in development process of LMS, many rules must be followed in order to obtain best results and produce software respecting the time and the budget defined in the beginning of the project. First, the customer (a person or a company) expresses his requirements in order to describe the main functionalities of the ordered system. According to these specifications, the development team studies its feasibility and tries to analyze them. Then, a general design of the system must be done; this phase helps the team to define the actors of the system and interactions between them, considered in different possible scenarios. Also, an initial interface can be created in this phase in order to obtain a global vision of the system design. If all previous phases were achieved with the customer agreement, the team starts the phase of coding. Generally, this phase takes more time and resources than the others. Duration of coding a system depends on the size of the project, the resources affected to it, the technology used and on other factors. The phase of testing comes after coding. Here, the testers must check what the development team has elaborated. If all tests are successful, the phase of deployment starts. The customer receives finally its targeted product.

The specification of a learning system development process resides in its specifications which are focalized on both students and teachers needs. These needs are in continuous growth and are changed permanently due to the large development that knows technologies every day.

Models of e-learning systems

A lot of development methodologies were proposed in order to improve the quality of e-learning systems and consequently offer a complete system that satisfies both teachers and students needs. Here are some models that were created for this goal:

- ADDIE model: a systematic instructional design model based on five steps: Analysis, Design, Implementation, and Evaluation [13].
- Dick and Carey model: a procedural system based on nine steps [14].
- Kemp design model: composed by nine components, this model is systemic and nonlinear consists of a continuous cycle of development process [15].

Our proposed methodology in this article will be focalized on ADDIE model.

Approaches used in the Proposed System

ADDIE Model

As said above, ADDIE is systematic approach composed by five phases:

- Analysis: In this phase, goals and objectives of the course must be clarified. Also, audience, environment, instructional strategies and constraints (Learner skill for example) must be identified.
- Design: This phase must be systematic and specific. It consists on learning objectives, exercises, assessment instruments, content, etc.
- Development: Here, developers create the content assignments and assessments and build the course structure. This phase is based on Design phase.
- Implementation: In this phase, procedures of training are created for facilitators and learners in order to test the new learning application or website.
- Evaluation: This phase comes to ensure that all goals specified in other phases were achieved.



Figure 1: ADDIE Model

Even if it helps us to think about the design and the steps of a course, the ADDIE model has many advantages. First, it is considered as a linear model, a time consuming model and too systematic. In this article, we will suggest a methodology to improve the quality of development process of e-learning systems, based on ADDIE model, which will be combined with MDA (Model Driven Architecture) to ensure interoperability and agile methodologies to ensure the agile concept for e-learning systems.

Model Driven Architecture

MDA was created by the Object Management Group (OMG) in 2000; it is a framework that uses models to describe how the system will be built [16] in different levels of abstraction [17]. By adopting this framework, developers will be able to deploy the software to one or more platforms. Principal models in MDA are:

- CIM (Computation Independent Model): It is a model for requirements; it describes the functionalities of the system and its actors independently of any technologic platform.
- PIM (Platform Independent Model): This model describes the system without details of use for a specific platform; it also describes the structure of the system.
- PSM (Platform Specific Model): The view of the system from a specific platform. It also can be the PIM projected on a specific model.

MDA allows its users to benefit from:

- Portability of existing functionalities which can be rapidly migrated into new environments and platforms;
- Productivity and time by automating many tasks;
- Maintenance of the system becomes easier;
- Quality of the final product will be improved.

The following figure explains the process of transformation of MDA models.

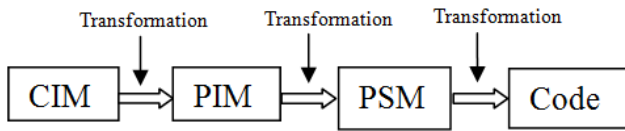


Figure 2: MDA Process

Agile development

An agile methodology defines many good practices, tools and techniques that can be applied during a software development [18] [19]. The concepts of this methodology are based on delivering a great value to the customer by involving him in all stages of project development cycle. In this methodology, changes in requirements are possible in any stage of development process [18], which can make communication and feedback between the customer and development team easier. Agile methodologies are various but we are interested in this work on eXtreme Programming (XP) methodology.

XP method is one of the most successful methods. It is based on five values [20]:

- Communication
- Simplicity
- Feedback
- Courage
- Humility

In this method, the customer is located in the core of the project. By this, a current communication between the customer and the team is usually present. Also, changes in requirements are possible in all stages of development, which can decrease risks of the project and increase success rate of the project.

Proposed System

Based on ADDIE model, our proposed process takes the five phases of this model as a reference since it is the most used model for design and development of e-learning systems. The objective of our idea consists on improving the quality of e-learning systems by applying XP practices and the bases of MDA on the five phases of ADDIE model. The Table 1 explains how XP practices and MDA models will be applied. By doing this, the interoperability of e-learning platforms will be improved. On the first hand, the application of MDA will allow developers of e-learning platforms to have an independent architecture of any technologic platform. That means that the targeted system will be operational on different technologic platforms which will be very interesting when developers need to develop a mobile version of the e-learning system. This is one of the biggest advantages of our proposed methodology in a way that the mobile version of the targeted system will be easier to implement and will not need much time. Also, implementation of MDA on development process of e-learning systems helps developers to generate code (which can be ameliorated using recent tools) that can be re-used for every new requirement or change. Consequently, the time of development will be reduced and re-use of the code will be ensured. In addition to this, a high level of abstraction will be guaranteed. MDA models will be elaborated in three

phases of ADDIE model, CIM model in the Analysis phase (Use cases in UML [21]), PIM model in Design phase (Class diagram in UML) and PSM model will be elaborated in Development phase, where initial code will be generated for the different targeted platforms.

Table 1: Methodology of applying XP practices and MDA Models on ADDIE Model

ADDIE phases	XP Practices	MDA Models
Analysis	User stories: (What the system will do for us?) Must be written by some professors collaboratively with some students. Daily stand up meetings in order to discuss requirements.	CIM Model: Use Cases based on User Stories
Design	Simplicity: A simple design must be done System metaphor choosing CRC (Class, Responsibilities, and Collaboration) cards used in order to design the system by a team not by just one person. Creation of spike solutions to explore potential solutions in order to reduce the risk of a technical problem Refactoring must be considered	PIM model: Independently of any technologic platform, the Class Diagram must be elaborated.
Development	Communication between the system users and development team must be present in all stages of development Unit tests must be created first Code must be written to agreed standards Pair programming	PSM model: models for the targeted platforms: Java, PHP, Mobile, etc. Developers start from the generated code and develop it in order to implement all requirements
Implementation	Unit tests must be done to detect bugs	
Evaluation	Acceptance tests: professors and students must verify the correctness of these tests	

On the other hand, by applying XP practices, developers will benefit from its simplicity and robustness. Also, XP will allow the team to reduce time of maintenance due to its big

advantage of the permanent communication between developers and the final users of the system. Furthermore, risks of non-satisfaction of teachers and students will be reduced since they will be included in all the development process of the system.

The fig3 illustrates our proposed process and schematizes it.

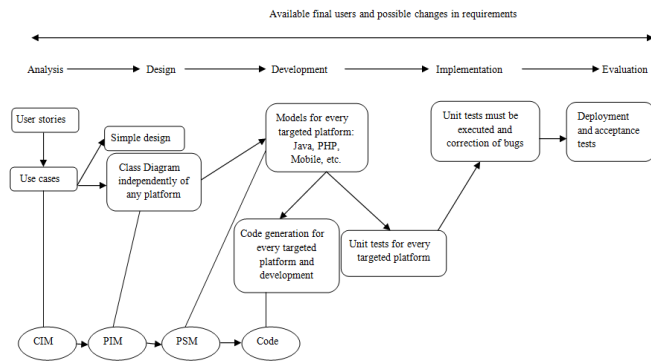


Figure 3: our proposed Method to improve e-learning systems development process

Conclusion

In order to improve the quality of learning, it is indispensable to ensure a learning system of quality. On the basis of this principle, we were motivated to elaborate a process to improve the quality of e-learning systems. We were based on ADDIE model which is one of the most used instructional models in the world of learning to ensure a process that follows standards. Also, our approach uses XP practices as a reference for good practices to be applied in an e-learning system since it answers the permanent changes in requirements asked by teachers. Furthermore, in order to guarantee a high level of abstraction and interoperability of e-learning systems, we applied MDA models on three phases of ADDIE, which will allow users to reduce time of development and will ensure them the characteristic of reusability of code since MDA approach is based on models.

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