

An Integration between Instructional Design and Software Engineering for Developing Virtual Learning Platforms

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Abstract: The purpose of this work is to propose a new instructional design (ID) approach which integrates software engineering (SE) into traditional ID approaches to become suitable for producing virtual learning platforms (VLPs), especially in designing and developing phases. We have made analyses of previous studies in regard to ID, SE, and VLP to specify various features of the proposed ID approach. It was found that the traditional ID approaches have some deficiencies in methodology for designing and developing e-learning and virtual learning products, especially VLPs. Based on these analyses, we have reached to a new suggestion of ID approach, which incorporate some SE techniques so as to resolve the deficiencies of the traditional ID process especially in designing and developing phases. Our suggestion would lead people who have interested in ID to develop a new generation of instructional products in the future.

KEYWORDS

Virtual Learning Platforms, Instructional Design, Software Engineering.

1. Introduction

Nowadays, technology has a rapid and continues developing on many fields including education. Educational technology makes a significant impact in improvement of learning process through embedding recent technology applications in school and universities such as e-courses, virtual labs and virtual learning platforms.

Virtual learning platforms (VLPs) are one of the modern applications of technology in developing education. The VLP work as an alternative solution of traditional learning through distance learning and can combine it with traditional learning through blended learning. In both ways, VLPs have a good impact on learning process since it enables teachers to control learning inside classrooms electronically in comparison with traditional classrooms. Furthermore, it provides teachers with tracking data of the learner's performance. Moreover, it works to increase students' technological skills. Finally, we claim the VLPs are considered as one of the main importance technology tools reliable to reach to mastery of learning at present, and future.

During the work of our project to design and develop a virtual learning platform with a new feature for teaching for university stage, we faced the problem of how to design and develop a virtual learning platform as an instructional product according to instructional design. We found the traditional instructional design (ID) process does not provide to us enough guidance to produce the VLP.

The core of the traditional ID process according to Gustafson & Branch [1] consists of five elements such as analyze, design, develop, implement, and evaluate (ADDIE). In addition Molenda [2] confirmed ADDIE is a generic traditional ID process. We see this process has some deficiencies in methodology for designing and developing

virtual learning products, especially VLPs. Generally speaking, the traditional ID process only focuses on educational content. It means the designing and developing phase is not suitable because it does not provide a scientific way for designing and developing VLP function tools / interface tools with enough details. Thus, educational technology specialists (researchers, instructional developers / designers, postgraduate students and undergraduate students) need new methodology for designing and developing such instructional products like the VLP.

In order to improve current traditional ID process, we suggest a new approach combine software engineering (SE) approach with ID through analysis of SE process and synthesis of the SE process and the traditional ID process to produce VLP by the specialists.

There are some previous attempts to improve the traditional ID process through SE approach. Tripp and Bichelmeyer [3] claimed a rapid prototyping as an alternative instructional design strategy. In addition, Peter and Lloyd [4] presented another attempt by agile methods of SE to develop the curriculum process.

We found the above attempts do not provide enough ID process for developing VLPs. Douglas [5] claimed a rapid prototyping as the SE process has some pitfalls with regard to users, developers, management and maintenance. In addition, Peter and Lloyd attempted to focus on developing content only by integrating the learning modules with the ready-made course and/or learning management systems (LMS).

We suggest a simple software engineering process to improve the instructional design process. This process consists of three phase as analyses, construction and deployment phase. Then, we integrate the SE process into the traditional ID process (ADDIE) to become suitable for

designing and developing VLPs.

The focus of this paper is to suggest an instructional design approach combine SE with ID for developing VLPs to the specialists in the field of educational technology through clear and organized steps. This approach would provide a framework to reach suitable ID approach to design and develop VLPs as a new product in the future educational institutions.

2. Reasons of Integration

2.1. VLP has no ID process or model

VLP is a new instructional product in educational technology and has no ID process to explain design and development of the VLPs in the various education stages for specialists. Therefore, we made analyses of some recent previous studies in the field of VLPs [6], [7], [8], [9]. The main question of the analyses is as follows: Does it contain the ID process model for designing and developing VLPs or not? The results showed the VLP has no attempts specialized for the suggestion ID process to design and develop VLPs as an instructional product for specialists. So, we consider SE can support to suggest a sufficient ID process for developing VLPs easily.

2.2. Unsuitableness of traditional ID design process

The VLP consists of two parts: the main part is VLP function tools/interface tools, the second part are course contents. We made analyses for some previous studies [10], [11], [12] which addressed generic ID process (ADDIE). This analysis focused on what was the main target of (ADDIE) in design? We found its concern in the design process for course content only. Based on the results, we concluded the ID process (ADDIE) neglected design and development of VLP function tools and does not mention any method for development VLPs. On the other hand, SE provides enough processes/methods for developing software projects. Thus, we can use the SE approach to add designing and developing phases for the VLPs.

2.3. VLP Architecture Design is necessary

The VLP contains many complicated function tools. They need easy way to create architecture design of VLP tools. As we know, SE provides the specialists with a good way for designing VLP through Unified Modeling Language (UML) such as a use case diagram, a class diagram, etc.

2.4. Speed and Quality in Developing VLP

The VLP is considered as a large instructional project. It needs ID process with high efficiency in time, cost and quality in developing. Integration between ID and SE provides incremental development approach by dividing the VLP project into small parts (iterations). That enables the specialists to develop and update the VLP at a speedily time with low costs and high quality.

3. ID approach for developing VLPs

3.1. Syntheses of SE for VLP

In order to reach to our suggested approach, we have first made an analysis of diverse previous studies and literature review, in the field of software engineering [5], [13], [14], [15], especially main SE features and processes/models such as waterfall model, prototyping process, incremental development process, spiral model, and agile methods. Based on these analyses, we proposed simple software engineering process as described in Figure 1. This process consist of three phases (analyses, construction, and deployment) summarized them as follows:

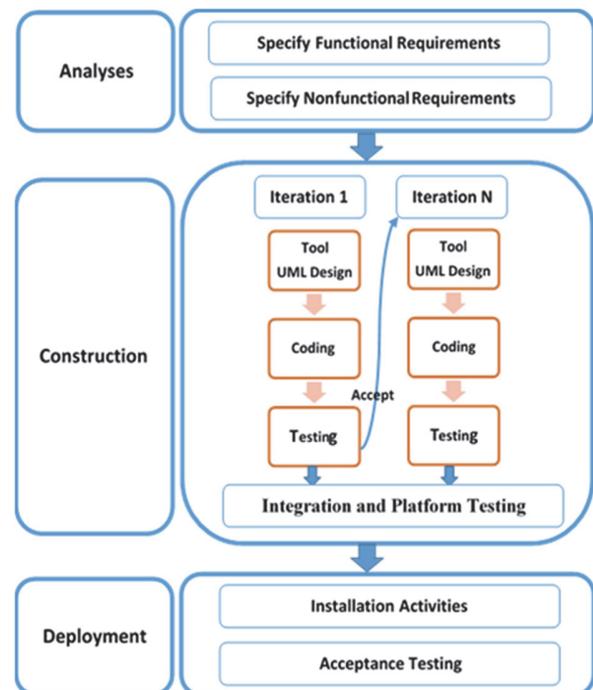


Figure 1. Proposed SE process for VLP as a system

3.1.1. Analyses Phase

Analyses phase provides enough inputs for properly construction and deployment of a system to target users. In this phase, developers and designers gather system requirements of the target users. And then, they specify functional requirements expected to be performed by the system. After that, they describe these requirements as a use case diagram and divide it to specific functional tools. Besides, they specify nonfunctional requirements such as system performance, security, constraints of coding and user's characteristics.

3.1.2. Construction Phase

In this phase, the developers begin to create a system incrementally. They develop diverse tools step by step through iterations. Each iteration represents one tool. We are

clearing the steps of the construction phase as follows:

- a) Make up tool design by Unified Modeling Language (UML) such as class diagram.
- b) Implement the tool design by actual coding of computer language such as PHP, C++.
- c) Conduct validation and verification testing for each developed tool. If the tool is accepted, they can move to the next iteration. The tool has a code error or doesn't meet the functional requirements, on the other hand, they make modification and revision.
- d) Conduct an integration for testing, functional tools to reach the final system. In this step, they use an incremental testing approach.

3.1.3. Deployment Phase

Deployment is the final phase of the proposed development process. In this phase, the developers publish the system for operational use by the target users. They should perform installation activity requirements on the server, such as providing enough capacity for VLP and installing required software before transfer VLP to server. Furthermore, they ensure good performance and stabilize the system in any environment. The target users should conduct acceptance test of VLP/system to gather feedback in regard to system accessibility, usability, functionality tools, robustness, security, and performance. Finally, the developers fix the each kind of technical errors, then the system becomes ready to use.

3.2. Adoption of the proposed SE process into a traditional ID process (ADDIE)

This approach combines the SE process to the traditional ID process (ADDIE) to overcome the deficiencies in traditional ID process in developing VLPs. Consequently, we have decided to propose our ID approach for developing VLPs as described in Figure 2 because we believe it is necessary to become widespread of developing VLPs in various educational institutions.

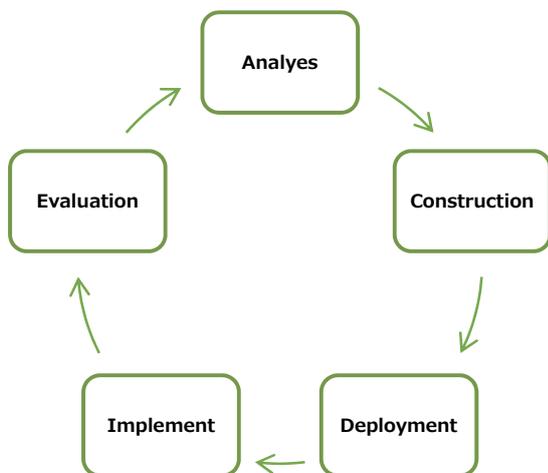


Figure 2. ACIDIE approach for VLP

3.3. Features of ACIDIE Model

We add proposed the analysis phase of the SE process into the ADDIE analysis phase directly. The new analysis phase in the ACIDIE process includes a new aspects with regard to VLP SE analysis. This aspect asks the developers to specify VLP functional requirements and divide them into iterations as educational function tools. They also specify VLP nonfunctional requirements. Besides, traditional aspects of analyses are also required such as user's analyses and VLP course analyses that they intend to teach in the VLP and general objectives. Finally, they decide to specify course topics and divide it into segments. Analysis elements of the ACIDIE model are summarized in figure 3

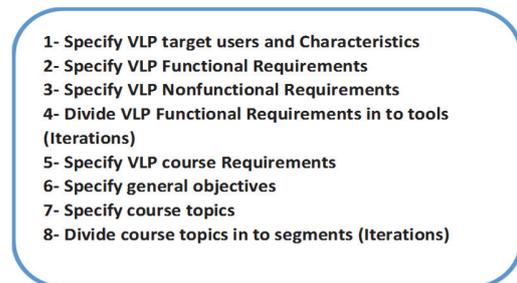


Figure 3. ACIDIE analysis phase for developing VLPs

We replaced design and development phases in the traditional ADDIE model by construction phase in the proposed SE process. Thus, construction phase includes two parts: VLP interface tools and VLP contents as described in Figure 4. In each part, we follow the SE incremental approach. The VLP interface tools have explained previously. Thus, we explain VLP contents steps as follows:

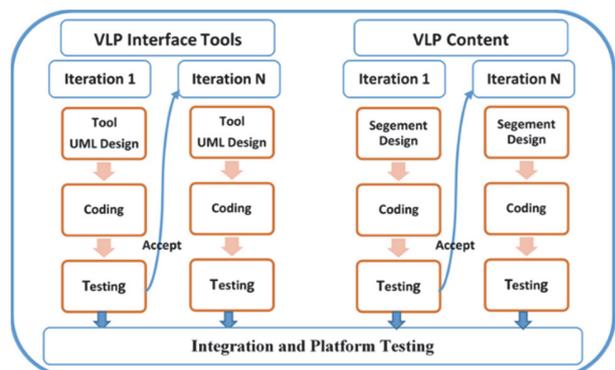


Figure 4. ACIDIE construction phase for VLPs

- Make up a segmented design by specifying behavioral objectives, actual contents, educational media and activities and evaluation Style
- Implement the segment design by actual coding of computer language and programs
- Conduct validation and verification testing for each developed segment. If the segment is accepted, they can move to the next iteration. If the segment has a code

error or does not meet content expert requirements, on the other hand, unless instructional they make modification and revision.

- Conduct an integration for testing segments by using an incremental testing approach.

Finally, we add a new phase in the traditional ADDIE model as the deployment phase in the proposed SE process to make it easy in installing in the server and testing to reach of good quality before implementation in real environment.

4. Conclusion

In this paper, we proposed the instructional design model called ACDIE by combining the traditional ADDIE model and the SE process for designing and developing the VLPs in order for specialists in educational technology to improve their skills with a new form and components in the near future schools and universities. We made the analyses of the previous studies about and the ADDIE model and main SE features and processes. Based on the results of the analyses, we proposed the certain SE process consists from three phases such as analyses, construction, and deployment. We also combine it with traditional ADDIE model. The proposed ACDIE model would be able to overcome the deficiencies of the traditional ADDIE model in designing and developing the VLPs for modern educational systems. The proposed ID approach contains five phases, analyses, construction, deployment, implementation, and evaluation. In the near future, we will apply the proposed ID approach in developing our project of the VLPs for students at university stage and test the effectiveness of the VLP experimentally through practical use.

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