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Abstract—The problems of most Learning Management Systems (LMS) are first of all of a pedagogical nature and then of a technical one. Studying these problems, which are interrelated, provides a useful conceptual reference that enables us to design a new model for a more relevant solution. In this paper, a new conceptual model of an LMS is presented. The model is based on the hybridization between four learning theories, namely the traditional pedagogy, the behaviorism, the cognitivism, and the social constructivism. We will present at first each of these learning theories by discussing both their advantages and limits. Then, together the main principles of these learning theories and the technical functionalities of the proposed LMS that result from the hybridization of these principles are outlined. We finally discuss the implications of the new conceptual model for how to design and develop new LMS that fit the needs of their final users, in particular learners.

Keywords—Learning Management System; learning theories; the modeling of LMS

I. INTRODUCTION

During the last decade, e-learning platforms have evolved considerably. However, a number of comparative studies [17], [22], [23], [26], [29], [33], [34], [36], [38] have shown that their life cycle continue to change at a fast pace. Therefore, we have conducted a comparative and analytic study on free e-learning platforms based on our own approach of evaluating the e-learning platforms quality [1], [2], [5]. Different approaches of evaluating the e-learning platforms quality have been already proposed [24], [25], but no one of them has been adopted here because they focus only on technical aspects and neglect other important aspects such as security, maintainability, portability, compatibility, performance effectiveness and usability.

In light of our studies and the previous ones we think that most of e-learning platforms including the LMS were initially developed a decade ago, based on a classical training model. The teacher is considered as the one who holds the knowledge and transmits it, according to different modalities, to future learners in order to foster their learning. They are mostly TMS[1], that is to say tools at the teacher's service to create and manage courses rather than at the service of learners and the learning process. Therefore, we have decided to work on a new conceptual model that combines between learning theories in order to promote both the teaching and learning processes.

Our LMS was built on the idea that we should give the same possibilities of action to both teachers and learners by distributing their control on the platform.

It is evident that the use of any tool in the field of education must be justified according to its pedagogical support and its capacity to address the real needs of its final users, particularly learners. However, it should be noted that although seen as an effective solution for overcoming space-time restrictions, the platforms might be an obstacle for the learning process to the extent that the pedagogical principles are neglected during their design. Thus, when designing our LMS we have tried to answer at first the following questions:

- How an LMS should be modeled to fit better the requirements of standards and norms of e-learning programs?

- To what degree of specificity could the LMS respond as an innovative technical system?

- To what degree of specificity the learning theories could promote the online learning?

These and many other questions were investigated within our conceptual model. Our objective was to test and to check if our proposed model is worthy and useful for the design, development and diffusion of e-learning systems, particularly the LMS.

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[1] **TMS:** Teaching Management System

The present study attempts to bring some light into the questions above by exposing at first the four learning theories that were judged the most important and relevant to our modeling, namely the traditional pedagogy, the behaviorism, the cognitivism, and the social constructivism. Then, these learning theories which have inspired for a long time the design of computer applications are combined and put into perspective with several emergent pedagogical functionalities to build an original modeling for our new LMS. This reveals that this proposed modeling that is presented to readers here looks for ways to leverage technology for learning by considering users as being human actors and not human factors [11].

II. LMS AND ONLINE LEARNING

An LMS or e-learning platform is a software including a range of services that assist teachers with the management of their courses. It offers many services allowing the management of content, particularly by creating, importing and exporting learning objects. The set of the available tools in the LMS represent all these services that help in managing the teaching process and the interaction between users such as the access control services, synchronous and asynchronous tools of communication and user administration services.
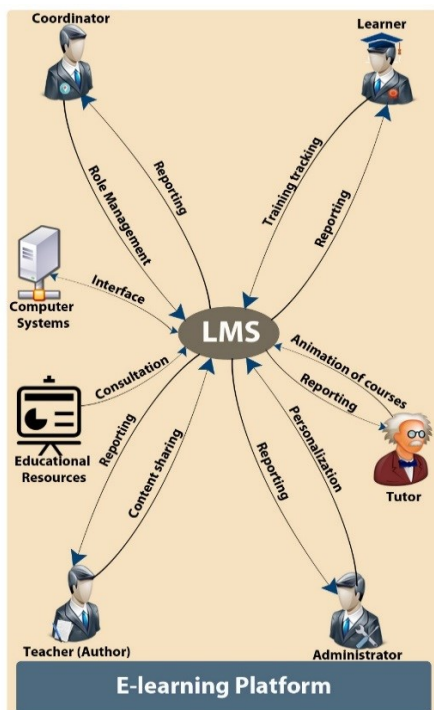

Fig. 1. The general architecture of an LMS

Figure 1 illustrates the general principle of the operation of an e-learning platform LMS by presenting the key features associated with the main actors: learners, teachers, tutors, coordinators, and administrators. The learner can consult and/or download the resources made at his/her disposal by the teacher, he/she can create his/her learning activities while following his/her progress in training. The teacher, who is responsible of one or more modules, can create and manage the educational content he/she wishes to broadcast via the platform. He/she can also build tools for monitoring learners' activities. The tutor accompanies and monitors each learner by providing the tools of communication and collaboration. Concerning the coordinator, he/she ensures the management of the overall system. Finally, the administrator is responsible for the customization of the platform having the rights of the administration deriving from it (system installation, maintenance, access management...

III. LMS AND THE UNDERLYING LEARNING THEORIES

Although their considerable potential in the construction of knowledge and competence development, the LMS can generate a real pedagogical success only if, their use relies on solid and proven learning theories [12].

In the next part, we will evoke the transposition of the use of four learning theories in the design and development of LMS. For that purpose, we will do the correspondence between the tools available in LMS and the learning theories to which they refer. As a latter part will show, the hybridization of these learning theories that we have judged more important and relevant to our modeling work can only be a source of enrichment to improve the quality of online learning.

A. LMS and the traditonal pedagogy

The conception of learning as supported by traditional pedagogy is essentially relying on a direct and systematic mode of transmission. Indeed, we put forward the authoritarian role of the teacher who must deliver fixed and unchanging knowledge, evaluate and involve learners by following the different stages of a pre-established scenario. From this perspective, learners are only passive recipients of information who respond ideally to external factors provided by their teacher in advance in a particular environment.

Among the main ideas that are associated with the traditional pedagogy [15], we mention lecture-based teaching, the idea of transmission and reception, individualism, the sanction.

These main ideas from the traditional pedagogy have had an impact on the design and development of LMS, which focus on learning by reception. Indeed, this kind of software integrates different spaces in order to allow teachers organizing, structuring, exposing their knowledge and particularly assessing the learning progress.

B. LMS and the behaviorism

The term "behaviorism" appeared at the beginning of 20th century in parallel with works of the American psychologist John Watson. This latter is considered as the pioneer of the behaviorism. He proposed making the general psychology a scientific discipline by using experimental laboratory methods to set exploitable results that can then statistically evaluated [9].

To teach a certain skill, the behaviorist approach proposes to break it down into sub-objectives, which have to be simultaneously assimilated and mastered. In this perspective, the teacher should be able to present information to learners under restricted stimulus associated with reinforcement. Obviously, the learners' role here is to respond to these stimuli by adopting the expected behavior. The teacher also proposes progressive practical exercises that allow checking the acquisition of knowledge while giving positive and/or negative feedback based on the responses provided.

The mark of behaviorism can be found in the LMS which display systematic exercises allowing learning by repetition (trial and error) and in which the principles of conditioning are integrated.

C. LMS and cognitivism

Cognitivism is born at the same time as the Artificial Intelligence, in 1956. Miller and Bruner propose it in reaction to Behaviorism. It focuses on the ways of thinking and solving problems. Learning cannot be limited to a conditioned recording, but should rather be considered as requiring complex processing of the received information. Memory has its own structure, which involves the organization of information and the use of strategies to manage this organization [13].

For an LMS based on the cognitivist approach, the learner is an active information-processing system, similar to a computer: it perceives information that comes from the outside world, recognizes them, stores them in memory, then recovers them from his/her memory when he/she needs it to understand his/ her environment or resolve problems [10]. Teacher is the manager of learning, he guides, animates, directs, advises, explains, regulates, and remedies. Knowledges become an external reality that the learner must integrate into his/her mental patterns and reuse rather than acquire observable behaviors [8].

D. LMS and the social constructivism

The social constructivism outlines learning by construction in a community of learners. In this light learners are expected to interact with the available human resources (teachers, tutors …) in the proposed learning environment. In this way, the learners' psychological functions increase through socio-cognitive conflicts that occur between them. These conflicts lead to the development of the zone of proximal development[2] [14] and thus facilitate the acquisition of knowledge.

Based on the social constructivist approach, the design of LMS were oriented towards integrating online communication and collaboration tools. In practice, a wide range of platforms, particularly the social constructivist ones, propose a set of tools, which allow sharing, exchanging and interacting in synchronous and asynchronous mode such as blogs, wikis, forums…

In addition, connectivism can considered as a branch of the social constructivism. It is not necessarily a learning theory, but rather a pragmatic concept of participatory teaching and learning [6], which is relying on assumptions of Latours Actor-Network-Theory [7]. If viewed as a theory by itself, it would also overlap with the social constructivist paradigm in terms of the importance of interaction in social structures.

George Siemens and Stephen Downes who developed the connectivism, they are based on the principles of connection, online networking and thus interactions between objects of the world. They stated that connectivism is based on the use of a network composed of nodes and connections as a central metaphor of learning [4]. In this metaphor, a node can be information, data, feelings, pictures or simulations.

The connectivism benefits [3] as a new learning theory reside on the importance given to the principle of connection which leads to the understanding of the learning process by describing how and why connections are formed in different levels: neural, cognitive/conceptual and social.

IV. EDUCATIONAL MODELING OF AN LMS

The problems of most Learning Management Systems (LMS) are first of all of a pedagogical nature and then of a technical one. Studying these problems, which are interrelated, provides a useful conceptual reference that enables us to design a new model for a more relevant solution. This solution can only be a new learning system (LMS) that has to be developed to address the needs of all its users, particularly learners.

The modeling presented here tries to propose a relevant solution to some of these problems based on the following three principles:

- Describing the type of the learning activities proposed and their paths (free, sequential, conditional…),

- Identifying different actors and/or groups of actors according to their roles and the tasks they have to achieve,

- Describing different spaces of activities in the learning system. Each space includes various resources such as forums, wikis, video conferencing, mind maps, exercises…

A. The conceptual model

The modeling of our LMS that will be presented in details here offers both pedagogical and technical richness in terms of functionalities. It allows not only supporting the learning process but also the teaching process.

Our LMS is based on an original pedagogical reference that combines between four learning theories and their emerging functionalities aiming to improve users' teaching.

As seen in Figure 2, each of the four theories of learning involved in our modeling brings benefits in terms of the teaching-learning process and contributes to the enrichment of our LMS.

Based on behaviorism, the LMS that we propose is broken down into learning units, which offers the possibility to present structured knowledge and learning activities (progressive application exercises) and assistance. Social constructivism allowed us to justify the integration of services allowing the installation of internal and external applications enabling communication and collaboration between educational actors. In this manner, the knowledge building in a group outweighs the individualization of learning path. In addition, the cognitivism leaves room to multiple learning pathways in order to take into account the different individual variables that can may influence the way in which learners' process information. The cognitivist teacher will be invited to use ICTs that promote high interactivity with learners, such as simulators, experiments and intelligent tutorials. This obviously does not prevent the development of personal learning environments in parallel to the services offered according to the needs of each of the actors involved in the training device.

Furthermore, the traditional pedagogy, the behaviorism, the cognitivism, and the social constructivism, as for them, have allowed us to propose an activity space, which consists of different subspaces for activities of teaching and learning within the LMS.

In these subspaces, both teachers and learners have the opportunity to:

- Transmit and present structured information in different formats: text, video... (disciplinary information subspace);

- Communicate with one or more actors (communication subspace);

- Sharing with one or more actors (sharing subspace);

- Interact and collaborate together and/or with other actors (collaboration subspace);

- Evaluate themselves and evaluate the resources of information produced (evaluation subspace);

- Produce information (production subspace); Select and use various tools according to their needs (self-management subspace);

- Propose and / or receive personalized assistance (assistance subspace).

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[2] "The distance between actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (Vygotsky, 1978, p. 86)".

Fig. 2.   The conceptual model of an LMS

Thus, the modeling that we propose in this paper makes at the disposal of its users a wide range of spaces for information, production, assessment, communication, collaboration, assistance and self-management in order to enable them to manage well various online training systems (e-learning, blended learning, MOOCs…). In the context of MOOCs which "*refer [...] to massive online training[s] relying on numerical technologies and social web*" [The translation is ours] [18], these spaces are presented in a way that ensures more freedom of choice and action for all users, particularly learners. Thus, the latter can control their training and learning. Indeed whether in xMOOC, which relies on traditional pedagogy [16], and thus focuses on the content, or in cMOOC, which is based on connection that means network-oriented [19], according to our modeling all final users are able to configure the LMS as they like thanks to the integrated web services. These web services are available through modular interfaces designed independently of the LMS. In this way the different users are allowed to access to the malleability offered by our LMS. According to Hoogstoel, this malleability which "*allows improving the individual motivation of actors and promoting their engagement*" [The translation is ours] [20] is possible

through automatic configuration of the proposed tools, adaptation to the proposed interfaces and their customization in accordance to the defined roles.

It is therefore clear that the hybridization of the four learning theories has allowed us to provide the greatest pedagogical and technical richness for both learners and teachers.

Obviously, the principle of reusability and interoperability were taken into consideration when working on the proposed modeling. Therefore, we applied the focused-resources approach, which is mainly based on the notion of "bricks" and "aggregates" [21]. This approach aims to allow the use and re-use of the learning objects in different contexts regardless of the mobilized pedagogical approaches and the designed scenarios. Another approach that has also inspired us is the one developed by Rob Koper [21], which outlines the notions of learning units and pedagogical activities. In practice, the final users of our LMS can model their needs and the type of activities they like in accordance with the assumed roles in the proposed learning environment. The latter provides various services, resources, and relevant tools to achieve the objectives in terms of learning.

Finally, it is worth noting that the modeling proposed here ensures the best management of online interactions; reinforces

the learners' autonomy and sustains their motivations. Thus, our modeling reflects our intention of centering the user around the following two concepts, allowing the entire transversality and the desired personalization: customizable personal office, activity spaces and generic tools.

B. Customizable personal office

All is centered around the customized personal office that each user can customize to his/her own requirements through a widgets system. Moreover, each user can also create learning spaces, aggregate and produce resources… and further like, comment on, and tag them…etc. Thus our LMS will allow freedom of action to all its users regardless their roles (teachers, learners, tutors…) in order to ensure more activity, creativity and re-appropriation of the learning process.

For more customization of the proposed LMS, a rapid start with it and more ease of its use, we will have developed:

- Graphic interfaces which can be configured to fit the needs of users and be adapted to the used peripherals (responsive design),

- Dashboards and customized statistics,

- A user "office" that aggregates information flows and customized home pages (tabs, texts, widgets).

Particularly other more important ideas seem to be at the heart of human motivations within a personal office such as:

- Distinctive behavior, which can be identified when someone tries to be objective, factual and struggles to advocate his/her ideas using the logic of finding holes in other's ideas.

- Connected behavior, which refers to a subjective individual who listens and asks questions in order to understand other's views.

- Constructed behavior that refers to someone who is conscious of his/her approaches and mobilizes them in accordance with the situation encountered.

In general, learning can be stimulated through a good quantity of interconnected behaviors within a learning community. Indeed, not only individuals are brought together but also their psychological functions are developed and promoted by replacing the existent beliefs.

C. Activity spaces and generic tools

Our LMS was modeled in light of a particular vision that aims to accelerate the teaching and learning rhythm by using various activity spaces and generic tools.

In the proposed LMS, the learner has a personal space like that of the teacher. Both of them have the possibility to create forums. Thus the focus is put on making the user, regardless his/her roles, more active by enabling him/her to customize his/her office, create various activity spaces, aggregate, copy and share resources in each activity space. The LMS will make at the disposal of its final users a set of resources and tools for creating and managing online training systems such as MOOCs (e.g. badges, peer assessment, management of groups…

Our LMS is focused on the user and his/her activity. It allows creating and organizing activity spaces, proposing various types of learning activity, creating forums, blogs, and managing the interactions within it. It also allows the management of resources in accordance of users' needs. Therefore, the same possibilities of action were given to both teachers and learners for more distribution of the platform control.

Furthermore, other tools were integrated in our LMS such as courses, quizzes, forums, instant messenger, and blogs. A wide range of external and internal tools were provided and configured to adapt to different supports (computers, tablet or Smartphone).

V. DISCUSSION

Several research [30], [31], [32] had for goal to implement and present the functionalities of LMS platforms and their possibilities to effectively manage users assessment approach (teachers and/or learners) within training institutions. Paquette [37] elaborated e-learning portals editor that opens the way to more diverse and evolved pedagogical models on the pedagogical plan. Moreover, in the framework of the European project Mediasite [35], a reference model for the process for distance learning has been developed. This theoretical framework has led to the integration of several applications (video-conferencing, document manager, portal...) in order to define an electronic training platform for online communication and/or collaboration.

Other research aimed at proposing the modeling of new units, approach, architecture, or adaptive, flexible and interactive e-learning devices. For example, Sadiq proposed the modeling of learning units on e-learning platforms, which relies on the application of the standard IMS Learning Design [39]. Tonye proposed a distance education model adapted to the African context [28]. Aammou proposed implementing traditional features of adaptive hypermedia in an open environment, for describing learning objects and architectural models based on the use of ontologies [40]. Dahmani also presented an ontology-based modeling for interactive learning. His work deals with interactive learning and focuses particularly on the possibility of using the results of the ontological engineering in the modeling of educational domains [27].

Based on these various research works, which seemed to us incomplete, we proposed a modeling portrait of a LMS platform. This latter is anthropocentric and relies on a learning conception that is located at the intersection of the most used learning theories. Indeed, the idea is to orient the design work research towards a great and optimal compatibility between the services offered by e-learning platforms and the needs of all users, particularly learners, for better optimization of online learning.

VI. CONCLUSION AND PERSPECTIVES

In this paper, we proposed an educational modeling of a new LMS platform based on the hybridization of four learning theories, namely the traditional pedagogy, the behaviorism, the cognitivism, and the social constructivism. Our first motivation was to provide a more learner-centric LMS while opening it up dynamically to the teacher. Indeed the proposed LMS offers a range of customizable web services that fits users' needs. In this way, freedom of choice is left with regard to teaching and learning concerning the creation, adaptation, and personalization of various components of the LMS.

One of the most important qualities of the proposed LMS, apart from the fact that it integrates several pedagogical functionalities, is allowing the concerned users (teachers and learners) having the same possibilities of interactive intervention in the system through configuration interfaces that are easy to use. These interfaces include, in addition to a customizable personal office, various activity spaces. This obviously ensures better optimization of the online teaching and learning.

The technical development of the proposed LMS is still taking place. We are looking at the implementation of its first prototype as part of university training with groups of teachers and learners. This will allow us to check the validity of our modeling work with the target audience and therefore take

relevant decisions for better exploitation and wide dissemination of the LMS in the future.

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