A Review On E-learning: Perspectives And Challenges

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***Abstract*—E-learning has been receiving increasing attention in recent years. Many educational organizations have implemented Technology Enhanced Learning Environments (TELE) to improve student learning performance. This paper presents an overview of e-learning area, with a goal of providing references to fundamental concepts and identifying challenges for the broad community of e-learning practitioners. Until now, pedagogical content has been considered as a critical issue. Thus, we discuss recent content personalization's studies and the most important approaches.**

Keywords-E-learning; Technology Enhanced Learning Environments (TELE); Massive Open Online Courses (MOOC); Dropout Problem; E-learning Content Evaluation.

I. INTRODUCTION

Distance education or distance learning has existed for centuries, before the advent of the Internet. The way of practicing has evolved with the development of technologies. In the beginning, mail was used to send homework and receive corrections. By 1921, courses were broadcast in the United States. From 1939, it was the turn of the telephone and television. Since 1990, distance learning has emerged in the United States and Canada with the development of the Internet. Today, we are using TELE that allow us to do everything we have done by correspondence.

This study gives a historical overview of the field of e-learning and provides details on the existing challenges, focusing on those regarding the dropout rate of learners.

In spite of the limits that exist, e-learning offers acceptable solutions. This paper is designed to inform practitioners, policy developers and other stakeholders about the necessity of e-learning, which is becoming an important factor for education as well as business [1][2]. We dedicate this paper to those who want to reflect more deeply upon the adaptive capacity of e-learning to technological mutations [3]. This paper can interest, also, those who want to gain a greater understanding about how e-learning is a promoting field of scientific research.

The aim of this study is to identify key concepts, studies and issues, to highlight the learning dropout phenomenon and make recommendations especially for data scientists to guide future research towards the improvement of pedagogical content. For the purpose of this review, electronic database like Google scholar, ScienceDirect and JSTOR were searched using keywords such as e-learning, e-learning definition, MOOC, learner dropout. Selection criteria included: articles published in English, articles focusing on e-learning, recent articles.

This paper is organized as follows. Section 1 begins by giving general panorama of the paper. In Section 2 we present the concept of e-learning, underline the content personalization issue and trace the advances in TELE. In Section 3, we highlight the Massive Open Online Course (MOOC) revolution and examine some taxonomies. In Section 4, we draw attention to the most interesting challenge: the dropout rate of learners in e-learning. In Section 5, we finish by a conclusion, in which we give foretaste of our future work.

II. E-LEARNING

E-learning or electronic learning, literally means learning on the internet. Sangra et al. [4] identified four definitions categories, where each category focus on a specific aspect of the neologism: technology, knowledge, communication and pedagogy. The first category, Technology-Driven Definitions, portrays e-learning as the use of technology such as the web and electronic media for learning. The second one, Delivery-System-Oriented Definitions, presents e-learning as a mean of accessing knowledge. However, in the third category, Communication-Oriented Definitions, e-learning is considered like a communication, interaction and collaborative tool. The last category, Educational-Paradigm-Oriented Definitions, introduce e-learning as a new way of learning. However, learning needs change very quickly and the concept and functions of e-learning must continuously be adapted to these needs [4]. Nowadays, most of the efforts are addressed to the smart e-learning. Personalization is one of the promising subjects [5] and can be considered as an essential aspect of e-learning. Figure 1 below summarizes the five principal aspects of e-learning: knowledge, pedagogy, technology, communication and personalization.

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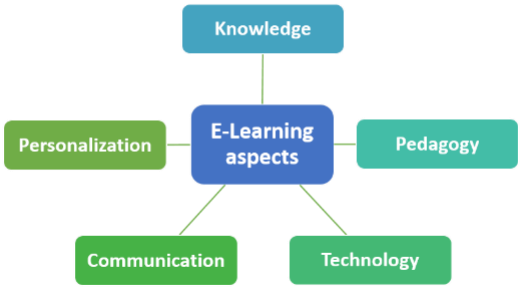

Figure 1. E-learning aspects.

As mentioned by Park et al. [6], "the students' performance can be improved through adaptive e-learning environments that suit their needs". Generally, there exist numerous methods, strategies and approaches to do that, namely personalized interfaces, personalized learning content, personalized learning paths, personalized diagnosis and suggestions, personalized recommendations, personalized prompts/feedback, and personalized professional learning guidance [7]. The challenge now is to give the most appropriate content to learners according to their interests and needs [8], and adapted to their profiles, abilities, preferences, characteristics, goals, talents, etc.

Chorfi and Jemni [9] have developed a personalized learning management system called PERSO. It is based on adaptation of the content to the learner's preferences and knowledge level. The latent semantic analysis was used to analyze learner's answer to a dynamic questionnaire to determine with a high accuracy the learner's knowledge level. Personalization have been also applied to new forms of learning delivery, such as the MOOC [10].

Based on the diversity of approaches, Esselmi et al. [11] provide generalized metrics to foresee the personalization strategies, which are the most appropriate to a specific course.

Sarwar et al. [12] tried to take advantages of web 3.0 and developed an adaptive e-learning framework, named Ontology based Adaptive, Semantic E-Learning Framework (OASEF). OASEF allows the delivering of learning contents that takes into account not only pedagogical requirements but it also considers learning activities as well.

An Educational Recommender System (ERS) exploring the use of argumentation based recommendation techniques as persuasive technologies was proposed by Heras et al. [13]. The purpose of the ERS is to show how arguments can be used as explanations to influence the behaviour of users towards the use of certain items. On the one hand, the ERS uses a database of Learning Objects (LOs), in which each LO included his metadata. On the other hand, the learner should register as a user in the ERS and fill out his educational information, such as his educational level or topics of interest. Then, he should answer a test to automatically determine his learning style. In this manner, the system can explore both characteristics of a student profile and LOs' metadata to recommend e-learning contents that meet the needs of the learner.

Employing ontology in education recommender systems interests many researchers. It is often considered as a useful tool for knowledge representation in ontology-based recommenders. Tarus et al. [14] explained that future works will focus more on hybridization of ontology-based recommendation with other advanced recommendation techniques to improve the recommendation's performance of the learning resources.

Personalized learning has become possible by implementing intelligent learning systems analyzing individual learning data. In this area, Belarbi et al. [15] propose a video recommender system across a Small Private Online Course (SPOC). They analyse firstly users' video behaviour while enrolling into a SPOC to estimate their interest in videos. Then, they try to find learners with similar profile using the unsupervised K-Means clustering algorithm and recommend target user the same videos, in which similar users are interested in.

Bourkoukou and El Bachari [16] propose an adaptive learning system-LearnFitII. As an automatic courseware authoring based on learning identification and collaborative filtering techniques, this system recognizes different patterns of learning style and learners' habits through testing the psychological model of learners and mining their server logs using K-Nearest Neighbors (KNN) and association rule mining algorithms.

Meunier [17] adopts an ontology-based approach to enriches an e-books and shows how it can be an adaptive and collaborative learning device.

After examining some interesting works, we can propose a new e-learning category definition in which e-learning is considered as a mean that provides personalized education. Thus e-learning can be defined as a new way of learning, using the technology to deliver a personalized training in a highly interactive environment.

A. Technology Enhanced Learning Environments (TELE) : Overview

In this Section, we focus on the major developments that have taken place in distance learning solutions from 1920 until now.

The first teaching experiences using computing as a pedagogy tool date back to the mid-1920s when Sidney L. Pressey designed several machines for the automatic testing of intelligence and information [18]. In the beginning, the device could only test and score. A student should press the right answer to move to the next question. If they are wrong the error is tallied. The last machine's generation could teach, but the behaviour of students had not been improved because examinations were corrected and returned after few hours or days.

In 1953, the psychologist Burrhus Frederic Skinner, inspired by Pavlov's work on conditioned reflexes, developed a method of teaching called programmed instruction. This method is based on the systematic progression of acquisitions by pre-structured and individualized programs. The fit between Skinner's

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behavioural theories and the technical possibilities revealed the concept of "Teaching Machine" in 1958 [19]. In front of a machine, the learner could follow a teaching by question/answer and learn by observing his own acts and the resulting consequences.

During the 1970s, the introduction of computer technology into programmed instruction gave birth to Computer-Assisted Education (CAE). CAE makes a dialogue between a learner and a computer possible. The dialogue is designed by teacher to help the learner achieve certain measurable goals in terms of knowledge and skills. CAE allows student the discretion of content, time, place, and pace of the training as it offers him the possibility to participate in simulations of situations and phenomena. Later, it may be noted that research on education and more generally on cognition, oriented computer applications on problems more directly related to learning than to teaching. Hence, “Computer-Assisted Education” (CAE) has been replaced by “Computer-Assisted Learning” (CAL) [20].

In the same period, the trend of learn by playing began to take its place in the world of distance education. The serious game was born [21]. It refers to games used for training, advertising, simulation, or education that are designed to run on personal computers or video game consoles [22]. The player experiences situations that are impossible in the real world for reasons of safety or cost for example to acquire knowledge and develop skills. So, as mentioned in Figure 2, a serious game is defined as an application with three components: experience, entertainment, and multimedia [23].

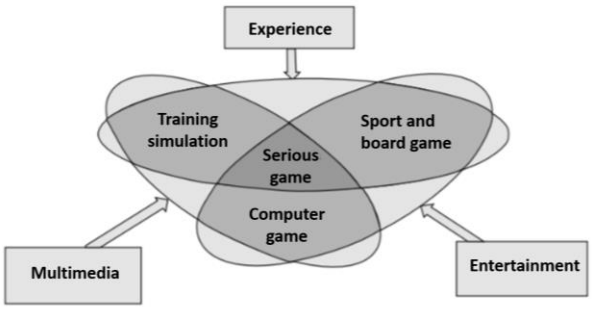

Figure 2. Definition of serious games [23].

By 1980s, CAL became in turn the ICAL Intelligent Computer-Assisted Learning. ICAL was appeared thanks to the contributions of artificial intelligence. Then, the intelligent tutors were born [24]. To perform his job successfully, an intelligent tutor has to be both pedagogue and expert in the domain to teach, he has also to know his students well and manage a real dialogue with them. Like this, learning has become more interactive and adapted to the learners.

At the turn of the 1990s, problem-solving systems were replaced by interactive problem-solving systems. We no longer talked about computer-assisted learning, but rather about learning through interactions with the teacher and other learners. These are the Interactive Learning Environments with Computer [25].

In the early 2000s, TELE emerged [26] to encourage, support and personalize learning. Today, a TELE refers to any computer environment designed to foster human learning, remotely at home or in-class at school, mobilizing human and artificial agents. A TELE can have multiple roles. It is not only used as an environment, which helps actors to realize educational activities, but it is also a presenting information tool, a communication tool and a support tool for teachers.

In TELE, courses can be distributed via a simple intranet, but can also be managed by specialized software called e-learning platform, learning management system or training management system.

There is a large number of e-learning platforms in the international market. Among the freely licensed platforms, we can mention, Claroline, Ganesha, and the open source solution Moodle, which took off in the 2000s to become an international reference. There also exist licensed proprietary platforms such as e-doceo, myTeacher, and Blackboard, which was born in the late 1990s. One of the most famous organizations in distance learning is the British Open University, which has been training hundreds of thousands of people around the world since the 1970s. MOOCs appeared in the late 2000s as the most popular TELE [27].

B. Actors of Technology Enhanced Learning Environments (TELE)

Many educational organizations have implemented e-learning platforms to improve student learning performance. TELE integrate tools for different e-learning actors. The objective is to facilitate their roles and functions. Figure 3 below is an adaptation of the general outline of distance learning platforms proposed by Sébastien [28]. It describes a model of a TELE.

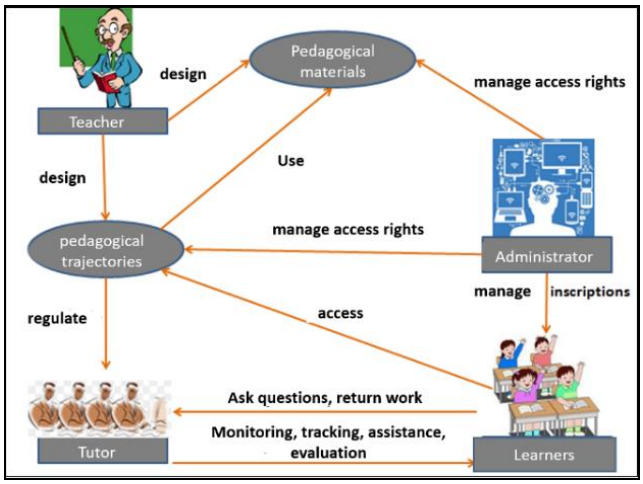

Figure 3. A TELE model.

A TELE involves essentially three main actors who are the learner, the tutor and the administrator.

The learner: consults and / or downloads the recommended educational resources, organizes his work, does exercises, self-evaluates and transmits questions and work to his tutor.

The tutor role can be subdivided into teacher-designer, teacher-trainer "tutor", teacher-corrector, etc. He/she creates pedagogical trajectories, follows up learners and provides them assistance.

The administrator: ensures the maintenance of the system, manage learners' registrations and the access rights as well to the platform as to the educational resources.

III. MASSIVE OPEN ONLINE COURSE: MOOC

MOOCs constitute a major evolution of the e-learning thanks to the increasing expertise in the use of open educational resources, among others. Since 2008, major universities all over the world offered MOOCs to promise the democratization of knowledge and lifelong learning. Anyone can access to online higher education courses anytime and anywhere. So how did MOOCs appear?

MOOCs were born from academic research on pedagogical methods, more specifically from an experiment conducted by two professors George Siemens and Stephen Downes from the University of Manitoba, Canada in august 2008 [29]. They published an online course about techniques of learning in a group entitled "Connectivism and Connective Knowledge" (CCK08) [30]. In few weeks, approximately 2,300 students signed for this course that was offered for free [31]. In the fall of 2011, the University of Stanford offers a massive free online course and gave the certificate to students who succeeded the exam. These students were evaluated by their professors. In December 2011, the American Massachusetts Institute of Technology (MIT) launched MITx; a non-profit organization that would offer online courses called "Massive Open On-line Courses" on an open-source basis [32]. More than 1.7 million registrants were reached [33]. In fall 2012, edX, a non-profit start-up from Harvard and the MIT, had 370,000 students in its first official courses [33]. EdX was offering high quality courses from the best universities and institutions to learners around the world.

A. Specificities of the Massive Open Online Courses

MOOCs are a revolutionary trend of educational technology today. Those online interactive trainings open to all are usually given by university professors and researchers and are intended for a public of learners, who will be supervised and accompanied in their learning [34].

As the name suggests, MOOCs are open, they are accessible to anyone who has an Internet connection and a computer, tablet, or Personal Digital Assisted (PDA). The registration is generally free [35]. Some MOOCs remain permanently accessible. Others can only be accessible after a registration to be made before a deadline and then become inaccessible; this is the case of France digital university (France Université Numérique). One can follow courses directly on the site of the establishment that produces them like the sites of FUN, Sorbonne and Harvard. One can, also, follow courses on platforms dedicated to MOOCs, such as, UDACITY, COURSERA and OPENCLASSROOMS, or on specific MOOCs specialized on certain areas.

The massive dimension is the feature that distinguishes the most MOOCs from classic e-learning. A course can be followed by millions of learners. By the end of 2017, the MOOC platforms have offered 9,400 courses worldwide and attracted 81,000,000 online registered students [36]. However, nearly in classical schools and universities, some professors integrate MOOCs into educational programs. They believe that it is more rigorous academically to experiment with interactive course formats; videos, PowerPoint and PDF documents, notes and abstracts. Thus, from massive and open, the courses become small and private, we speak here about Small Private Online Courses (SPOC), the knowledge's window held and diffused by teachers [37].

Initially, MOOCs were intended for students, today the typical profile of a participant in a MOOC is the employee who seeks to develop new skills. If he achieves his activities and succeeds MOOC tests, he can enhance his experience thanks to a certificate. We called this variety of MOOCs, Corporate Open Online Courses (COOCs) or Corporate MOOCs [38]. Designed on the model of MOOCs, COOCs are training modules for two types of public: the employees of a company and its customers. They are increasingly used in large companies like Renault, Bouygues, SNCF or Pernod Ricard to train employees and retain customers. MOOCs benefit from active pedagogy and innovations of Web 2.0. They get the best of the recent uses of social media and the contributions of the renewed conception of learning that promotes the co-construction of knowledge by the students themselves. Thus, learning is no longer vertical from the expert to the learner but is horizontal because of the exchanges between learners and pedagogical team, all thanks to the social features of the MOOC platforms. Indeed, learners can interact with the tutor and are invited to do it between them in the context of forums.

B. Typology of MOOCs

Between the first MOOC of 2008 called CCK08 and the first course proposed by MIT (MITx) the approach is visibly different. We are talking about two categories of MOOCs; cMOOC and xMOOC. The cMOOC, or the connectivist MOOC, is inspiring from connectivism, the learning theory proposed by Siemens [29] that focuses on the contribution of new technologies in learning and more specifically on the interactions of networked human communities. The cMOOC adopts a participative approach where learning is based on dialogue, interaction, and exploration. The cMOOC brings together a community of people over the same period. Everyone carries out its own researches, exchanges and collaborates with its peers, shares, publishes its own conclusions, produces around a common interest area and not around a precise subject. In this MOOC category, we talk about learning from others. The pedagogical content is partly co-built during the training.

Although, the role of the tutor is limited to a constant animation of the cMOOC to maintain the interest of learners. It involves facilitating interactions and identifying existing educational resources more than designing them. Thus, in the cMOOC the tutor is rather facilitator than instructor.

Known by transmissive MOOC, xMOOC tends to reproduce a traditional situation of teaching where the evaluation touches above the knowledge and not the skills. It adopts the transmission pedagogical model however it is organized with an attractive format using mainly pre-recorded video lectures and quizzes with no emphasis in networking. The content is predefined by the pedagogical team. Learning happens through the transmission of knowledge; the tutor is the expert, he distils its specific knowledge to learners who can communicate with him or ask questions and get answers on forums. xMOOC stands for eXtended MOOC. The term was coined in 2012 by Stephen Downes that says "It should be clear here that the xMOOC sense is not of eXtended MOOC but rather MOOC as eXtension of something else" [39]. One of the features of xMOOCs is to use them as a pedagogical resource in cMOOCs, or more generally, in the case of self-learning where the learner will build his own course according to his needs and own learning goals. Hence a MOOC is not necessarily either a xMOOC or a cMOOC. It can be a hybrid MOOC [40]. Some researchers wrote about other possible taxonomies [31], Market/Open/Dewey Model, Lane's classification, Clark Taxonomy.

IV. LEARNING DROPOUT PHENOMENON: DISCUSSION

In the world of training, increasing the success rate of learners is a major challenge. Nowadays, education is becoming a learner-centered market where learners are perceived as consumers of services. Most educational institutions at different levels work to attract those consumers and meet their needs. However, especially with the advent of MOOCs, this form of open and free distance training, the success rate remains tiny compared to the number of registrants. It usually runs around 10%. For example, of the 841,687 students enrolled at Harvard and the MIT, 5% earned such a certificate [41]. Is it really an alarming number? Can the certification rate be considered as an adequate performance metric for evaluating trainings in general or a TELE particularly? What knowledge and skills assessment techniques are most appropriate? Is it really the right place to talk about learner success or failure in a TELE? Several questions arise.

After studying uncertified learners' categories, we can say that problems related to success take mainly the form of dropping out of the online course, a phenomenon that has received a great deal of attention in e-learning [42][43][44][45]. School dropout, the term used for high school, college and university, is defined as the temporary or definitive studies interruption before obtaining recognition of prior learning, as a diploma or a certificate from an institution confirming the end of studies. In e-learning, the dropout rate varies from one TELE to another; around 7% to 10% [46] of the large numbers of participants enrolling in MOOCs manage to finish the course by completing all parts [47]. Thus, among uncertified learners, those who achieve trainings are far from being the majority. The percentage is explicable because motivations to follow a course or a training are numerous and varied, ranging from curiosity for the general theme of a course, to the desire to acquire knowledge and skills without being engaged or adopting a steady pace of work. As an example, Powell [48] distinguishes between learners who drop out in the first month, and those who leave during the training. He separates, also, between intrinsically motivated dropouts where learners have chosen to spontaneously pursue an online course or training outside the academic or professional program of extrinsically motivated learners who are indirectly engaged by their institutions. He shows that the last ones are the most persevering. The right question, then, is why some users manage to achieve courses, and others not? Generally, the learner's decision to interrupt his training cannot be attributed to an only one factor, but rather to a set of interrelated factors. Hence, the question of abandonment causes is complex. Until this moment, there is no real consensus in researches that can clearly identify the retention factors in e-learning platforms. However, according to Dalipi et al. [49] both student-related factors and e-learning platform related factors lead to a high number of dropouts. Pierrakeas et al. [50] summarize student-related factors in 4 major categories: financial, professional, academic and family, and personal reasons. On the other hand, concerning e-learning platform related factors, we found a need to distinguish between; problems, which can meet a learner in connection with the platform tools or services, and problems relevant to the quality of pedagogical contents such as text, picture, video and quiz.

V. CONCLUSION

With the advent of modern technologies, e-learning has been used in several sectors with significant impact. In this paper, we reviewed studies on the area of e-learning. We presented various definitions and proposed a new one. We described how e-learning has evolved. We revealed challenges and perspectives. To summarize, e-learning continues to grow around the world. The major challenge is to offer the learning where, when a learner wants and with the appropriate manner he/she desires [51]. The goal is to achieve learners' satisfaction. A specific attention is given to the phenomenon of dropping out called also non-persistence or disengagement from trainings. Nowadays, students' withdrawal has become the focus of learners, tutors, and researchers. As a result, issues of the e-learning efficiency continue to be the subject of a large number of recent scientific publications. The challenge for future TELE is to collect data produced by Learning Management Systems (LMS) and use this information to predict problems and opportunities that may arise [52].

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Our future work will focus on the evaluation of pedagogical content. The main objective is to help course designers in the educational reengineering. First, we will observe learners' behaviour throw their interaction traces in the TELE. Then, we will adopt machine learning approach to identify elements needing to be revisited in the content; the form, duration, presentation, etc. The aim is to detect courses content weaknesses in order to give course designers sufficient recommendations that could help to improve pedagogical content and undertake educational interventions.

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