Asian Journal of Applied Science and Technology (AJAST)
Volume 5, Issue 4, Pages 39-50, Oct-Dec 2021

Recent Trends in E-Learning and Technologies

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DOI: http://doi.org/10.38177/ajast.2021.5405

Article Received: 25 August 2021 *Article Accepted: 19 October 2021* *Article Published: 17 November 2021*

ABSTRACT

This work centers around the various advances accessible to help instructing and learning in e-Learning frameworks whose significance for schooling educators and framework designers is obvious. It is important to decide the most fitting e-learning advances to help the individual necessities in instructing, which make it conceivable to give the best learning freedoms to understudies, considering the current circumstance where instructive frameworks have quick requests got from the Covid 19 pandemic, which makes homeroom based instructive practices offer way to far off exercises. There are as of now drifts in the improvement of an assortment of accessible advances which might be outlined in Web environments and Virtual Reality among other arising advances; subsequently, the choice to utilize a specific innovation should be founded on strong exploration and obvious proof. This article audits a considerable lot of these e-Learning framework innovations and gives data, about their utilization, openings and patterns being developed.

Keywords: E-Learning, Web-based e-learning technologies, Virtual reality, Remote higher education.

1. Introduction

There have been many definitions of e-Learning since the term was first introduced in the late 1990s by Gerhard and Mayre [1]. For [2], e-Learning is "all forms of electronically supported learning and teaching, which are procedural in nature and aim to perform the construction of knowledge with reference to individual experience, practice and knowledge of the learner. Information and communication systems, whether networked or not, that serve as specific means to implement the learning process". Likewise, educators must be well informed and familiar with the available technologies, which they will use for the teaching process. However, the emergence of technologies that are available to educators continues to grow rapidly and technologies, which were not originally considered as teaching tools (such as Facebook), are now present in the teaching and learning spaces. There are growing expectations that educators will be experts in the use of technologies and that they will be familiar with a wide range of technologies. These expectations put increasing pressure on educators [3].

The rest of the paper is organized as follows: Section 2, describes the fundamentals of e-Learning; Section 3 deals with and explores e-Technologies; Section 4: deals with some current and future trends in e-Technologies; in Section 5, the conclusions and future recommendations for this work are established.

2. E-Learning

García-Peñalvo and Pardo [4], summarize the evolutionary process of e-Learning using the metaphor of generations, pointing out that there were three generations, and that the third generation is the contemporary one, which is characterized by the confluence of two aspects: The first is the technological aspect, in which the concept of learning platform (LMS) with technology serves as a technological ecosystem of learning that is defined as a community of living beings or an autopoietic system [5], whose main processes are interrelated and whose development is based on the physical factors of the environment that allow interaction and offer greater teaching

flexibility to teachers. The second aspect is centered on the concept of e-Learning, which becomes a more transversal and universal element, at the service of a broader formation of people.

At this stage, it is important to highlight the penetration of technology in people's daily lives, which has facilitated the elimination of the increasingly blurred boundaries between formal and informal learning [6]. Students must follow an educational path as specified in the e-Learning activities. In addition, supporting the student's skills is a necessary part of a person's self-awareness and self-esteem.

Lastly, until today, e-Learning is a commonly used term, although this definition is not universally accepted, but it can be considered as an enhanced learning technology, in which all kinds of digital technologies are used to support the learning process.

3. E-Technologies

E-Learning systems have various technologies and resources, for their implementation, and we proceed to review some of the most used by teachers and students.

3.1. Tools for evaluation

The tools for formative and summative evaluation used in higher education include: questionnaire and survey tools, e- Examinations and those for visualization and development of activities, whose conception and design was focused to encourage student learning and allow a better understanding of student behavior in teaching environments. The surveys or online questionnaires are generated for testing purposes, or are used as a learning tool that incorporates automatic feedback. Surveys can be created through an LMS or through web-based survey tools. Angus and Watson [7], found that the use of such online instruments leads to greater student learning.

The use of online exams, or e-Examinations, is becoming more frequent and there are efforts to move from multiple choice questions, to more sophisticated software tools, by including question banks, random test generators, etc. There are also a variety of visualization tools that help teachers better understand students' cognitive levels and how they can progress through learning concepts and materials. Although the focus with these tools is not on student assessment, they provide a means to better understand student behavior patterns, which allows for improved assessment processes.

3.2. Asynchronous Communication

In educational settings, e-mail is a commonly used asynchronous communication tool for one-to-one or one-to-many online communication. It can transmit files that include text, graphics, and other multimedia content, with or in messages. The strengths of e-mail include the immediacy of the technology, the ability to connect and stay connected, ease of use, and flexibility [8]. However, these can be seen as weaknesses, as they create the expectation that the educator will always be connected and reachable. For Koehler and Mishra [9], other weaknesses include the high rate of misunderstandings due to a lack of non-verbal triggers, such as tone of voice or mood, as well as the need to set and enforce limits and labels; these weaknesses can be accentuated when there is a correspondence with distance students who are developing courses in a second language.

3.3. Synchronous Communication

It is the most technologically compatible communication mode, closest to face-to-face communication and has the element of immediacy, which asynchronous communication lacks. It can be based on text or audio and can include video, multimedia and the possibility of using documents and the desktop.

This type of communication can be done through chat rooms, instant messaging and video conferencing which are usually used in education. Following the Covid 19 pandemic, a large number of educational organizations had to initiate distance education activities globally, which prompted the use of synchronous tools to facilitate communication in an environment in which government organizations dictated measures to maintain social distance, since face-to-face education is not possible at this juncture. In a variety of LMS these include small group video conferences, Webinars, professional development for teachers, virtual assistants as online facilitators, among other resources.

Although some researchers have suggested that there are differences in the use of synchronous tools depending on factors such as cultural [10] and social and economic factors, others have argued that the use of such tools may cross these potential barriers. Rutter [11] suggests that the use of synchronous communication tools brings benefits to student support through more efficient communication.

Such tools can also be used to promote cooperation between students who work individually on their computers from home, which can cross national and cultural boundaries. The immediacy of synchronous tools to facilitate classroom communications offers a number of benefits to students that asynchronous communication tools do not.

3.4. Digital Repositories

These technologies categorize the many different content management systems and the search engines that index them. Typical higher education digital repositories incorporate online bibliographic databases that provide abstracts and indexing of global scientific and technical documents, disciplines of great scope. Today there are more than 100 bibliographic databases, including: Web of Science, Scopus, Web of Knowledge, PubMed, IEEE Xplore, Google Scholar, among others, which can be easily accessed through institutional libraries. The research of hybrid applications of e-Learning use the technology of Harvesting Pedagogical Agents, such as the architecture proposed by [12], which provides students with agents that facilitate the information in these contexts in an automized way. This architecture is analyzed in more detail in point B of Section 4.

Another type of digital repository is that of learning created from combinations of internal and third party resources, allowing academics to retrieve and share these resources. The e-Portfolio is a type of digital repository that is focused on an individual's collection of artifacts and that facilitates the process of collecting, sharing, and presenting learning outcomes and other professional achievements through a digital medium.

Currently, innovative use is being made of e-Portfolios in areas that link education to the domain of planning, professional development, and are even used as resources for summative evaluation in the educational process, as well as in integrated learning at work. In this context, Dorninger and Schrack [13], emphasize the importance of having a common framework of content demands and technical environments.

3.5. Podcasts and Streaming

A podcast is an audio or video file used as an educational resource in this case, which can be created and made available for download from the Internet to a computer or mobile device that is capable of playing MP3 or MP4 files upon request. An alternative to podcasts are streaming files containing data sent in a compressed format, which are played in real time at the destination. These media are being widely used in educational activities, especially in distance learning, and are even used in prestigious universities around the world, which now distribute their lectures through services that incorporate these resources. The use of podcasts generated by teachers and students in LMS has been considerably researched and Hew [14], maintains that the most common use of podcasts is the delivery of lectures and complementary recordings.

Other studies, investigated and demonstrated the versatility and effectiveness of podcasts as a means of involving students in their own learning. For Hew [14], some barriers to the sustainable use of podcasts in education include lack of knowledge of technology and especially a perception that it would have little relevance to teaching-learning, as well as a lack of time to prepare podcasts. Middleton [15] highlights as obstacles to the institutional scalability of podcasting, the lack of technical support, knowledge and technical confidence of users. For [16], suggest that "most students felt that they benefited from learning from podcasts, and they also highlighted the flexibility of the medium".

3.6. Management and Administration Tools

The tools used for teaching and management of students and especially the management of their learning, include those of administration of student grades, reports of progress, as well as the detection of plagiarism. Tools to support the formation of groups and to provide infrastructure to support group work are included, such as private discussion spaces and spaces to share documents. The student information system, or electronic grade book, stores student demographics and allows the recording of grades and other data which can be edited, published for viewing and also exported. According to Dawley [8]: "Students really appreciate the ability to see their overall progress in a course at any time". Also, it is worth noting the tracking tools of accurate media reports to monitor student access to components of a course or completion of assignments.

On the other hand, according to [17], online plagiarism detection software can be used to encourage students to use reference standards correctly and write assignments in their own words. For teachers, it is a screening tool to verify authorship of work submitted by students. The most widely used plagiarism detection software in Turnitin high schools and universities and other alternatives have been developed such as the one proposed by [18], which can be used in conjunction with the Cross Reference. The categorized technologies should be used by teachers within the framework of the educational theories of educational sciences, educational psychology and knowledge management, as well as teaching and learning practices, to allow the development and appropriate use of educational technologies which support the educational process more efficiently; however, research on e-Learning systems is needed, focusing on making them more attractive in pedagogical terms, in which they can be focused from an adaptive perspective, as well as in the use of media as tools to improve communication and interaction with students.

The authors focus on establishing some of the current and future trends in the development of e-Learning systems, many of which incorporate the approach of some of the e- Technologies.

4. Some Current and Future Trends in the Development of E-Learning Systems

4.1. Semantic web technologies (SWT) and Ontologies in the design and development of e-Learning systems

The integration of e-Learning and the Semantic Web has allowed to obtain some important results [19], in the research on e-Learning, highlighting the combination of SWT with educational theories and practices of teaching and learning, for the development of educational technologies, which incorporate and use the theories of teaching/learning, which support the educational process more efficiently. The e- learning environment uses media as tools to improve communication and interaction with students.

The studies carried out by [20] and by [21], in relation to ontologies and the semantic Web for e-learning, stand out for the use and management of ontologies used for their capacity to be shared and reused, and are necessary to facilitate semantic interoperability. The research was widely extended, probably due to the fact that there are many technologies involved, being more and more important in the design and development of pedagogical applications [21]. Other studies have focused on issues related to interoperability, annotation, reuse and intelligent / adaptive systems, such as [22], which allows the integration of different systems and learning through SWT.

Al-Chalabi and Hussein [23], point out that the domain of ontologies in adaptive e-learning systems help to determine the extensible representation of knowledge related to particular domains, since it is possible to meet their requirements in a personalized way, according to their characteristics, interests of students and learning objects available in the system. There are also studies, which propose innovative approaches to recommend e-learning contents based on SWT [24].

Finally, for [25], semantic web technologies have had a positive impact in several areas of knowledge management, being in the educational field, where one of the most notable influences was registered. Some sub-areas, such as adaptive learning, learning objects, collaborative learning, instructional design and authoring tools were treated with this approach.

4.2. Hybrid e-Learning Systems

A pedagogical agent are intelligent agents with a pedagogical agenda [26] and are referred to characters generated by computational resources, to be used in educational environments, with the purpose of performing pedagogical activities. A pedagogical agent is an anthropomorphic virtual character [27], used in an online learning environment for educational purposes and to serve as a learning support tool, providing help and guidance, demonstrating principles, procedures and examples to assist students in understanding, processing and storing knowledge and information, so that they can learn at any time and in any place. From the e-learning point of view, there are two types of agents that are of special interest to researchers [12]: harvesters and pedagogues. Harvesting agents collect learning material from heterogeneous online repositories. The central properties of the agent technology (e.g., parallel and distributed execution, mobility and communication between agents) can bring significant benefits to the harvesting process. In [12], propose a standalone e-learning architecture called

HArvester, as well as a pedagogic agent-based e- learning system (HAPA), which is designed to assist students during the resolution of programming tasks (Fig. 1).

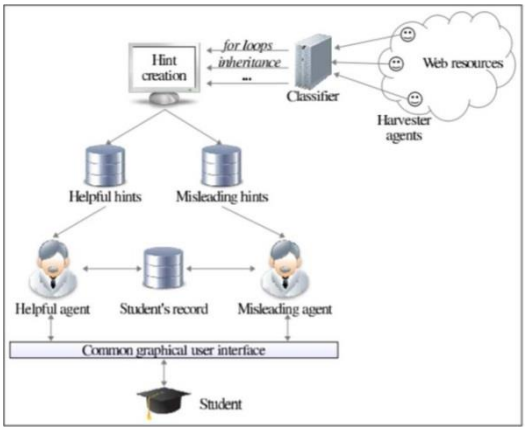

Fig.1. A high-level overview of the HAPA system (Source: [12])

HAPA has three main components: harvesting agents, sorting module, and pedagogic agents. The harvesting agents collect the appropriate learning material from the Web, which is then entered into the Classifier module, which performs automatic classification of individual learning objects. They also use two specially designed pedagogical agents, one useful and one misleading, to interact with students and guide them to understand the learning material. The useful pedagogical agent provides useful clues to solve the problem in question. The misleading pedagogical agent guides the learning process in the wrong direction. Because the student is never sure which agent(s) they are interacting with, this novel approach encourages students not to blindly follow the instructions of the agent/tutor, but to employ critical thinking.

The authors of this architecture believe that this "soft- stress" environment could help students to face real stressful and competitive work environments. This proposal suggests a hybrid system, making an LMS be associated with a Pedagogical Agent, which together with harvesting agents can collect additional learning material [28]. Harvesting agents are also defined as web crawlers, specialized in the collection of information. The proposal includes tools to prepare useful and misleading suggestions, and the implementation of the visual representation of the pedagogical agents.

4.3. Collaborative e-Learning

Research on Computer-Supported Collaborative Learning (CSCL) began in the early 1990s and focused on how computers could engage groups of students to improve their Learning [29], by forming small group learning communities. Framed in the theories of social constructivism [30], this paradigm offers opportunities in the process of educational construction. In a CSCL environment, the students learn in groups, through interactions among which it is possible to mention: to formulate questions, to explain and justify opinions, to explain their reasoning and to present before their peers [29]. The main form of collaboration is the support based on networks, with resources such as videoconferencing, email, chat, social networks, forums and 3D environments. Likewise, the Collaborative Virtual Environments (CVE), can be: Immersive Simulators, Virtual Learning Environments, Serious Games and 3D Virtual Worlds.

Nowadays, interesting implementations of CSCL in tutoring systems are emerging to show the benefits obtained from the interaction between students during the resolution of problems, such as the proposal of [31], maintain that in the presence of an increase in the number of students, in the presence of a lower growth rate of teachers, educational problems have arisen due to the lack of sufficient support for students in e-Learning activities, suggesting collaborative learning as a solution to the problem, in an e-Learning collaborative model using Cloud Computing, having developed a prototype, whose empirical evaluations demonstrated the effectiveness of the proposed approach.

On the other hand, Masud [32], proposes a collaborative e-learning content management environment, arguing that the heterogeneity of data in different LMS, present many difficulties to share data; such as how to integrate data, produce results for user queries as well as find the data, for which the authors present a solution for semantic data interoperability, distributed metadata management, and an agent-based query processing approach for supporting the exchange of learning content from different LMS. The authors also present an empirical evaluation of the user acceptability of the proposed solutions to find qualitative measures of the users' acceptability and satisfaction, whose proposed solutions resulted in high user satisfaction.

4.4. VR and AR in e-Learning environments

In [33], state that the three key elements that characterize VR are sensory immersion, where the user has the ability to look around, generally with the use of a head-mounted immersion helmet; interactive simulation, which consists of a simulation in the sense of recreating a virtual world, which only exists as a digital representation of the physical objects in a computer; implicit interaction, which allows a certain degree of control over the experiences, generally achieved with sensors and input devices such as joysticks or keyboards.

VR can be classified into: virtual worlds, augmented reality (AR), mixed reality (MR), and extended reality (XR). Virtual reality and its associated technologies tend to stimulate creativity and design capacity in engineering, as well as show a high penetration in the entertainment industry, which makes them of great interest for researchers in the field of education. VR, which can be associated with Artificial Intelligence (AI) approaches, as innovation focuses, are currently very isolated; however they can improve learning experiences, because they support direct experiences of real or even imaginary world phenomena [34], [35]. As the design and development of RV and IA become more accessible to institutions, the levels of use and dissemination may be greater, as research, evidence, and experience are currently limited. Some of these are:

In [36], propose a prototype of the virtual laboratory, dedicated to dimensional and geometric metrology, with traditional simulated measuring devices (caliper, micrometer, etc.) and coordinate measuring machines. Measurement simulation can be carried out in a 3D environment, based on models of parts with dimensions, orientation, position and shape errors (shape mask model) and on models of measuring devices, which present measurement uncertainties. In [37], proposed a work, focused on particular advantages that virtual laboratories have, to support the experimentation on non-observable phenomena, such as thermodynamics, chemical reactions or electricity. The authors argue that reality can be adapted, that is, the properties of the mathematical model underlying the virtual laboratory can be changed, to make the interpretation of certain phenomena easier.

4.5. Learning Analytics

The Learning Analytics proposes a promising approach for digital and adaptive learning environments [38]. Learning analytics uses static and dynamic information about students and learning environments, evaluating, obtaining and analysing them for real-time modelling, prediction and optimisation of learning processes [39], [40], learning environments and educational decision making [41]. The aim is to improve the satisfaction of the students' needs, offering individual learning paths, adaptive assessments and recommendations, or adaptive and Just in Time feedback, according to the states' motivations, individual characteristics and learning goals.

However, a better understanding of how learning processes are related is required and can be captured through the data available in current digital learning environments [42]. Therefore, learning analysis approaches may be appropriate, as they allow for additional information on online learning behaviour without being intrusive [43]. Current approaches to learning analysis focus on behavioural indicators in the digital learning environment, such as time spent online, access to various types of resources, or reading and writing of publications relating them to learning performance [44].

Furthermore, few approaches are enriched with learner characteristics, such as demographics or assessment results, to predict study success [43].

4.6. Remote Labs

The laboratories were initially conceived to carry out research and generate knowledge. Laboratories were introduced as part of the student curriculum in the late 19th century in the United States [45] and they are considered absolutely essential in engineering education in that the theoretical knowledge imparted to students in the classroom is adequately complemented by practical experiences through laboratory experiments [46].

The term "remote laboratory" describes laboratory experiments that can be controlled and monitored remotely from a distant location [47]. This offers numerous advantages in educational settings compared to a classical laboratory. Remote laboratories and virtual reality are widely discussed tools in the educational context. They offer a practical and motivating way of teaching students and are thus an interesting topic for scientific research [48].

5. Conclusions and Recommendations

An audit of the writing of ongoing years was done, comparable to e-Learning frameworks, e-Technologies and advancement patterns in these promising spaces of innovative work, a period wherein numerous developments and changes occurred in different angles, for example, mechanical and methodological, which became another part of a significantly more intricate mechanical environment, in light of administrations that interoperate with one another and that expect to satisfy the needs of foundations and people.

A point-by-point survey of arising innovative work issues in e-Learning was likewise completed, zeroing in on the components that impact these advancement patterns.

Instructors and understudies are confronted with a lot of material to study and explore and as a rule don't have the foggiest idea how to channel it, which debilitate cooperation with the framework. For this situation, some

e-Technologies and particularly the versatile e-Learning can be helpful, since it establishes the individual mentor for themselves and toward that path there are many moves comparable to the fitting techniques and systems, which should be applied to address the issues of the understudies.

At long last, this work, which is the aftereffect of a concise survey of the e-Learning and e-Technologies frameworks, permitted to concentrate some mechanical and functional viewpoints, truth that can contribute in the origination, plan and development of these frameworks, which will without a doubt work with crafted by understudies and instructors.

Declarations

Source of Funding

This research did not receive any grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing Interests Statement

The author declares no competing financial, professional and personal interests.

Consent for publication

Author declares that he/she consented for the publication of this research work.

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