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E-learning and artificial intelligence with students' perspective: a business sciences orientation backed bibliometric and systematic literature review

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ABSTRACT

This systematic literature review and bibliometric analysis aimed to explore E-learning and Artificial Intelligence in terms of students while considering the articles available in business sciences. From 400 screened journal and conference papers, only 44 passed the eligibility and significant contribution and impact criteria of PRISMA. VOS viewer was applied to the data of 44 papers for the Keyword Co-occurrence Map that projected the 6 themes and 39 constructs. The findings give the condensed literary sense of AI-backed e-learning for students by the research community of business sciences.

Keywords: *E-learning; Artificial Intelligence; Machine Learning; Learning Systems; Recommendation Systems; MOOCs; personalised learning tools; student data mining; chatbots*

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1. INTRODUCTION

E-learning and artificial intelligence go hand in hand in the research community as the present shifts in learning demand it. For evidence, the compilation of over 400 research publications that explore the application of artificial intelligence (AI) methods in the field of education, draws from two decades of educational research. An investigation using computer assistance was conducted to examine the progression of research topics related to Artificial Intelligence (AI) in prominent academic journals. highlights the growing trends and paradigm shifts in educational research (Guan et al., 2020). Researchers are exploring machine learning techniques for customised e-learning recommendation platforms for smart advisory to students regarding courses based on their prior knowledge and performance. Online exams can also assess the student's capacity to adapt to their personalised course recommendations. Each learner can have an individualised learning environment (Mondal et al., 2020). The reports of UNO on education are directing towards the integration of AI and e-learning as being the future of literacy elevation schemes in terms of the socio-economic dynamics of the world. The internet facility and chatbot services are being utilised for targeted information gathering, processing and communication to have robust learning management system (LMS) for this purpose (Shukla and Verma, 2019).

The integration of artificial intelligence (AI) technology in the education business has replaced traditional classrooms and revolutionised the delivery of education, which is highly regarded by many. Contrary to this viewpoint, certain scholars argue that the initial praise of AI's benefits is misguided and harmful to the education industry. This is because the introduction of modern AI teaching systems has raised lasting concerns about the role of teachers and classrooms in AI education in the twenty-first century (Wogu et al., 2019).

The low rates of student completion demonstrate that online education still lacks effective learning outcomes, notwithstanding its recent remarkable progress. Low student-teacher and student-student interaction is the cause of this impairment. AI-based robotic players can improve student engagement and learning outcomes in online, asynchronous settings, as shown in this case study. This study focuses on economics instruction. In a market where computerised trading robots actively seek arbitrage possibilities, students can learn about competitive markets. Students can also practise playing against AI-trained robots that replicate human behaviour, such as the Ultimatum Game, which involves anticipating retaliatory rejections to unjust offers. A proposer proposes a resource allocation, which the responder can accept or reject. Students can learn how different cultures make decisions in similar situations by training robotic players using historical data from several countries and regions. hence, AI can help online instructors bridge the gap and combine online and in-person learning benefits. (Coussement et al., 2020).

The data gathered by users on social networking platforms and commerce websites was utilised to investigate many aspects that influence people's willingness to use e-learning services. Therefore, approaches from different industries are being incorporated into e-learning to augment the quality of service (Adiguzel et al., 2023). Online education and e-degrees, which have been available since the mid-1990s, have gained significant prominence in the past decade. Furthermore, the global epidemic of the novel Coronavirus illness (COVID-19) has compelled numerous governments, including Italy, the US, and other countries, to extensively transition their education systems to an internet platform. Academics are currently using the crisis as a chance for institutions to more widely implement digital technology for instruction (Prenkaj et al., 2020).

The research questions are as follows:

RQ1: What is the current holistic literature status of E-Learning and Artificial Intelligence with students' perspective, having a concentration on business sciences studies?

RQ 2: What are the most cited journals?

RQ 3: What are the most cited relevant papers and their authors?

RQ 4: What are the main and latest themes in terms of RQ1?

RQ 5: What are the most cited countries?

2. METHODOLOGY

2.1 Data Collection

The terms for e-learning and artificial intelligence were sourced from past influential studies that have worked on the bibliometric analysis of e-learning and artificial intelligence. The Scopus database was accessed for this purpose. The twelve search terms used for e-learning are “E-learning”, “E-learning”, “eLearning”, “digital learning”, “virtual learning”, “mobile learning”, “web-based learning”, “online learning”, “learning environment”, “smart learning environment”, “learning process”, “learning analytics”. Various relevant studies were referred to explore these terms to have a holistic picture (Das, 2021, Djeki et al., 2022, Hung, 2012).
The fourteen search terms used for artificial intelligence are “Artificial Intelligence”, “machine intelligence”, “intelligent support”, “intelligent virtual reality”, “chatbot*”, “machine learning”, “automated

tut*", "personal tut*", "intelligent agent*", "expert system*", "neural network*", "natural language processing", "intelligent system*", "intelligent tutor", and they were sourced from several studies (Chen et al., 2022, Hinojo-Lucena et al., 2019, Hwang and Tu, 2021).

For systematic literature review, the technique used for data collection was PRISMA, or "Preferred Reporting Items for Systematic Reviews and Meta-Analyses," which is one of the most widely accepted methods for documenting the quality and rigour of systematic literature reviews diagrammatically. Therefore, the researchers applied the guidelines of the "PRISMA Statement" (Moher et al., 2009) for the identification, screening, eligibility and inclusion of data for the analysis (refer to Figure 1).

2.2 Data Analysis

The VOSviewer software was used to map the papers collected through the PRISMA statement. The key themes and constructs were mapped through the co-occurrence matrix. This bibliometric map is on a three-step process. Step 1: A similarity matrix is calculated by the software based on the co-occurrence matrix. This develops a database of all the keywords based on their co-occurrences with each other that altogether makes a matrix. Step 2: A map is illustrated through the VOS mapping mechanism for the similarity matrix. Step 3: The map is translated, reflected and rotated to be ready for inferring the results (van Eck and Waltman, 2010). The findings were chalked down based on the key themes and constructs by looking at the bigger picture and going beyond the data (Cooper, 2016).

2.2.1 Key Themes and Constructs

The key themes and constructs sourced from keywords co-occurrence are:

i) Machine learning approaches, collaborative filtering, online courses, classification of information, curricula, machine learning, and data mining; ii) Virtual learning environments, intelligent agents, cognitive systems, knowledge acquisition, expert systems, e-learning; iii) Graph neural networks, online education, student interactions, knowledge management, online systems; iv) Computer-aided instruction, students, distance learning, undergraduate students, reinforcement learning, artificial intelligence, education, information analysis; v) Moodle, learning process; vi) Teaching and learning, online learning, decision tree, learning, higher education, forecasting, learning analytics, decision making, information management, benchmarking.

Figure 1. Keyword Co-occurrence Map

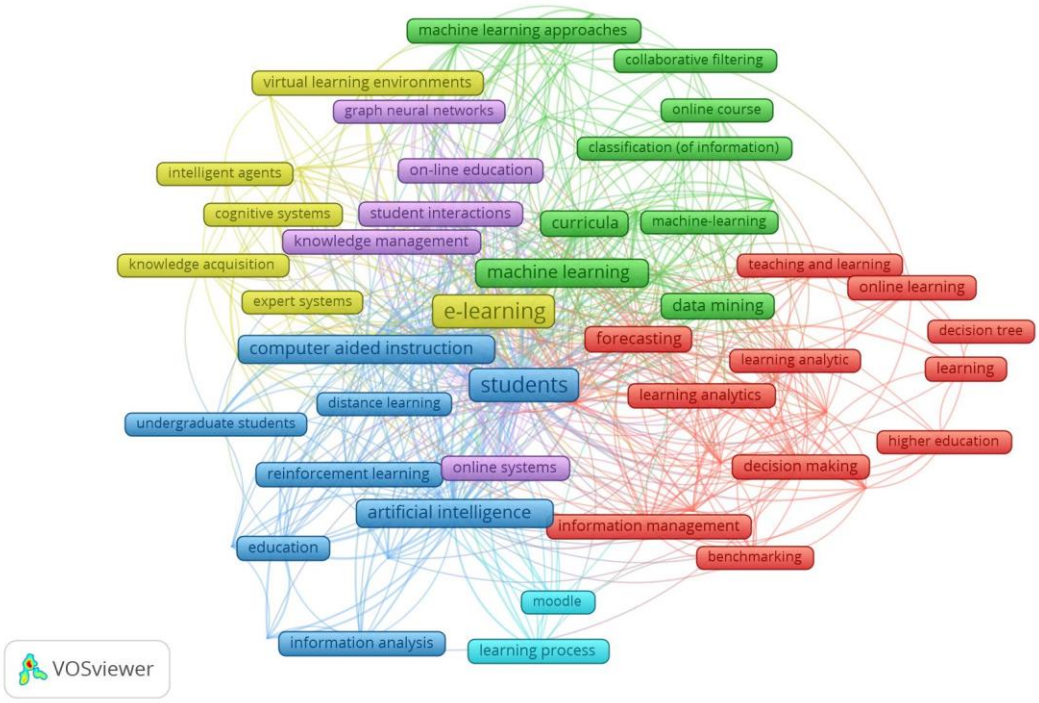
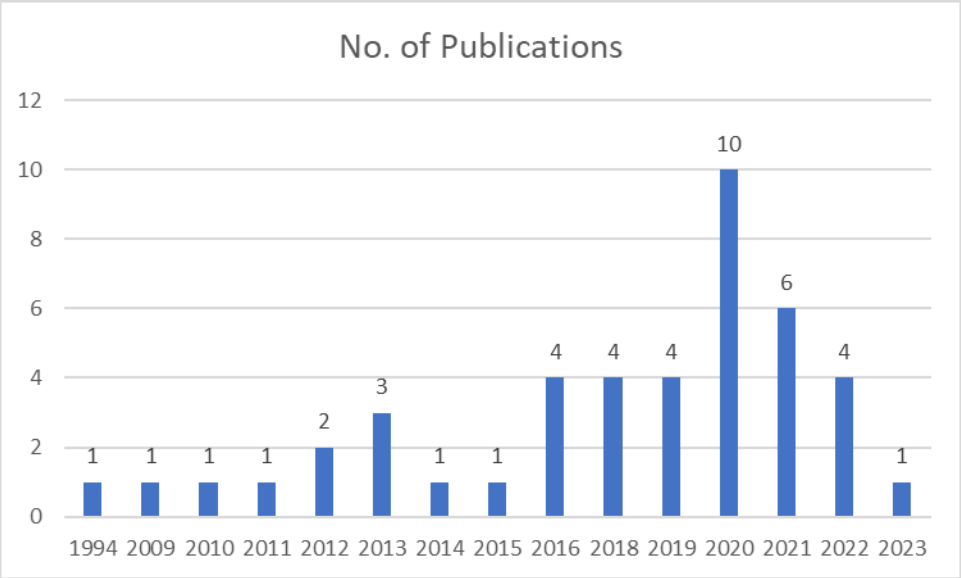


Table **1.** Most Cited Journals/Conferences

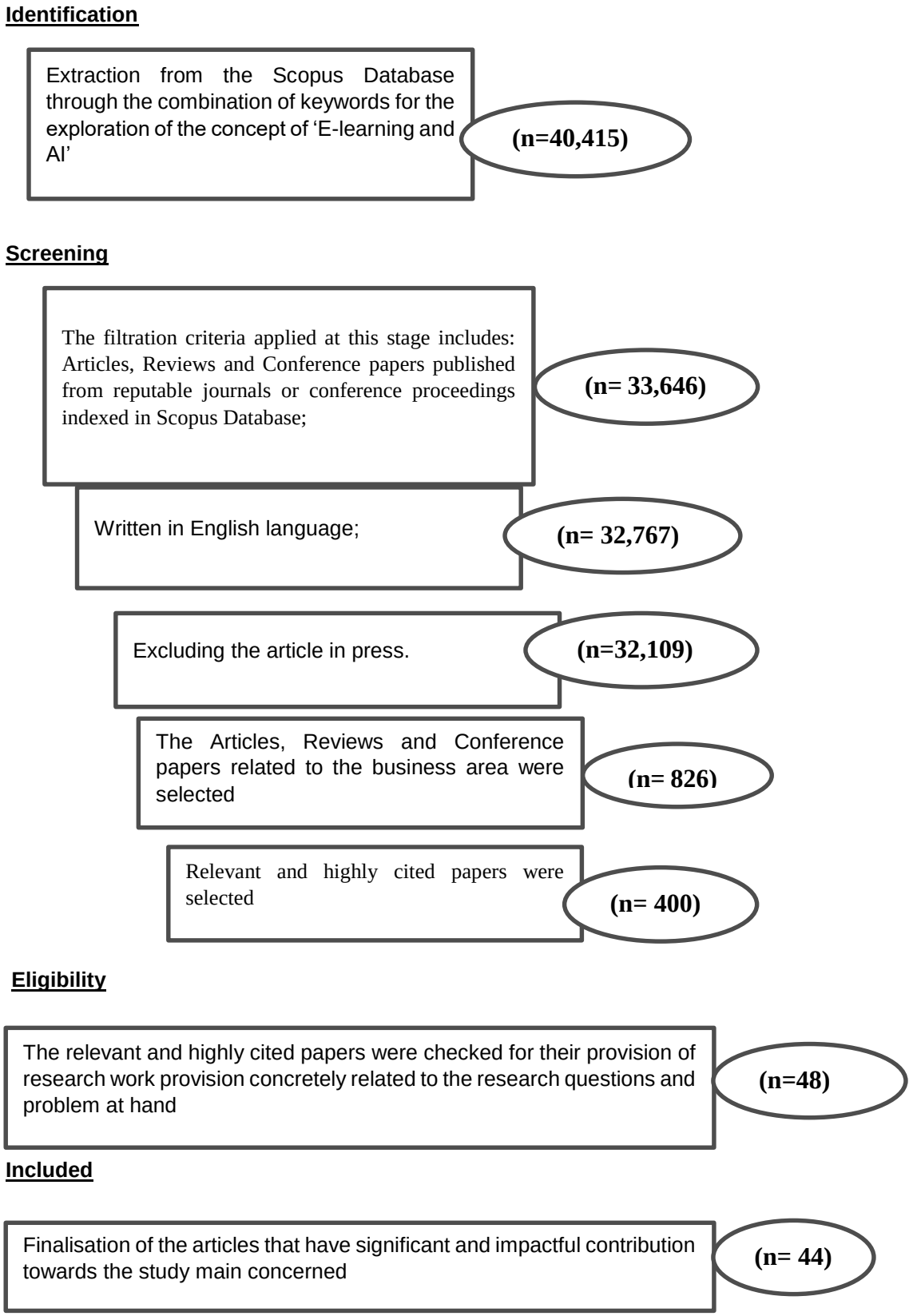
SrNo	Year	Journal/Conference Title	Citations
1	2020	Knowledge-Based Systems	427
2	2020	Technology in Society	98
3	2020	International Conference on Information and Knowledge Management, Proceedings	84
4	2014	Information and Management	82
5	2023	Decision Support Systems	72
6	2018	IEEE Engineering Management Review	46
7	2020	2020 International Conference on Computer Science, Engineering and Applications, ICCSEA 2020	29
8	2016	Journal of Cleaner Production	26

Figure 2. Number of Publications



It is interesting to note that the research outcome spiked after 2019 which projects the case of the pandemic pushed research work on e-learning and artificial intelligence with the students' perspective for exploring the application possibilities for the tools, systems, software and teaching techniques. The post-2019 is marked for the deeper studies in e-learning and artificial intelligence where the technological, and engineering management side is making its space. It can be traced from Table 1 that apart from “Journal of Cleaner Production” and “Technology in Society”, all other journals and conferences are about engineering and knowledge management and applications and related systems. This means that the implications are to be explored in terms of student experience, interaction and socialisation for the new research on e-learning and artificial intelligence from this point forward. This can be an opportunity for future studies.

Figure 3: PRISMA Statement



3. FINDINGS

The successful marriage of e-learning and artificial intelligence can be done in a manner that the data collected from course management systems can be mined to check the patterns of students' behaviour. So, data mining techniques can help in determining the behaviour pattern of students which can be a vital stream of information for course recommendation systems for robust algorithms. The experience gained from the course management system for any particular course or set of courses can be beneficial for the newly enrolled students and the process will move on. The continuous improvement in the recommendation system based on the inclusive behaviour pattern data stream from the student's interaction with the course management system will create a competitive edge for the academic service providers. The e-learning recommendation system will be part of the overall experience of the students and will grow with them to be a student-centric smart e-learning support tool (Aher and Lobo, 2013).

Another breed of support tools is student performance prediction software which now has a combination of classifiers for accuracy in terms of multiple performance association indicators. The e-learning and distance programs at the university level need such type of support tools to have a check on the student's performance. The algorithm of these tools needs the support of some cases of students' attempts for assignments and how they are marked so that the machine learning mechanism can be applied in a supervised manner to make the system a working environment fit (Kotsiantis et al., 2010). The integration of e-learning and artificial intelligence at the university level is a loud call and the need of the time.

One such type of university-led movement has been observed in the case of mobile-based learning or m-learning. The IT students at UPM Malaysia observed their input projected that the m-learning acceptance factors are related to knowledge management that enriches the theoretical reservoir of the technology-acceptance model (TAM). The knowledge management factors of acquiring, applying and securing the knowledge were considered vital for the perceived utility and ease of usage. The sharing of knowledge was not a significant indicator. This means that knowledge sharing through m-learning needs to be checked in terms of the bottlenecks that inhibit this knowledge management factor to be a beneficial one (Al-Emran et al., 2020).

The efficacy of e-learning is another dimension steered by artificial intelligence through Virtual learning environments (VLEs). The VLEs developed under constructivist principles and embedded with personalisation functions have the potential to meet diverse learner needs. The intelligent agents were implemented within a constructivist VLE model, enabling internal personalisation mechanisms. An e-learning efficacy framework was then developed integrating educational and information systems theories. According to student statistics, personalised e-learning boosts exam performance, contentment, and self-efficacy. According to the findings, adaptive, student-centred VLEs powered by artificial intelligence can improve outcomes by adapting to learning demands, styles, and orientations (Xu et al., 2014).

Because online learning provides 24/7 access, flexibility, a wealth of information, and inexpensive costs, educational institutions and organisations have embraced it. Excessive attrition, on the other hand, impedes economic and educational goals. Advanced dropout prediction analytics could identify and manage attrition reasons in students. This enables targeted retention campaigns to keep people engaged. These proactive, customised strategies show early promise in increasing retention, although dropout probability models require refinement. Predictive analytics should be used in future studies to investigate various online student support systems. Despite the many advantages of online learning, multidimensional approaches can have large attrition rates (Coussement et al., 2020).

Online education exercise suggestion systems use interaction logs to recommend exercises for each student. Predominant methods focus on unmastered content to fix existing issues. Additionally, long-term educational goals should include review, balanced challenge growth, and engagement. A multi-objective reinforcement learning framework balances urgent needs with learning journey markers. Initial testing demonstrates that optimising multiple objectives simultaneously enhances recommendation diversity, retention, and outcomes (Huang et al., 2019).

Despite the rapid spread of online education, low completion rates are due to a lack of student-teacher and peer contact. This study investigates the possibility of AI to overcome this challenge. Economic modules were environments for intelligent virtual agents to mimic situations and decisions. Students learned arbitrage in computerised marketplaces of trading bots. Bot-to-bot competition is enabled by reinforcement learning, which models human play with algorithmic strategy emergence. In the Ultimatum Game, students battled against culturally trained bots to demonstrate how background influences spitefulness in uneven splits. Early findings indicate that AI can help personify asynchronous online learning by exhibiting peer competitiveness and variation, as well as increasing engagement (Lin et al., 2018).

Knowledge tracing (KT) has arisen as an active study subject in online education, to assess conceptual mastery based on students' previous learning exchanges. Based on preliminary findings, deep learning-powered KT can outperform traditional Bayesian techniques in terms of predictive power. (Song et al., 2022).

Customising pedagogical rules to learner demands is a reinforcement learning (RL) problem in adaptive intelligent tutoring systems (ITS). Previous attempts at training RL agents from scratch have necessitated extensive interactions, rendering them unsuitable for real-world educational interfaces (Iglesias et al., 2009). Similar requirements were observed in the case of self-directed learning enhancement programmes through the introduction of tailor-made exercise recommendation software (Wu et al., 2020).

As open learning platforms, schools provide many online courses and certifications. Learners may select improper courses by accident and be unable to assess their aptitude and adaptation without face-to-face contact with an expert, wasting time and resources. Machine learning assessments and suitability methods can create tailored course suggestions based on their learning history and performance (Mondal et al., 2020).

Virtual labs (VL) and interactive simulations help students understand technology principles effectively. This aids in the teaching of science and engineering in a variety of ways. A virtual lab was developed for a graduate course on biomass power generation. The findings show that the majority of students believe VL aids learning and personal effort while also preparing them for real-world experiments (Redel-Macías et al., 2016).

Standard metadata information from e-learning platforms is combined with student preferences to create an environment that integrates student learning planning, subject area requirements, and operational issues. The strategy was deployed on Moodle and tested on various e-learning quality benchmarks with satisfactory results (Garrido et al., 2012).

There is an undisputed need for dynamic and customized learning materials to enhance students' understanding of the subject. Current eLearning course models must be adapted to the learner's abilities to gain the best understanding of the course (Anantharaman et al., 2018).

MOOCs appear to be the greatest alternative for providing professional and academic students with lifelong learning opportunities. These courses assist industry leaders in developing their workforce. Despite these advantages, online course dropout rates are high, and many students do not receive a certificate. Use machine learning to predict candidate dropout and provide intelligent automation aspects to keep them engaged (Cobos and Olmos, 2018).

Online learning is steered by a robust personalised learning platform to provide students with individually appropriate feedback to achieve their goals. It is recommended to keep an objective distance. It calculates the difference between a student's present skill level and the level required to complete the course. The target distance is the gap between a student's current ability and the level required to finish the course (Chaichumpa and Temdee, 2018).

Analysis of social media behaviours can increase college participation. High information quality is related to usability and comprehensiveness in social media, hence information quality is more important than service quality. Service quality, on the other hand, includes efficiency, contentment, and system

usability, which will allow students to interact with the university. This has ramifications for student collaboration, active learning, and expectations (Meyliana et al., 2015).

Using expert systems for courses in production and operations management can improve student learning. Expert systems might significantly enhance the learning environment, according to evaluations of student views of expert system use and learning metrics (Moffitt, 1994).

Numerous downstream activities on online learning systems, including dropout rate estimation, strategic intervention facilitation, and adaptive online learning, can benefit from student "performance prediction." Students can practice their knowledge of online education by answering engaging interactive questions from interactive online question pools (Li et al., 2020).

One of the fields of data mining that is used to collect, analyze, and present information that is of concern is educational data mining (EDM). To uncover hidden information, an analysis of online learners' behaviours was conducted utilizing clustering and classification approaches. This could assist in the early identification of underperforming students so that prompt action can be taken to enhance student performance and lower the dropout rate for online learners (Shrestha and Pokharel, 2019).
The online courses and e-learning management tools combined can gain gained advantage by employing machine learning (ML) as an e-planning tool to improve learning and courseware development rather than student assessment surveys (Singh and Lal, 2013).

Growing acknowledgement of the significance of raising an AI-literate public has been witnessed in recent years. Students may be able to experience artificial intelligence (AI) as it relates to problem-solving in the real world thanks to the cooperative gamification of the learning environment that includes rich problem-based learning situations (Lee et al., 2020).

Using the chatbot to gather data and build a question bank, then using the fresh inquiries to enhance the chatbot's functionality to help with the course project A chatbot can be developed with a small collection of questions and is a practical method for distributing information to pupils (Ch'ng et al., 2019).

One of China's ongoing major challenges is the disparity of educational possibilities between rural and urban regions. Consequently, compared to their rural counterparts, urban children can take advantage of highly qualified professors and state-of-the-art facilities. As a result, compared to their rural counterparts, urban students are more likely to enrol in higher education institutions. A cloud-backed e-learning environment is crucial in this kind of situation to deliver high-quality education in remote locations (Safdar et al., 2022).

There have been multiple domains of research opportunity on which the studies have shed light like using computer-based business gamification principles in higher education to develop specific knowledge and competencies in finance teaching (Grijalvo et al., 2022). The continuous student tracking and assessment for computer-assisted education to effectively deliver tailored education, (Samarakou et al., 2016). The observation of system interface-based ‘Collaborative Wall’ for utilisation of machine learning to capture, analyse and recommend for the ideation process (Salas-Rueda et al., 2021). The support system is the new normal for post-pandemic self-regularised academic styles of Thai undergraduate learners (Nuankaew, 2020). The upgradation of information and system quality elevates the chances of the e-learning platform's success (Chen et al., 2019). Personalised tools for promoting smart e-learning movement and making it available for cognitively disadvantageous learners (Vullamparthi et al., 2011). The web-enabled systems have the capability of being adaptive to student competency and behaviour in terms of quizzes and assessment questions presentation (Lincke et al., 2021). The gamut of asynchronous and synchronous tools of engaging with the students in task-related situations and socialising for a balance between control and care (Hernández-Lara et al., 2021). The academic community of Indonesia has welcomed the use of Artificial Intelligence for smart team-based learning as a set of teaching strategies that can enhance the group-level learning process and engage in group tasks online (Pardamean et al., 2021). The elevation in accuracy for the prediction of student performance through the integration of the right information input and AI algorithms can enable better proactive sense (Alnassar et al., 2021). The requirement of customisation of online course management systems based on programs for undergraduate students was felt by the academia (Keith Wright, 2016). Utilisation of higher education institutional data from France for dropout rate prediction and building the

capacity muscle for data-driven decision-making (DDDM) for related academic matters (Phan et al., 2023). There is a need for a shift in paradigm for the integration of tools and technologies for smart online education solutions that cater for the new factors of learning by students (Embarak, 2022). The usage of facial expression recognition as a new medium of detecting the state of learning by students in educational institutions (Li et al., 2021). Working on any specific ability of students, the ability to listen, at the self-learning platforms powered by artificial intelligence mechanisms (Zhou, 2020).

Moreover, for business studies, chatbots have been observed as a supporting arm for education providers to support the learning process inside the class and elsewhere for teaching assistance in tax regulations and related subjects (Mellado-Silva et al., 2020). The inculcation of STEM programs for engaging the students to adapt to multiple skill requirements of science, technology, engineering and math sciences as well as supporting them through evidence and outcome-based education practices (Burg et al., 2016). In the subcontinent, the Indian government has been observed to be determined in the application of Web 2.01, tailor-made education programs with globalisation sense for a thriving educational sector (Gulati, 2013). The deployment of Intelligent Tutoring Systems that are AI-enabled for processing, recording and application of knowledge and conducting social interaction exercises for experiencing the learning by the students (Javadi et al., 2012).

This means that e-learning and Artificial Intelligence with students' perspective could pave the way forward for research and application opportunities that cover the domains of students' performance, success prediction , social interaction, quiz and assessment presentation, facial expression recognition, group base activities online tracking, student data mining for customised course management system and student behaviour mapping for e-learning, m-learning and personalised tools, virtual learning environments and e-learning efficacy framework, student-centered support tools and systems, knowledge tracing (KT), exercise recommendation systems, adaptive intelligent tutoring systems, Massive Open Online Courses (MOOCs) personalised recommendation tools, prediction of the e-learning dropouts, measuring the objective distance for student's ability, expert systems for business courses learning management, chatbot's for asynchronous and synchronous learning processes and supporting the ecosystem for self-directed learning.

Table 2. Detailed Citations Mapping of Relevant Authors and Journal Titles

			<2019	2019	2020	2021	2022	2023	Subtotal	>2023	Total
Year	**Title**	**Authors**	**237**	**53**	**107**	**193**	**229**	**274**	**856**	**6**	**1099**
2013	Combination of machine learning algorithms for recommendation of courses in E-Learning System based on historical data	Aher & Lobo	49	18	19	23	34	20	114	0	163
2010	A combinational incremental ensemble of classifiers as a Technique for predicting students' performance in distance education	Kotsiantis et al.	82	10	17	12	15	12	66	1	149
2020	Towards a conceptual model for examining the impact of knowledge management factors on mobile learning acceptance	Al-Emran et al.	0	1	8	39	27	23	98	0	98
2014	Enhancing e-learning effectiveness using an intelligent agent-supported personalized virtual learning environment: An empirical investigation	Xu et al.	34	5	13	11	13	6	48	0	82
2020	Predicting student dropout in subscription-based online learning environments: The beneficial impact of the logit leaf model	Coussement et al.	0	0	4	22	18	22	66	2	68
2019	Exploring multi-objective exercise recommendations in online education systems	Huang et al.	0	0	9	13	13	27	62	1	63
2018	Artificial Intelligence, the Missing Piece of Online Education?	Lin et al.	2	2	5	10	13	13	43	1	46
2022	A survey on deep learning based knowledge tracing	Song et al.	0	0	0	0	1	40	41	1	42
2009	Reinforcement learning of pedagogical policies in adaptive and intelligent educational systems	Iglesias et al.	10	5	9	5	6	6	31	0	41
2020	Exercise recommendation based on knowledge concept prediction	Wu et al.	0	0	0	5	10	17	32	0	32
2020	A course recommendation system based on grades	Mondal et al.	0	0	0	3	12	14	29	0	29
2016	Virtual laboratory on biomass for energy generation	Redel-Macias et al.	8	5	3	6	3	1	18	0	26

2012	Using AI planning to enhance e-learning processes	Garrido et al.	14	1	4	2	1	1	9	0	23
2018	Modelling an Adaptive e-Learning System Using LSTM and Random Forest Classification	Anantharaman et al.	0	0	1	2	3	9	15	0	15
2018	A Learning Analytics Tool for Predictive Modeling of Dropout and Certificate Acquisition on MOOCs for Professional Learning	Cobos & Olmos	0	0	3	3	6	2	14	0	14
2018	Assessment of student competency for personalised online learning using objective distance	Chaichumpa & Temdee	2	1	3	5	2	1	12	0	14
2022	Computer-based business games in higher education: A proposal of a gamified learning framework	Grijalvo et al.	0	0	0	0	3	10	13	0	13
2015	Evaluation of social media channel preference for student engagement improvement in universities using entropy and topsis method	Meyliana et al.	3	2	1	4	1	2	10	0	13
1994	An Analysis of the Pedagogical Effects of Expert System Use in the Classroom	Moffitt	13	0	0	0	0	0	0	0	13
2020	Peer-inspired Student Performance Prediction in Interactive Online Question Pools with Graph Neural Network	Li et al.	0	0	0	2	7	3	12	0	12
2019	Machine Learning algorithm in educational data	Shrestha & Pokharel	0	0	0	2	9	1	12	0	12
2013	Educational courseware evaluation using machine learning techniques	Singh & Lal	6	1	2	2	0	0	5	0	11
2020	Challenges and Solutions to the Student Dropout Prediction Problem in Online Courses	Prenkaj et al.	0	0	0	4	4	1	9	0	9
2020	Designing a Collaborative Game-Based Learning Environment for AI-Infused Inquiry Learning in Elementary School Classrooms	Lee et al.	0	0	0	2	2	4	8	0	8
2019	Preliminary Findings of using Chat-bots as a Course FAQ Tool	Ch'ng et al.	0	0	0	2	6	0	8	0	8
2022	Using cloud-based virtual learning environments to mitigate increasing disparity in urban-rural academic competence	Safdar et al.	0	0	0	0	2	5	7	0	7
2016	Evaluation of an intelligent open learning system for engineering education	Samarakou et al.	1	0	2	2	1	1	6	0	7
2021	Use of the collaborative wall to improve the teaching-learning conditions in the bachelor of visual arts	Salas-Rueda et al.	0	0	0	5	1	0	6	0	6
2020	Clustering of mindset towards self-regulated learning of undergraduate students at the university of Phayao	Nuankaew	0	0	1	3	1	1	6	0	6

2019	Examining E-learning systems success continuance intention user by integrating TAM and DMIS model	Chen et al.	0	0	0	1	3	2	6	0	6
2011	A smart tutoring aid for the autistic: Educational aid for learners on the autism spectrum	Vullamparthi et al.	4	1	0	0	0	1	2	0	6
2021	The performance of some machine learning approaches and a rich context model in student answer prediction	Lincke et al.	0	0	0	1	3	1	5	0	5
2021	Game learning analytics of instant messaging and online discussion forums in higher education	Hernandez-Lara et al.	0	0	0	0	0	5	5	0	5
2021	Model of learning management system based on artificial intelligence in team-based learning framework	Pardamean et al.	0	0	0	0	2	3	5	0	5
2021	How Well a Student Performed? A Machine Learning Approach to Classify Students' Performance on Virtual Learning Environment	Alnassar et al.	0	0	0	0	3	2	5	0	5
2016	A design theory for vigilant online learning systems	Keith Wright	4	0	0	1	0	0	1	0	5
2023	A decision support framework to incorporate textual data for early student dropout prediction in higher education	Phan et al.	0	0	0	0	0	4	4	0	4
2022	An adaptive paradigm for smart education systems in smart cities using the internet of behaviour (IoB) and explainable artificial intelligence (XAI)	Embarak	0	0	0	0	0	4	4	0	4
2021	Recognizing Students' Emotions based on Facial Expression Analysis	Li et al.	0	0	0	0	1	3	4	0	4
2020	Design of AI-based self-learning platform for college English listening	Zhou	0	0	0	0	2	2	4	0	4
2020	Effective learning of tax regulations using different chatbot techniques	Mellado-Silva et al.	0	0	0	0	0	4	4	0	4
2016	A STEM incubator to engage students in hands-on, relevant learning: A report from the field	Burg et al.	0	0	2	0	1	1	4	0	4
2013	Framework for cognitive agent based expert system for metacognitive and collaborative E-Learning	Gulati	2	1	0	1	0	0	2	0	4
2012	Improving student's modeling framework in a tutorial-like system based on Pursuit learning automata and reinforcement learning	Javadi et al.	3	0	1	0	0	0	1	0	4

Table 3. Most Cited Countries with documents frequency

Country	Documents	Citations
China	7	235
United States	8	228
India	5	217
Greece	2	156
Australia	2	124
Spain	6	122
Malaysia	2	106
Austria	1	98
France	2	72
Belgium	1	68

Table 3 projects that China is in first position. The reason behind it is its close research publication ties with authors and organisations in France, Greece and Malaysia that were evident from the studies considered for the study. There were several funding organisations from China including the National Natural Science Foundation of China and the National Key Research and Development Program of China. The USA gained the second position due to the significant involvement of authors from Kean University, University of Illinois at Urbana-Champaign, North Carolina State University, and Harvard University and having funding from the National Science Foundation.

Table 4. Most Cited Authors with documents frequency

Author(s)	Documents	Citations
Aher & Lobo	1	163
Kotsiantis et al.	1	149
Al-Emran et al.	1	98
Wang	2	86
Heales et al.	1	82
Coussement et al.	2	72
Benoit et al.	1	68

The authors' gaining the first position through the article "Combination of machine learning algorithms for recommendation of courses in E-Learning System based on historical data" got consistent attention from the research community due to its usability in a wide variety of ways. It was published in 2013 but inferring from the post and pre-2019 situation due to the new normal being introduced by the pandemic and global catalytic digitalisation, it was referred by the business science researchers as it gave the research compass for e-learning in the direction of smart recommendation services for the students to learn to the recommended courses. The second-positioned authors secured the position with the contribution of "Technique for predicting students' performance in distance education". It became very important for the teachers, institutions, students, and governance bodies that the performance of the students needs to be predicted for non-physical education. The next in the race worked on "Towards a conceptual model for examining the impact of knowledge management factors on mobile learning acceptance" which gained much attention in 2021 as the global research and practitioners community stressed it due to the global reach of mobile networks in the developing economies.

4. CONCLUSION

The utilisation of AI-enabled e-learning can develop the capability for monitoring the behavioural stages of students for recording the neurophysiological markers. To maintain students' progress in their schoolwork and minimise disruptions to the overall course, various AI planning methods can assist in both facilitating and identifying deficiencies in the online learning process. AI-based techniques enhance online learning by facilitating interactive learning models, hence increasing student engagement. An argument in favour is that businesses or platforms that provide e-learning alternatives through recommender systems have a competitive advantage. This enhances the personalised communication and learning facility that matches the needs of the learner for greater adaptability. By utilising advanced algorithms and considering factors such as heterogeneity and uncertainty, recommendation systems have improved their effectiveness and adaptability. To optimise e-learning platforms and services, it is essential to incorporate these technological enhancements. AI-powered suggestion generation systems in the context of e-learning can enhance student retention rates and long-term competitive advantage.

The advent of online education has led to a shift in emphasis from the instructor to the student. Creating a comprehensive AI-assisted e-learning strategy poses challenges. Furthermore, the implementation of comprehensive documentation can enhance the scalability, operability, and marketability of online learning using advanced multimodal deep learning technology. It is essential to optimise e-learning systems to enhance their exposure and expand their reach to a broader audience. An effective approach to enhance the online educational system is by using online courses customised recommendation systems and support tools. E-learning is essential in business education due to its ability to enhance the tracking of student learning, curriculum development, exam administration, performance and concentration monitoring, and overall systemic integration, resulting in improved efficiency. The utilisation of deep learning pathways in the presence of artificial intelligence (AI) enables the creation of educational assessments that better predict student success in learning. The integration of e-learning and AI creates opportunities for interdisciplinary investigations involving scholars from various domains. The objective of the Learning 4.0 movement is to include and give priority to artificial intelligence alongside human expertise. This movement is propelled by the Fourth Industrial Revolution. For this region to progress, STEM (Science, Technology, Engineering, and Mathematics) online courses must be integrated as a fundamental component of mainstream STEM curricula. It is essential to contemplate online education as a prospective choice to maintain competitiveness and adapt to the constantly evolving educational landscape. The field of e-learning utilises many methodologies, structures, and technological tools to create a system, which intersects with other areas of artificial intelligence and technology-enabled education.

The limitations of this study were based on the challenges that are posed to business research studies in terms of systematic literature review and bibliometric analysis. Further studies are needed to explore studies that deal with a single specialised dimension of e-learning and its related AI topics. This study has projected the overall bigger picture that can be utilised by educational managers when making decisions for the integration of AI in e-learning modes of education. There have been several research opportunity areas that have been highlighted by the researchers.

REFERENCES

Adiguzel, T., Kaya, M. H. and Cansu, F. K. (2023), "Revolutionizing education with AI: Exploring the transformative potential of ChatGPT", *Contemporary Educational Technology,* Vol. 15 No. 3.

Aher, S. B. and Lobo, L. M. R. J. (2013), "Combination of machine learning algorithms for recommendation of courses in E-Learning System based on historical data", *Knowledge-Based Systems,* Vol. 51, pp. 1-14.

Al-Emran, M., Mezhuyev, V. and Kamaludin, A. (2020), "Towards a conceptual model for examining the impact of knowledge management factors on mobile learning acceptance", *Technology in Society,* Vol. 61.

Alnassar, F., Blackwell, T., Homayounvala, E. and Yee-King, M. (2021), "How Well a Student Performed? A Machine Learning Approach to Classify Students' Performance on Virtual

Learning Environment", in *2nd International Conference on Intelligent Engineering and Management, ICIEM 2021*, pp. 1-6.

Anantharaman, H., Mubarak, A. and Shobana, B. T. (2018), "Modelling an Adaptive e-Learning System Using LSTM and Random Forest Classification", in *2018 IEEE Conference on e-Learning, e-Management and e-Services, IC3e 2018*, pp. 29-34.

Burg, J., Pauca, V. P., Turkett, W. and Santago, P. (2016), "A STEM incubator to engage students in hands-on, relevant learning: A report from the field", in *2016 ACM Conference on Innovation and Technology in Computer Science Education, ITiCSE 2016*, Vol. 11-13-July-2016, pp. 142-147.

Ch'ng, S. I., Yeong, L. S. and Ang, X. Y. (2019), "Preliminary Findings of using Chat-bots as a Course FAQ Tool", in *2019 IEEE Conference on e-Learning, e-Management and e-Services, IC3e 2019*, pp. 52-56.

Chaichumpa, S. and Temdee, P. (2018), "Assessment of student competency for personalised online learning using objective distance", *International Journal of Innovation and Learning,* Vol. 23 No. 1, pp. 19-36.

Chen, J. K. C., Shu, K. C. and Lee, H. H. Y. (2019), "Examining E-learning systems success continuance intention user by integrating TAM and DMIS model", in Kocaoglu, D. F., Anderson, T. R., Kozanoglu, D. C., Niwa, K. and Steenhuis, H. J. (eds), *2019 Portland International Conference on Management of Engineering and Technology, PICMET 2019*.

Chen, X., Zou, D., Xie, H., Cheng, G. and Liu, C. (2022), "Two Decades of Artificial Intelligence in Education: Contributors, Collaborations, Research Topics, Challenges, and Future Directions", *Educational Technology and Society,* Vol. 25 No. 1, pp. 28-47.

Cobos, R. and Olmos, L. (2018), "A Learning Analytics Tool for Predictive Modeling of Dropout and Certificate Acquisition on MOOCs for Professional Learning", in *2018 IEEE International Conference on Industrial Engineering and Engineering Management, IEEM 2018*, Vol. 2019-December, pp. 1533-1537.

Cooper, H. M. (2016), "Scientific Guidelines for Conducting Integrative Research Reviews", *Review of Educational Research,* Vol. 52 No. 2, pp. 291-302.

Coussement, K., Phan, M., De Caigny, A., Benoit, D. F. and Raes, A. (2020), "Predicting student dropout in subscription-based online learning environments: The beneficial impact of the logit leaf model", *Decision Support Systems,* Vol. 135.

Das, S. (2021), "Research Trends of E-Learning: A Bibliometric and Visualisation Analysis", *Library Philosophy and Practice,* Vol. 2021.

Djeki, E., Dégila, J., Bondiombouy, C. and Alhassan, M. H. (2022), "E-learning bibliometric analysis from 2015 to 2020", *Journal of Computers in Education,* Vol. 9 No. 4, pp. 727-754.

Embarak, O. (2022), "An adaptive paradigm for smart education systems in smart cities using the internet of behaviour (IoB) and explainable artificial intelligence (XAI)", in *8th International Conference on Information Technology Trends, ITT 2022*, pp. 74-79.

Garrido, A., Morales, L. and Serina, I. (2012), "Using AI planning to enhance e-learning processes", in *22nd International Conference on Automated Planning and Scheduling, ICAPS 2012*, Atibaia, Sao Paulo, pp. 47-55.

Grijalvo, M., Segura, A. and Núñez, Y. (2022), "Computer-based business games in higher education: A proposal of a gamified learning framework", *Technological Forecasting and Social Change,* Vol. 178.

Guan, C., Mou, J. and Jiang, Z. (2020), "Artificial intelligence innovation in education: A twenty-year data-driven historical analysis", *International Journal of Innovation Studies,* Vol. 4 No. 4, pp. 134-147.

Gulati, N. (2013), "Framework for cognitive agent based expert system for metacognitive and collaborative E-Learning", in *2013 IEEE International Conference in MOOC, Innovation and Technology in Education, MITE 2013*, Jaipur, pp. 421-426.

Hernández-Lara, A. B., Perera-Lluna, A. and Serradell-López, E. (2021), "Game learning analytics of instant messaging and online discussion forums in higher education", *Education and Training,* Vol. 63 No. 9, pp. 1288-1308.

Hinojo-Lucena, F. J., Aznar-Díaz, I., Cáceres-Reche, M. P. and Romero-Rodríguez, J. M. (2019), "Artificial intelligence in higher education: A bibliometric study on its impact in the scientific literature", *Education Sciences,* Vol. 9 No. 1.

Huang, Z., Liu, Q., Zhai, C., Yin, Y., Chen, E., Gao, W. and Hu, G. (2019), "Exploring multi-objective exercise recommendations in online education systems", in *28th ACM International Conference on Information and Knowledge Management, CIKM 2019*, pp. 1261-1270.

Hung, J. L. (2012), "Trends of e-learning research from 2000 to 2008: Use of text mining and bibliometrics", *British Journal of Educational Technology,* Vol. 43 No. 1, pp. 5-16.

Hwang, G. J. and Tu, Y. F. (2021), "Roles and research trends of artificial intelligence in mathematics education: A bibliometric mapping analysis and systematic review", *Mathematics,* Vol. 9 No. 6.

Iglesias, A., Martínez, P., Aler, R. and Fernández, F. (2009), "Reinforcement learning of pedagogical policies in adaptive and intelligent educational systems", *Knowledge-Based Systems,* Vol. 22 No. 4, pp. 266-270.

Javadi, S. L., Masoumi, B. and Meybodi, M. R. (2012), "Improving student's modeling framework in a tutorial-like system based on Pursuit learning automata and reinforcement learning", in *2012 International Conference on Education and e-Learning Innovations, ICEELI 2012*, Sousse.

Keith Wright, M. (2016), "A design theory for vigilant online learning systems", *International Journal of Information Systems in the Service Sector,* Vol. 8 No. 1, pp. 13-33.

Kotsiantis, S., Patriarcheas, K. and Xenos, M. (2010), "A combinational incremental ensemble of classifiers as a technique for predicting students' performance in distance education", *Knowledge-Based Systems,* Vol. 23 No. 6, pp. 529-535.

Lee, S., Mott, B., Ottenbriet-Leftwich, A., Scribner, A., Taylor, S., Glazewski, K., Hmelo-Silver, C. E. and Lester, J. (2020), "Designing a Collaborative Game-Based Learning Environment for AI-Infused Inquiry Learning in Elementary School Classrooms", in *25th ACM Conference on Innovation and Technology in Computer Science Education, ITiCSE 2020*, p. 566.

Li, H., Wei, H., Wang, Y., Song, Y. and Qu, H. (2020), "Peer-inspired Student Performance Prediction in Interactive Online Question Pools with Graph Neural Network", in *29th ACM International Conference on Information and Knowledge Management, CIKM 2020*, pp. 2589-2596.

Li, X., Yue, R., Jia, W., Wang, H. and Zheng, Y. (2021), "Recognizing Students' Emotions based on Facial Expression Analysis", in *11th International Conference on Information Technology in Medicine and Education, ITME 2021*, pp. 96-100.

Lin, P. H., Wooders, A., Wang, J. T. Y. and Yuan, W. M. (2018), "Artificial Intelligence, the Missing Piece of Online Education?", *IEEE Engineering Management Review,* Vol. 46 No. 3, pp. 25-28.

Lincke, A., Jansen, M., Milrad, M. and Berge, E. (2021), "The performance of some machine learning approaches and a rich context model in student answer prediction", *Research and Practice in Technology Enhanced Learning,* Vol. 16 No. 1.

Mellado-Silva, R., Faúndez-Ugalde, A. and Blanco-Lobos, M. (2020), "Effective learning of tax regulations using different chatbot techniques", *Advances in Science, Technology and Engineering Systems,* Vol. 5 No. 6, pp. 439-446.

Meyliana, Hidayanto, A. N. and Budiardjo, E. K. (2015), "Evaluation of social media channel preference for student engagement improvement in universities using entropy and topsis method", *Journal of Industrial Engineering and Management,* Vol. 8 No. 5, pp. 1676-1697.

Moffitt, K. (1994), "An Analysis of the Pedagogical Effects of Expert System Use in the Classroom", *Decision Sciences,* Vol. 25 No. 3, pp. 445-460.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., Antes, G., Atkins, D., Barbour, V., Barrowman, N., Berlin, J. A., Clark, J., Clarke, M., Cook, D., D'Amico, R., Deeks, J. J., Devereaux, P. J., Dickersin, K., Egger, M., Ernst, E., Gøtzsche, P. C., Grimshaw, J., Guyatt, G., Higgins, J., Ioannidis, J. P. A., Kleijnen, J., Lang, T., Magrini, N., McNamee, D., Moja, L., Mulrow, C., Napoli, M., Oxman, A., Pham, B., Rennie, D., Sampson, M., Schulz, K. F., Shekelle, P. G., Tovey, D. and Tugwell, P. (2009), "Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement", *PLoS Medicine,* Vol. 6 No. 7.

Mondal, B., Patra, O., Mishra, S. and Patra, P. (2020), "A course recommendation system based on grades", in *2020 International Conference on Computer Science, Engineering and Applications, ICCSEA 2020*.

Nuankaew, P. (2020), "Clustering of mindset towards self-regulated learning of undergraduate students at the university of Phayao", *Advances in Science, Technology and Engineering Systems,* Vol. 5 No. 4, pp. 676-685.

Pardamean, B., Suparyanto, T., Cenggoro, T. W., Sudigyo, D., Anugrahana, A. and Anugraheni, I. (2021), "Model of learning management system based on artificial intelligence in team-based learning framework", in *6th International Conference on Information Management and Technology, ICIMTech 2021*, pp. 37-42.

Phan, M., De Caigny, A. and Coussement, K. (2023), "A decision support framework to incorporate textual data for early student dropout prediction in higher education", *Decision Support Systems,* Vol. 168.

Prenkaj, B., Stilo, G. and Madeddu, L. (2020), "Challenges and Solutions to the Student Dropout Prediction Problem in Online Courses", in *29th ACM International Conference on Information and Knowledge Management, CIKM 2020*, pp. 3513-3514.

Redel-Macías, M. D., Pinzi, S., Martínez-Jiménez, M. P., Dorado, G. and Dorado, M. P. (2016), "Virtual laboratory on biomass for energy generation", *Journal of Cleaner Production,* Vol. 112, pp. 3842-3851.

Safdar, S., Ren, M., Chudhery, M. A. Z., Huo, J., Rehman, H. U. and Rafique, R. (2022), "Using cloud-based virtual learning environments to mitigate increasing disparity in urban-rural academic competence", *Technological Forecasting and Social Change,* Vol. 176.

Salas-Rueda, R. A., Ramírez-Ortega, J. and Eslava-Cervantes, A. L. (2021), "Use of the collaborative wall to improve the teaching-learning conditions in the bachelor of visual arts", *Contemporary Educational Technology,* Vol. 13 No. 1, pp. 1-10.

Samarakou, M., Fylladitakis, E. D., Karolidis, D., Früh, W. G., Hatziapostolou, A., Athinaios, S. S. and Grigoriadou, M. (2016), "Evaluation of an intelligent open learning system for engineering education", *Knowledge Management and E-Learning,* Vol. 8 No. 3, pp. 496-513.

Shrestha, S. and Pokharel, M. (2019), "Machine Learning algorithm in educational data", in *2019 International Conference on Artificial Intelligence for Transforming Business and Society, AITB 2019*.

Shukla, V. K. and Verma, A. (2019), "Enhancing LMS Experience through AIML Base and Retrieval Base Chatbot using R Language", in *2019 International Conference on Automation, Computational and Technology Management, ICACTM 2019*, pp. 561-567.

Singh, S. and Lal, S. P. (2013), "Educational courseware evaluation using machine learning techniques", in *2013 IEEE Conference on e-Learning, e-Management and e-Services, IC3e 2013*, Kuching, Sarawak, pp. 73-78.

Song, X., Li, J., Cai, T., Yang, S., Yang, T. and Liu, C. (2022), "A survey on deep learning based knowledge tracing", *Knowledge-Based Systems,* Vol. 258.

van Eck, N. J. and Waltman, L. (2010), "Software survey: VOSviewer, a computer program for bibliometric mapping", *Scientometrics,* Vol. 84 No. 2, pp. 523-538.

Vullamparthi, A. J., Khargharia, H. S., Bindhumadhava, B. S. and Babu, N. S. C. (2011), "A smart tutoring aid for the autistic: Educational aid for learners on the autism spectrum", in *3rd International Conference on Technology for Education, T4E 2011*, Chennai, Tamil Nadu, pp. 43-50.

Wogu, I. A. P., Misra, S., Assibong, P. A., Olu-Owolabi, E. F., Maskeliūnas, R. and Damasevicius, R. (2019), "Artificial intelligence, smart classrooms and online education in the 21st century: Implications for human development", *Journal of Cases on Information Technology,* Vol. 21 No. 3, pp. 66-79.

Wu, Z., Li, M., Tang, Y. and Liang, Q. (2020), "Exercise recommendation based on knowledge concept prediction", *Knowledge-Based Systems,* Vol. 210.

Xu, D., Huang, W. W., Wang, H. and Heales, J. (2014), "Enhancing e-learning effectiveness using an intelligent agent-supported personalized virtual learning environment: An empirical investigation", *Information and Management,* Vol. 51 No. 4, pp. 430-440.

Zhou, J. (2020), "Design of AI-based self-learning platform for college English listening", in *2nd International Conference on Machine Learning, Big Data and Business Intelligence, MLBDBI 2020*, pp. 544-547.