Indonesian Journal of Electrical Engineering and Computer Science
Vol. 38, No. 2, May 2025, pp. 1219~1230
ISSN: 2502-4752, DOI: 10.11591/ijeecs.v38.i2.pp1219-1230

Emerging approaches of artificial intelligence tools for distance learning: a review

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Article Info

Article history:

Received Apr 12, 2024
Revised Nov 3, 2024
Accepted Nov 11, 2024

Keywords:

Artificial intelligence
Communication platforms
Distance learning
E-learning
Higher education
Meta analysis

ABSTRACT

Learning management system (LMS) is the best way to deliver educational content in the context of higher education, by settings students worldwide with high-quality educational material. This paper principally seeks to examine the use of e-learning platforms in the last years from 2019 to 2023, which has coincided with the pandemic period, by elucidating the benefits and limitations of e-learning platforms, analyzing the real-world artificial intelligence (AI) algorithms used and their operating context. A comprehensive literature search was conducted on different electronic databases to identify relevant studies related to e-learning and AI tools used during this period by applying inclusion, exclusion criteria and preferred reporting items for systematic reviews and meta-analysis (PRISMA) process. Based on this review the tools were necessary social media and free communication platforms that offer the flexibility and build autonomy to students. On the other hand, many challenges are arisen due to the lack of experience in the term of using those tools or due to technical problems, for this reason, the use of AI tools to enhance learning experience still one of the approved solutions.

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1. INTRODUCTION

With society's progress throughout, the university students always increase their demand for the content and forms of higher education [1], presently; existing university and college curricula are currently unable to meet the needs that are driving the process of profound reform in higher education [2]. Consequently, the use of social media and learning management system (LMS) platforms is the available solution to ensure distance learning. In addition, the penetration of information and communication technologies (ICT) has increased in developing countries, and their applications have led to their use in various fields, including education, but there is still a huge gap between the need for ICT infrastructures and their use and availability [3].

The importance of ICT has been observed even more during the health crisis of COVID-19, online education, as well as other alternative teaching modalities, have increased in the traditional environment. Although the demand for these alternative educational modalities has increased [4]. On December 31, 2019 the World Health Organization (WHO) received numerous reports concerning a disease as flu in China [5]. The novel coronavirus caused a highly contagious disease named COVID-19 [6]. This virus quickly led to

major changes affecting all the aspects of life including education. The pandemic conduct to the closing of universities and colleges in the worldwide in the hope that social distancing could help to reduce total fatalities and confirmed cases.

Under this situation, online teaching has become important in the period of the crisis [7]. The concept of "Virtual universities" has taken hold, the university educational staff by using the tools above mentioned or developing their own platforms (taking the example of Mohammed VI Polythechnic University UM6P in Morocco) [8]. Furthermore, in Iraqi universities, especially International University in Sulaymaniyah campus various tools are used to serve students during this period such as: Mercury (specific software that allows students to track course videos, assignments, and other related materials), Vimeo (video platform for subjects), Zoom (online software to present live sessions), PIS (normal university system that allows students to track their grades and attendance), and Zipgrade (online exam platform). Among the tools used in Egypt there are free communication splatforms, e.g., Google Classroom and Zoom. Social media, e.g., Facebook, WhatsApp and Youtube to communicate with their students via formal groups on the teachers' social networking pages [9]. Challenges have arisen when using these tools, due to a lack of experience in terms of use, lack of communication and interactions between students and teachers, or others related to the equipment and the internet. Therefore, it is particularly important to explore learning approaches in higher education that are consistent with the teaching experience of universities and colleges and increase pedagogical impact [10], by forced instructors and students to allow a new methodology of teaching, transmitting knowledge and assessment.

Thus, the added value of this work is to bring together all the methods used regardless the geographical background (taking the example of different contexts in the world), certainly several articles have addressed this subject but each article deals with some of these methods in certain countries. Furthermore, the previous papers don't' shed light on preferred reporting items for systematic reviews and meta-analysis (PRISMA) checklist that is dedicated mainly to reviews. However, our research tackles the different scenarios of e-learning in the period of study by introducing real-world examples of artificial intelligence (AI) algorithms for distance learning, and comparing the most well-known e-learning platforms.

In the light of the rising and deepening need for smart higher education in universities and colleges, introducing real-word examples of AI technology in education especially their applications on predicting students' performance, interactivity and education development is also important because it represents a solid basis for future works to take into consideration the students' perceptions in order to reinforce e-learning environments and encouraging researchers to develop adaptive e-learning platforms far from social media whose main purpose is not distance learning. In addition, students have different preferences, needs, rhythms, thus, we propose to integrate AI in e-learning platforms and encouraging the development of adaptive learning platforms. This article is structured as follows: the first section presents methodology. The second section discusses results and discussion; and the third concerns conclusion.

2. METHOD

2.1. Search methodology

A comprehensive literature search was conducted on different electronic databases to identify relevant studies related to e-learning tools used during the confinement imposed by the epidemic, than discuss challenges and opportunities. The search was restricted to identify only the papers published on the time of crisis in the last (2019-2023). The articles were gathered from sources that have a significant number of research articles, particularly relating to educational institutions: Science Direct, Emerald, Wiley Online Library, JStore, Springer Link, and Scopus were among the publishers that were targeted. The use of larger databases, covering nations from all over the world, was considered in order to increase the sample's representativeness.

The search was based on keywords taken from Google Scholar's basic search. The keyword search used terms including education, e-learning, online teaching, challenges, opportunities and higher education. These keywords were occasionally combined using the advanced search option, Boolean operators, to access to a wider range of resources as shown in Table 1. The initial search strategy's results were then filtered by title, abstract and keywords of literature published during the last years (2019-2023), according to inclusion and exclusion criteria as illustrated in Table 2.

In this review, only peer-reviewed studies that investigated the online learning in the period of study were included for analysis. Selected studies that were not written in the English language or non-indexed, were excluded. During the search process, only articles related to online teaching and higher education were extracted from the databases. During the screening process, a further some articles were deleted because they did not fully meet the inclusion and exclusion criteria set out in the Tables 1 and 2.

To more illustrate the idea, we specify the various inclusion and exclusion criteria used in this article. Figure 1 shows some of search chains used in our searching process. For information, this study is based on three main research questions:

- What are the mainly tools used worldwide to ensure the teaching practices?
- What are the benefits and limits of those tools?
- How can AI tools overcome the challenges and ensure pedagogical continuity through virtual classrooms?

Table 1. Keywords and search terms

Keyword	Search terms
Higher education	'Higher education', 'Tertiary education', 'University education'
Artificial intelligence	'Artificial intelligence', 'AI'
E-learning	'E-learning', 'Online teaching', 'Distance learning'

Table 2. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Publications published in the three last years	Publications published outside the fixed period
Publications that deals with E-learning	Articles not written in English
Publications that contains the keywords above	Non-indexed publications

Higher Education **OR** tertiary Education **OR** University Education **AND** E-learning **AND** Artificial Intelligence

Artificial Intelligence **OR** AI **AND** Online teaching **OR** Distance learning

Figure 1. Examples of search chains

2.2. Statistical analysis

The PRISMA process [11] was adopted as the document filtering process, the Figure 2 presents the documents filtering stages from selected papers to adopted ones.

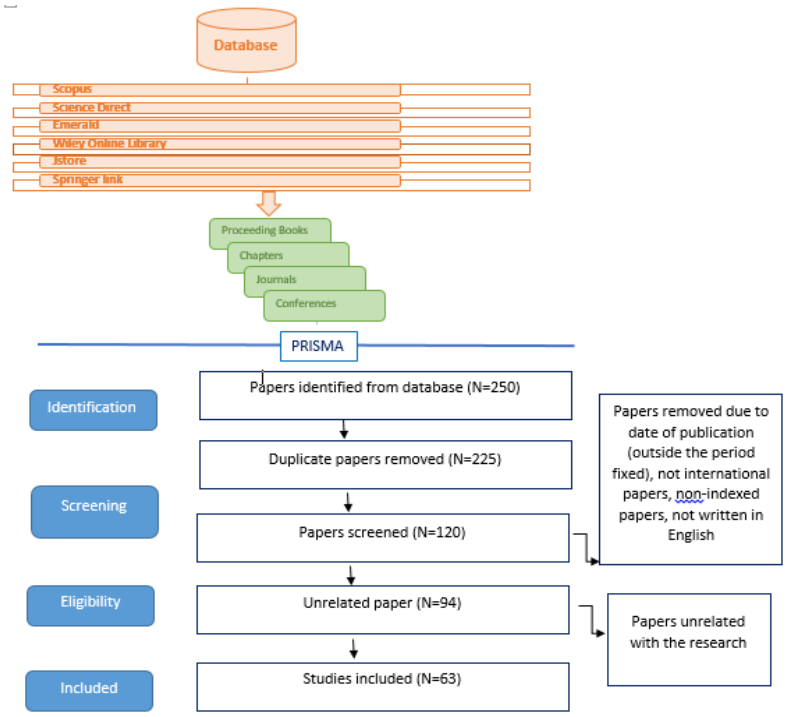

Figure 2. Papers' filtering process

The PRISMA [12] published [13] in 2009 was designed to help authors prepare transparent reports of their reviews, and its recommendations have been widely endorsed and adopted. To fill out the above PRISMA flowchart, the following steps are taken:

- Step1: in the first stage, we run the searches we designed through the abstract, keywords and databases selected.
- Step 2: this step concern the search into databases chosen, for each database, we entered each key search term individually. This included all our search terms. We combined all the search terms in the various combinations using Boolean operators such as AND OR, where appropriate. We applied all our limits (search years, full text only, and English language only) once all the search terms had been combined and we had applied all the relevant limits, we obtained a number of records or articles and entered it in the top left-hand box of the PRISMA flowchart for each database.
- Step 3: this stage is about eliminating duplicates articles or those that don't meet the criteria (not written in English, and not indexed)
- Step 4: the next step (screening articles) is to add the number of items we have selected. This is the same number we entered in the duplicates deleted box.
- Step 5: we reviewed all full-text articles to see if they could be included in the final review. At this stage, we checked our guidelines to see how many articles we still had to review.
- Step 6: the final step was to subtract the number of items or records excluded during the full-text eligibility review. The number obtained may vary according to the type of assignment, and has been entered in the last box. The PRISMA flow chart is now complete and can be included in the study results section.

2.3. World cloud

World cloud is a potent data visualization technique [14] that allows people to quickly and easily identify the subject domains of a large collection of textual documents and become familiar with their content. Rather than reading a large number of files, the content could be automatically retrieved, processed, and presented as a word cloud using only the most important terms. Typically, the most significant and frequently appearing words are visualized in different colors and higher font sizes so they catch attention immediately. To create a word cloud in our study we proceed as follows:

- Extract the main words from abstract and keywords and add them in Excel file.
- Install the main libraries: matplotlib and word cloud than importing some functions: image color generator and STOPWORDS to remove words that carry much less substantive information about the meaning.
- Generate the algorithm and show the graphic.

To analyze the data easily power BI [15] is used. This visualization tool provides many features to visualize data. We use it in our study to locate the papers' taken into account in the study and show more details concerning papers' source, and type. The combination of PRISMA and word-cloud was very beneficial; on the one hand, PRISMA allows improving the reporting quality of a systematic review and provides substantial transparency in the selection process of papers in a systematic review and world cloud based on the articles collected allows visualizing the main terms to determine domains of research to readers.

3. RESULTS AND DISCUSSION

This section is based on the review outcomes of a selection of articles published in the area of online learning during the period of COVID-19 pandemic. Most of the papers reviewed in this study focused on the response of educational institutions to COVID-19, the approaches adopted to overcome the harmful effects of the crisis and the challenges associated with online learning, as well as the opportunities arising from the pandemic. An exploration of the results is shown in the subsections below.

3.1. Analysis of selected papers

Figure 3 demonstrates the special papers' distribution obtained using PRISMA checklist, color gradation shows the number of articles, the darker color means the huge number of articles and the lighter one means that this country has a smaller number of articles compared to the others. Figures 4 and 5 provide a visualization of the variety of sources to access research papers and their types (conference paper or journal articles), the majority of articles are taken from Science Direct (28%) and Scopus (24%), 80% of those papers are journal articles and 20% are conference paper.

Figure 6 shows the annual distribution of research from 2019 to 2023. It has been observed that the number of studies increased in 2020, which is to be expected, since this is the year when all countries

switched to online education out of obligation rather than choice, to combat the spread of the virus. Figure 7 Shows the word cloud of the most frequently words appeared in the papers selected with different sizes and colors to present the importance of each word.

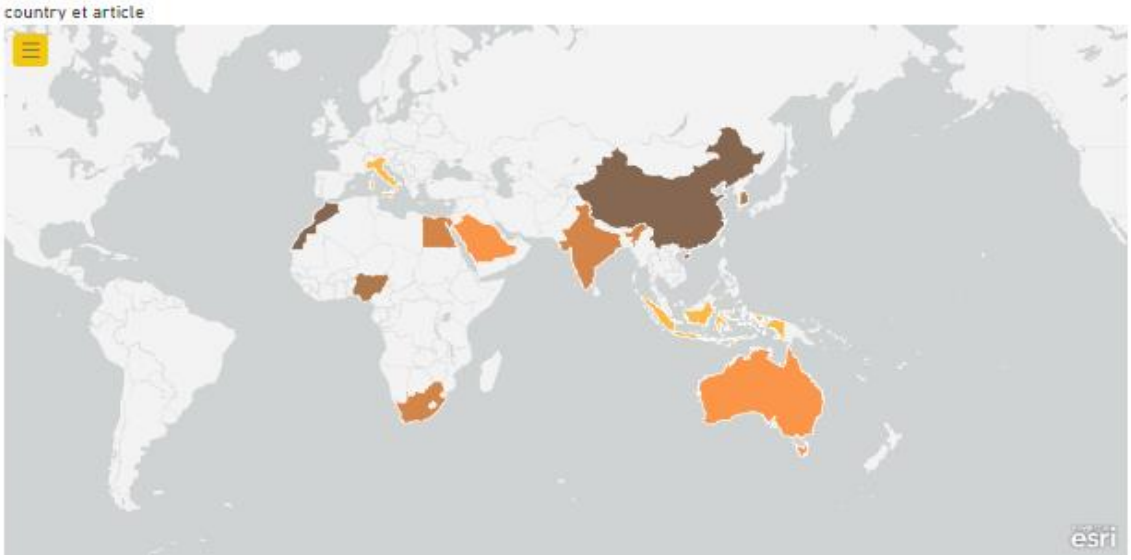

Figure 3. Spatial distribution of papers by country

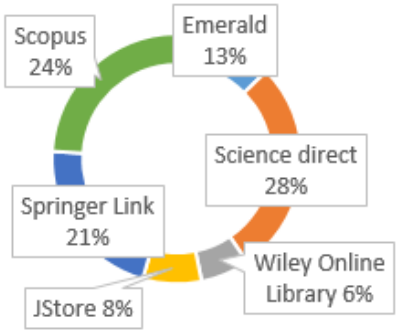

Figure 4. Papers selected for review publisher

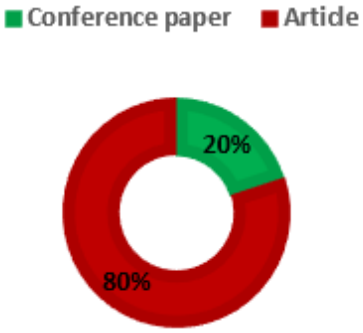

Figure 5. Type of selected papers

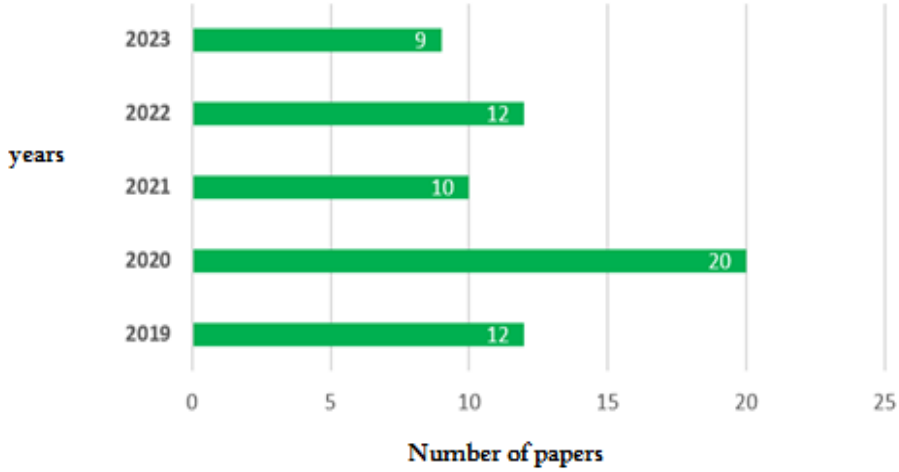

Figure 6. Distribution of studies by year of publication

Figure 7. WordCloud of the most appeared terms

3.2. RQ1: what are the mainly tools used worldwide to ensure the teaching practices?

In December 2019, the first suspected case of COVID-19 in Wuhan City in China, was reported to the World Health Organization (WHO). At that time, no one could foresee that this new virus would bring daily activities to a halt and impose social distancing [16], especially school and student life, requiring the urgent use of distance learning methods that allows students and instructors are in different physical locations. This learning option allow avoiding the spread of the pandemic. They are two types of online teaching asynchronous and synchronous, both proved to be at least as satisfactory as the traditional face-to-face approach [17], generally, the students used as materials laptop, mobile, desktop or a combination of all these [18].

The rapid development of information and communication and the web are changing the principles and approaches to teaching programming to computer science graduates in higher education institutions [19]. As cited in [20], Google is a popular Web 2.0 tool that offers many interesting features and applications. It has teaching and learning potential with its unique integrated features that provide educational, social, and technological benefits. Google Classroom is the most downloaded online learning application during COVID-19; it has created a new adaptation for the teacher and students to learn the new teaching and learning model.

Utomo *et al.* [21] tools combination strategy was recommended, Google Classroom tool was used as a learning app, WhatsApp group as broadcast messaging and zoom as a video conference media for distance learning. The Indonesian campus has prepared the e-learning process by using other tools like Edmodo, Google Meet and social media (Facebook, Telegram and Instagram). Other materials have been used also such as Skype, Cisco and Microsoft teams [22]. In United States [23] an adaptive remote teaching illustrated by the "pandemic plan" was adopted which is divided into several steps:

- Lecture shorts and slides: the instructors provide recordings and slides that summarized his lecture materials.
- Team presentations and discussion boards: teams post their slides and questions based on their analysis and the colleges try to ask the questions and provide their feedback on the readings.
- Live, and course announcements: the instructor arranged weekly live meetings with the zoom during office hours for students to come in if needed to ask questions or just talk. The instructor provided daily email correspondence to maintain the connection between faculty and students.
- Individual exam projects (IEP).

The Table 3 presents a description of the platforms used during the COVID-19 era.

Table 3. Description of platforms

Platforms characteristics	Skype	Cisco	Microsoft teams	Zoom	Edmodo	Google classroom	Google meet
Type of platform	Web service	Digital communication technology	Collaborative communication application	cross-platform instant messaging and video-conferencing platform	Learning management system	Web service	Videoconferencing service
Mobile application	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Video conference	Yes	Yes	Yes	Yes	-------	No	Yes
Media storage space	Limited	--------	Limited	Limited	Limited	Limited	Limited
Cloud deployment	------	Cloud	Cloud	Cloud	Cloud	Cloud	Cloud
Site URL	https://www.skype.com/fr/	https://www.cisco.com/site/in/en/index.html	https://www.microsoft.com/en-us/microsoft-teams/group-chat-software	https://zoom.us/fr/	https://edmodo.com	https://classroom.google.com/	https://meet.google.com/

3.3. RQ2: what are the benefits and limits of those tools?

The success of any information system depends on the use of the system by the users, which often poses challenges. In the COVID-19 era that coinciding with the study period, the adoption of e-learning platforms and tools is so challenging for students and educators as the same time, among the difficulties encountered it is cited in [24], that those challenges are grouped into four categories: technological challenges, individual challenges, cultural challenges related to the context and readiness of each culture and course challenges that are illustrated by internet experience, computer self-efficacy, poor interface design, inadequate technical support, lack of IT skills poor network infrastructure and weakness of content development.

A study conducted [25] puts the technological issues as the main challenge in the COVID-19 that encompasses: scarcity of e-devices, lack of expertise in online teaching, poor network infrastructure and high-cost internet packages needed for smooth connectivity and other factors that impact the online teaching. Other challenges are discussed in [26] related to internet speed, online access and the material used: some students could not access to online examination and the absence of lab sessions.

On the other hand, the online teaching during the COVID-19 era has many benefits such as pedagogical effectiveness, development of virtual skills, time flexibility in online learning and ability to interact with teachers in online courses [27]. In Ukraine, among the benefits of online teaching is that e-learning provide to students the opportunity to build self-discipline and self-education, for teachers it is time of mastering the latest methodologies and tools for distance learning and for the institutions it is about [28]:

- Practical tests of the technical capabilities of distance learning
- Defining a clear strategy of distance learning where students not only acquire knowledge, but also collaborate with teachers in a feedback mode
- The awareness of the need for a quick update of the content to learn at home has been brought

Mutton [29] states, the major opportunity of distance learning is the development of a new pedagogy for online teaching and a new ways for working, it is considered as a situation to adopt an innovative pedagogical approaches and rethink teacher education in a bold and exciting way. The most positive experiences of COVID-19 pandemic is the variety of alternative ways to help students pursue learning, the imagination of colleagues in designing new forms of learning support and assessment, and the willingness of staff to deploy new technologies are generating lasting impacts [30].

3.4. RQ3: how can AI tools overcome the challenges and ensure pedagogical continuity through virtual classrooms?

To make online teaching successful, it is cited in [31] that students think accessibility to the papers, connection, software and autonomy is essential. For Peter Goodyear. Successful e-learning requires excellent communication skills, careful design and active learners' involvement, while for Lourdes Guàrdia, five signposts on the roadmap of innovative approaches to teaching should be respected:

- Using AI to enhance learning experience.
- Distributed pedagogy that includes collaborative partnerships between institutions and deliberate separation of services to allow learners to select different aspects of their learning experience.
- Engaging pedagogy where learners are encouraged to actively participate in the learning process.
- Agile pedagogy that includes personalized learning paths and individualized support for learners.
- Situated pedagogy embraces the idea of contextualizing learning and emphasizes the need for curricula with real-world elements.

To further clarify the use of AI, there is some application on educational field in the following paragraph.

In the educational field, the use of AI seems necessary to enable the development of intelligent machine systems that go far beyond the limits of human work that helps to create a digital classroom, which is valid until the post-covid era. Shaikh *et al.* [32], the use of AI and machine learning help to rationalize different learning models and develop systems that motivate students to master new skills. Moreover, it can create new areas that offer fresh perspectives that produces energetic methods of learning in which instructors may shift much of the regular human labour to AI systems in education to promote learning productivity.

Among the AI algorithms used there is linear regression, decision tree and random forest to predict students' performance during the pandemic [33]. Other are used by Bhardwaj *et al.* [34] like CNN models for students' engagement in a virtual classroom through the emotion recognition. Table 4 describes the AI models used in the field of education.

Table 4. AI models used in education

Model	Type of model learning	Topics covered
Linear regression	Supervised learning	Predicting students' performance. Analyzing and predicting educational development [35]. Examines the students' academic performance [36].
Decision tree	Supervised learning	Predicting students' performance [37]. Formative evaluation of students symptom [38].
Random forest	Supervised learning	Predict students' performance. Impacts of COVID-19 on stress among secondary school teachers and staff [39].
CNN	Supervised learning	Students' engagement in a virtual classroom.

3.5. Comparison with the existing literature

Based on the existing literature, in this study we explore the evidence that contribute to understand the online practices and methods used in the period of lockdown in the COVID-19 era, furthermore the opportunities and challenges of the online teaching. These studies address in general the impact of the pandemic on education sector especially higher education. Further, address the shift from classroom teaching and learning to online teaching and learning because of the COVID-19 lock-in.

Otherwise, some researches discussed the subject from its large perspective, for example, the Kausar *et al*. [40] attempt to cite the major difficulties and benefits of e-learning and propose some solutions. This paper highlight the latest online platforms like Open Learning, eDX, and Udemy. In the same context Darren Turnbull and al. shed light on challenges in using online teaching, and the most used technologies [41]. Zethembe [42] also discussed the advantages and disadvantages of online teaching during this period. Toquero [43] where the advantages and constraints are largely discussed to take advantage from the challenges in order to strengthen the educational practices and make them more responsive to students' learning needs, even outside the traditional classroom. In the Philippine context many measures are suggested to overcome coronavirus defies such as migrating courses, align curriculum competencies, scale up teachers' training for online learning Instruction and strengthen research efforts, data monitoring, and evidence-based practices.

The previous studies deal with the subject in a more or less conventional way, citing the advantages and disadvantages of online teaching. On the other hand, some articles deal only with the case of their own country, or sometimes the method used to select the articles is not sufficiently clear. This is why we introduced the PRISMA method, which is mainly dedicated to journals, and applied it to a large number of articles (covering more or less several countries) and highlighted the most important terms using a global cloud to make it easier for readers to know what the article is about. Moreover and despite the important role that artificial intelligence plays in our world, it has not been used as a remedy to develop a personalized system for distance learning [44].

The added value of this work is to take advantages from all the experiences that deal with the subject, write an article review respecting the norms (PRISMA method) and introducing the vital role of AI to overcome some difficulties relating to distance learning taking into consideration students' emotional state is also important and that can be a challenge if students aren't satisfied about the learning process. This is what we'll try to propose in the next section.

3.6. Proposed solutions

In order to overcome the challenges, it is recommended also [45] to introduce the open educational resources (OER) that are considered as a solution for higher institutions to face these challenges: including free textbooks, instructional materials, audios, videos, computer applications. The students using OER achieved the same learning outcomes as those using paid resources. In addition, most students and instructors feel that OER is less likely to help students learn while helping to save money. Regarding all the previous articles, we proposed the Table 5 that suggest solutions for the major challenges with platforms.

Table 5. How AI can overcome challenges

Research issue with online platforms	Artificial intelligence remedies
Static design of platforms	Automate basic activities in education
Students feedbacks, needs, rhythms and preferences aren't taken into consideration Lack of content adaptation	Educational software can be adapted to student needs. AI can also allow to compare students' action to didactic content, strengthen autonomy and intelligence by designing smart models and predicting students preferences.

In the Table 5, it is mentioned that AI can help to develop appropriate educational software that can be adapted to students' needs. In this perspective we get the idea to propose an adaptive e-learning system based on students' needs, preferences and emotional state. To start with, no one can deny that a distance learning system brings together principally: learners, trainers and institutions for support as presented Figure 8, while using a range of tools and resources to achieve the objectives sought by the institutions [46].

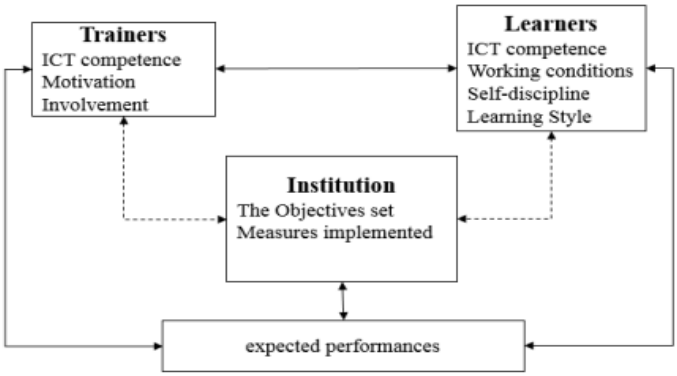

Figure 8. E-learning system components

Meanwhile, this e-learning system can be impacted by different factors imposed by learners' preferences that differ from learner to other. For Keefe (1979) [47], it is defined as follows: "composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment". The major effective factors on learning styles according to Ellis [48] are:

Abilities (intelligence, ability or memory).

- Tendencies (motivation, anxiety, personality or willingness to communicate).
- Students' knowledge (learning and teaching preferences).
- Students' actions (students strategies).

According to Figure 9 and corresponding to Kolbs' (2005) theory, learning styles are represented in a four-stage cycle: concrete experience (CE), reflective observation (RO), abstract conceptualization (AC) and active experimentation (AE). In addition, a four-type definition learning style are introduced based on the combination of two preferred styles, rather like a two-by-two matrix of the four-stage cycle.

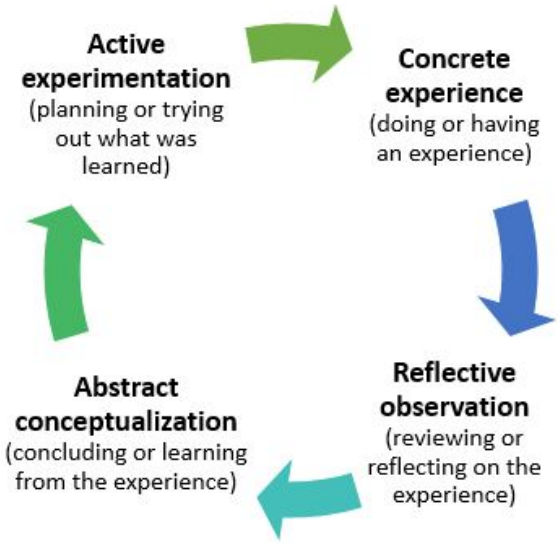

Figure 9. Kolb's learning styles cycle

Kolb's learning model has deeply influenced how to approach learning design and this is so important for developing an adaptive learning system. AI can help to develop those systems based on algorithms or machine learning to improve the learners' experience by:
Individually suggest training and courses based on personal prior knowledge and existing skills;
- Offer personalized support through real-time feedback and AI-based chatbots [49].
- Send learning reminders.
- Offer different learning methods and courses formats.

4. CONCLUSION

The higher education worldwide is affected due to the pandemic. The closing of educational institutions in a very limited time was a temporary solution in order to apply social distancing measures; therefore, teachers and students face surmountable challenges in their planning, implementation and evaluation systems. Rational exploitation of these challenges builds a solid foundation for improving the way schools provide educational services and focus on emerging technologies. The COVID-19 situation is an opportunity for teachers and students to be oriented on use of different online educational tools to enhance teaching and learning. Therefore, it is recommended to adopt a hybrid flexible model that considers the gaps and challenges of distance education as well as the benefits of integrating new technologies into the educational field.

The objective of this review is to identify, synthesize the articles that have addressed the pedagogical methods used in virtual classrooms during the COVID-19 and to introduce the role of intelligent tools to improve e-learning. The fact of using AI tools is also very important to highlight the students' preferences, in hope to develop adaptive learning systems based on students' feedbacks to overcome the difficulties cited. Nevertheless, in this respect, a question arises: to what extent can adaptive learning have an impact on student interaction? This question could form the basis for further research.

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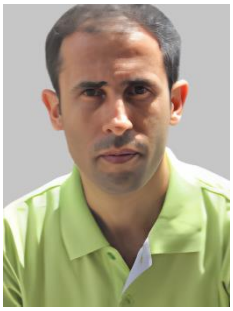

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