

Designing an Adaptive Learning System Based on a Balanced Combination of Agile Learner Design and Learner Centered Approach

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Abstract

Improving teaching effectiveness, facilitating learning among learners, encouraging long life learning and maximizing motivation as well as reducing the dropout rates are among the main issues of Adaptive Learning Systems (ALS) that conquer the interest of educational actors and partners, especially in higher education. The present paper aims to give the foundation of a framework for an ALS that gives extensive attention at each stage of the design process to the end-user: learners. The system proposed is based on balanced combination of Agile Learning Design (Agile LD) and Learner-Centered Design.

Keywords: ALS; learning; Agile LD; Learner-Centered Design.

1. Introduction

One of the challenges faced by institutions of higher education in morocco is the increasing number of students and the low rate of supervision. Moreover, most of these institutions emphasis on maximizing motivation, reducing the dropout rates as well as encouraging long life learning. Thus, many universities have embraced digital technology to optimize learning and training especially the use of ALS. The uses of Adaptive Learning concept present many greater opportunities to support online learning and training from managing the learning and training process, through to monitoring assessment process. Furthermore, the most ALS provide instructional content that can be specifically tailored to meet individual learner needs in a specific time.

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The first question that arises is how to design and create quality and pertinent ALS, able to build courses based on huge information of an individual user and use this throughout the interaction for adaptation to the needs of that user. This is due to the fact that ALS deal with diverse backgrounds, such as software developers, web application experts, content developers, domain experts, instructional designers, user modeling experts, pedagogues, etc. [1].

Moreover, the process of defining and developing e-learning material for an ALS is often expensive to produce -especially in a single context setting- making the return on investment difficult to quantify [2]. The most of ALS currently available provide similar sets of features.

The most of them are designed and developed from scratch, without taking advantages of the experience from previously developed applications, because the latter's design is not codified or documented [3]. Thus, development teams are wasting time and efforts to reinvent the wheel. Various works have been presented in the literature in order to support the design of ALS [2,3,4,5,6]. Thus, there are several learning design methods presented in the literature, such as ADDIE, OULDI, Design thinking, Xproblem, etc. However, the most of them don't involve learners until late in the project which is in our view an obstacle for the adaptation of the content to the features learners which leads to lack of motivation even the dropout.

In this work, we focus on one of the recent works proposed to design ALS, which is called Agile LD. This choice is based on a comparative study of the most used approaches in the literature that was subject of other publications [7,8].

A learner-centered approach that is increasingly being encouraged in higher education- will be implemented to Agile LD process to involve the learner in each stage of the design process.

2. Background and related work

This section presents two concepts Agile LD and the Learner-Centered Approach and gives some of their advantages. Moreover, it will give some response to how can we integrate learner-centered approach into Agile LD process to improve the teaching effectiveness, facilitate learning among students, and maximize motivation as well as reducing the dropout rates?

2.1. Agile LD

The Agile LD is an iterative model of learning design that focuses on collaboration and rapid prototyping. Agile LD can be adapted to fit the needs of the learning and training community by providing an ethos for the design of learning [12]. Several Agile methods have been presented and developed (SCRUM^a, Extreme Programming^b, Feature-Driven Development^c, etc.)

^a www.scrum.org

^b <http://www.extremeprogramming.org/>

^c <http://www.featuredrivendevelopment.com/>

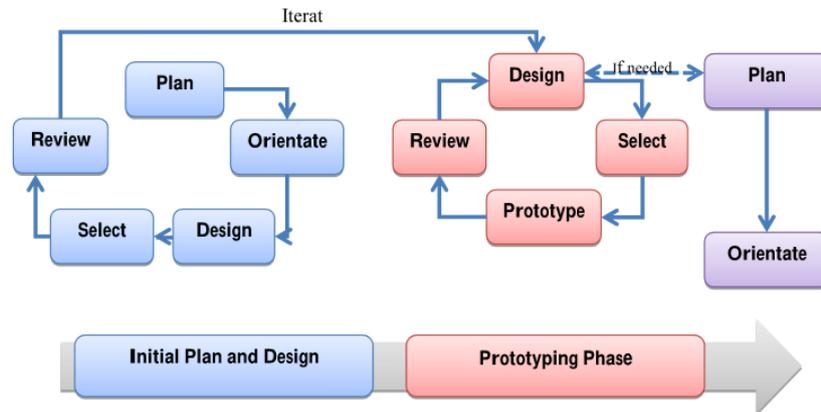


Figure 1: The lifecycle of Agile LD

The lifecycle of agile LD may contain several iteration/sprint Fig.1 (see below). Each sprint consists of initial analysis in the first phase, followed by the development of a single feature of the final product. Once this single small part of your course is finished you can start testing and evaluating the efficiency and the return on investment of this part. If results are satisfying a new iteration begins, until the course or the project are fully finished. Otherwise the designer has to take one step back, understand what went wrong, and correct.

2.2. Learner-Centered Approach

In the literature, the terms Learner-centered, learning-centered teaching or student-centered learning, are commonly used to design this approach. The term learner-centered will be used through this work even if some authors use the other terms.

According to [18], Many authors underlined that the didactical formula based on lectures where the teacher teaches (teacher telling or talking or lecturing) and students learn is not more adequate: the new paradigm fostered by the use of technologies is “students teaching themselves with teacher’s guidance” [18].

In line with above, Reference [19], states that learners have to participate actively to the learning process. They have to discuss, read, write, solve problem, analyze, evaluate and synthesize. Moreover, learners have to be cooperative and participate in tasks as a group.

Therefore, the new role of instructors is facilitator of learning and training. They have to attract all learners, guide and emphasis on debate along courses. As far as the learners are concerned, they have to be cooperative contributors not only listeners.

Several authors [14,15,16] assert that when the focus becomes learner, higher rates of student retention is attained and have better prepared graduates than those students who were more traditionally trained.

Moreover, Reference [17] claimed that adopting learner centered approach; learners are proactive independent, responsible for both what they learn and how they learn. The course provides a flexible framework, supportive

environment and collaborative learning culture, with faculty guiding learners through their learning as mentors, with the focus on developing students' critical thinking, problem-solving and research skills. This enables them to become effective life-long learners.

2.3. Agile Learner-Centered Design

Agile – Learner Centered Design is based on the two proven approaches: Agile LD and Learner Centered Design. The two approaches have a lot of similarities such as focusing on learners and their needs; encourage communication and collaboration between learners and teachers, use adaptive and iterative processes to achieve goals and increase the probabilities for providing a prosperous educational system.

However, some authors such [20,21] claimed that even if Agile LD and learner-centered design are compatible, there are some dissimilarities. As an illustration, we evoke the concept of learner involvement and the end-learner. Thus, in the learner-centered design, learners involved in the design process are the same learners that will interact with the system in last. For the agile LD, learners involved in the design process are not necessarily the end users of the system. This may affect the efficiency of the learning as the end learners are not those who were involved in the design process.

Reference [20] presents three approaches to explain how learner-centered design may be integrating with Agile LD.

- Integrating learners-centered design practices into the agile development methodology.
- Apply Agile LD practices into learner-centered design framework.
- Balanced combination of Agile LD and learner-centered design.

The study of the three approaches, lead us to choose the third one because it is in line with our goals. Indeed, it permits us to combine the most useful practices of the Agile LD and the learner-centered design to achieve the development of an ALS in which learners are part of the team of the design and at the same time they are the end learners.

3. Toward a framework based on Agile Learner-Centered Design

3.1. The Design of the framework

The Agile LD method used to implement the framework is organized in main four phases (Design, Develop, test and evaluate). We notice that we use the same phases to design all the components of the framework.

In the initial plan and design, we establish the initial content of the ALS. In this stage, we use as a starting point, an architectural design of the proposed system which is composed by three main components (Fig.2).

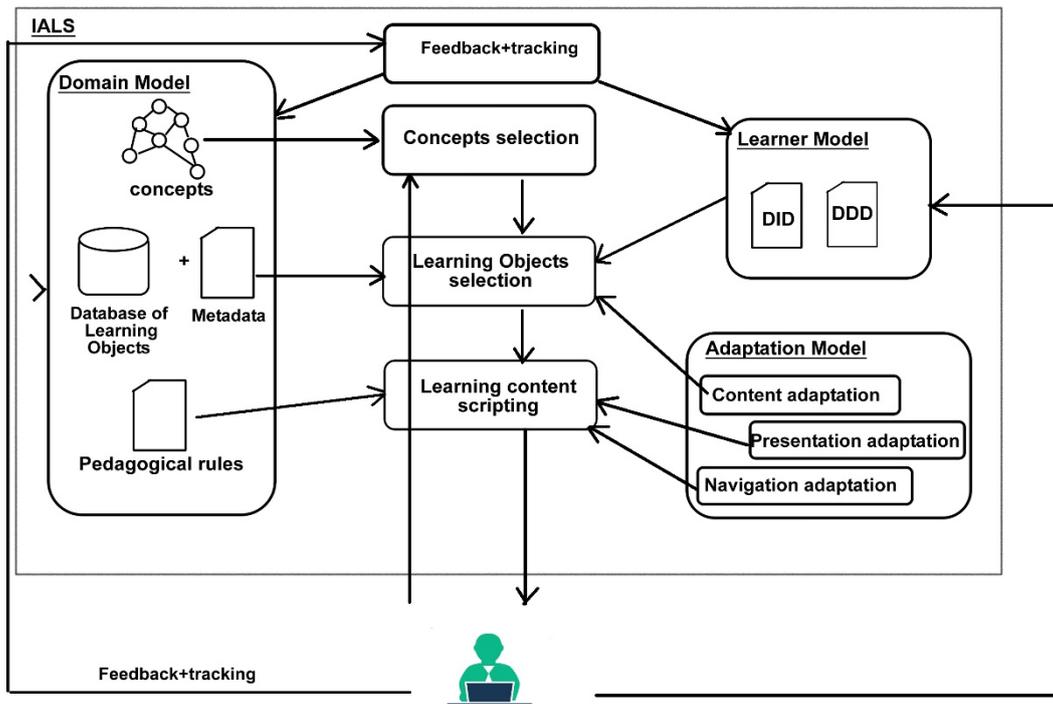


Figure 2: Adaptive Content generation process

In the following, we present these components, their descriptions, their features and interactions between them

- a) The Domain Model: The domain model is characterized by its competence in terms of representation of concepts to learn, the resources available to learners and the structuring of various elements of the field.
- b) The Learner Model [19]: The Learner Model allows changing several aspects of the system, in reply to certain characteristics (given or inferred) of the learner. It includes two type of information grouped in two domains Domain Independent Data (DID and Domain Dependent Data (DDD)
- c) The Adaptation Model: The adaptation Model deals with the generation of adaptive content that will be subsequently presented to the learner. This component has four sub components: the navigation model, the presentation model, the content model and the pedagogical rules. Each sub-component contains a set of rules to achieve the adaptation.

After specifying the initial requirement and the main components of our system, every component was subject of a series of iterations, analyzing, designing, developing and testing each feature in turn. In the stage of testing we focused on remarks and feedbacks of learners. We collect all information that could be used to improve the succeeding sprint and to contribute to the constant enhancement process.

We notice that all data used in all stage of the design process, were collected through survey or during meeting. The next paragraph presents the Learner Model Design as an example of the implementation of our approach

3.2. Example of process design : the Learner Model

The Agile LD method used to implement the Learner Model is organized in four phases:

- Establish the initial content of the Learner Model. In this stage, we use as a starting point, the Learner Model giving in generic ALS that allows changing several aspects of the system, in reply to certain characteristics (given or inferred) of the learner [22].

The Learner Model in ALS includes two type of information grouped in two domains:

- Domain Independent Data (DID): are composed of two elements: the Psychological Model and the Generic Model of the learner Profile, with an explicit representation [23]. These data are more permanent which allows the system to know beforehand which the characteristics that it must adapt to [24]. The DID include several aspects such initial learner knowledge, objective and plans, cognitive capacities, learning styles, preferences, academic profile (technological studies, knowledge of literature, artistic capacities, etc.), etc.
- Domain Dependent Data (DDD): information referring to the specific knowledge that the system judges that the learner possesses on the domain. Martins [25] say that the components of the DDD correspond to the Domain Model with three-level functionality: (a) Task level, with the objectives / competences of the domain that the learner will have to master. In this case, the objectives or intermediate objectives can be altered according to the evolution of the learning process; (b) Logical Level, which describes the learner knowledge of the domain and is updated during the student's learning process; (c) Physical Level, that registers and infers the profile of the learner knowledge.

Those two elements and theirs contents were discussed with prospective learners, and the member of our team to approve the initial architecture of the Learner Model, presented below.

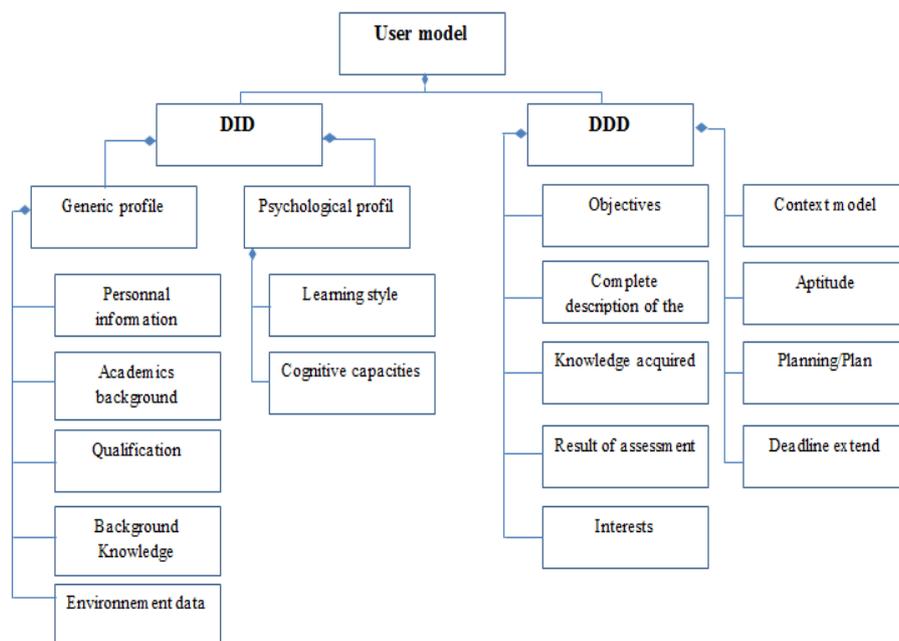


Figure 3: Characteristic used in the Learner Model

- **Plan and create the structure.** In this stage, we agree the content of the Learner Model in adequacy with our learning context. We highlight that we can refine this model (add or delete some content) since we can do iterative design.

- **Implement the component.** In this stage, we start the implementation, we agree the technologies that we will use to implement our Learner Model and the design of the learner interface.

Two different types of techniques are used to implement the Learner Model: Knowledge and Behavioral based. The Knowledge-Based adaptation typically results for data collected through questionnaires and learner studies, with the purpose to produce a set of initial heuristics. The Behavioral adaptation results from the monetarization of the learner during his activity [25].

For the DID, we developed a form application from which we will collect all the information about DID

- **Evaluate:** In this step evaluates and approves the work. Some learners create their account in the component of that learner Model, fill in the form and evaluate the initial version of the Learner Model. In this stage, we focus on remarks and feedback of learners. We collect all information that can be and used to improve the succeeding iteration and to contribute to the constant enhancement process.

3.3. Some results and discuss

The first version of the framework presented in previous section, has already been implemented and tested to validate the proposed approach with some selected learners. As we work in faculty, we can't work in the stage of the design with much learner, especially with our first experience.

For the first version of the system we highlight that the Agile LD method allows designs to be modified, repurposed and evolved according to the needs of learners emerging during development. In terms of the applicability of the method, the preliminary results indicate that the method is useful, easy to use. Furthermore, it focuses on the final client which is in our case the learners and their interactivity with the system. Another result is the human contact with the learners, they have not been considered without knowledge but rather partners who participate in the improvement of the system. This motivated them to give their best and develop further learning in the discipline. At the end of the project, we conducted a survey that aimed to have the opinion of the learners on the new way to learn. We can highlight from the results of the survey that the most learners accepted the new learning model and expressed their satisfaction with the new learning experience. This lead us to believe that the implementation of those two approaches in the learning will surely diminish the dropout rate. Indeed, learners enjoy learning and give their best when they are involved in the learning experience and considered as partners not only listeners.

4. Conclusion

In this paper we proposed a general view of how to support the design and the implementation of an ALS respecting the Agile LD method and integrating the learner-centered approach. First, we expose the interest of

integrating the learner-centered approach and using the Agile LD. Furthermore, we present the preliminary results showing the success of this approach in designing and implementation of the components of ALS.

We intend to complete our system and to enhance our proposal based on the results of the experiment and on the feedback from learners. For further validation, Firstly, we plan to embed more learners on the experiment of the all components of ALS, enhance our proposal based on the results of the experiment and on the feedback from those learners. Secondly, we plan to improve the proposal pedagogical model, including more materials to make learning more effective, amusing and attractive.

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