



A Systematic Review of Emerging Technologies in Shaping the Learning Environments

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Abstract

In this digital age, society is always changing, and education is also changing in significant ways. This paper provides an in-depth review of how emerging technologies influence the formation of learning environments and predicts their influence on the future of education. Artificial intelligence, virtual reality, augmented reality, and machine learning are the most prominent emerging technologies that are causing a revolution in educational paradigms. Emerging technologies are the combination of theory and practical. These technologies provide novel opportunities for personalized learning experiences, designed to accommodate a wide range of learning styles and facilities. The findings of this study shown that emerging technologies have positive impact on teaching and learning process. The findings of this study will useful for teachers, students and administrators to incorporate emerging technologies in teaching and learning process.

Keywords: Emerging Technologies, Teaching, Learning Environment, Artificial Intelligence, Virtual Reality, Augmented Reality, Machine Learning, Internet of Things

1. Introduction

Emerging technologies is a subject of significant attention and discussion in the contemporary era. These technologies are continuously evolving and have the capacity to transform several aspects of our life. Emerging technologies are technological advancements that are now being developed and used, with the potential to radically alter our interactions with our environment (Tiwari, 2022). These technologies are frequently at the forefront of modern research and development, and can encompass a diverse range of sectors, including artificial intelligence, biotechnology, renewable energy, and nanotechnology (Aparicio et al., 2024). New and emerging technologies have given rise to novel methods of teaching and learning that focus on developing critical thinking skills necessary for the quickly evolving and sophisticated digital world (Meletiou-Mavrotheris et al., 2022).

Technology in education means all the tools and resources that are used to make teaching, learning, and innovative research effective (Bacos, 2020). Education is an extensive sector that may use all the latest technologies. The term smart education refers to a novel technological domain that is closely associated with the subject of education. This novel domain is dependent on rising technology. The incorporation of these newly developed technologies can offer beneficial characteristics that can be universally applied in the field of education, particularly within a classroom setting (Memos et al., 2020). Education and technology are closely connected, with a reciprocal relationship between them. Education possesses the capability to accelerate the progress of technology. Furthermore, technology also have an impact on the educational system. The world is undergoing gradual and rapid progress, particularly in the fields of education and technology (Dwinggo Samala et al., 2023). Emerging technologies, an ever-evolving set of innovations, are redefining the dynamics of higher education. These include advances such as artificial intelligence (AI), virtual reality (VR), augmented reality (AR), machine learning (ML), internet of things (IoT), and data analytics (Sembey et al., 2024; Aparicio et al., 2024). AI technology is gradually being integrated into schools, spanning from basic education to higher education and adult education. These systems have the potential to enhance individuals' learning outcomes and facilitate the attainment of their educational objectives (Hinojo-Lucena et al., 2019). VR and AR create immersive learning environments that may imitate real-world scenarios (Dayagbil, Plaisent, Pogyo, & Prosper, 2022).

Furthermore, ML enables the creation of intelligent tutoring systems that adapt to students' learning styles and paces, offering personalized recommendations and feedback. This improves the learning experience by making it more personalized and efficient. On the other side, IoT technology enables the establishment of smart classrooms, in which interconnected equipment such as sensors and smartboards collect and analyze data in real time to optimize the learning environment. IoT also promotes remote and hybrid learning models by enabling seamless connection between physical and digital areas, ensuring that educational resources are available anytime and anywhere (García, Queirós, & Cerqueira, 2021; Li, Song, & Guan, 2020).

1.1. Rationale

Emerging technologies, continuously undergoing development or just launched to the market, hold the potential to transform teaching and learning by providing innovative and efficient opportunities. These technologies provide robust resources that can personalize learning, facilitating a learning environment that is more customized to the unique needs of learners (Comesaña-Comesaña et al., 2022). These technologies enhance active learning in addition to personalization. These tools facilitate the creation of interactive instructional environments that promote and stimulate active participation by learners (Wang & Wegerif, 2019).

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Furthermore, the implementation of emerging technologies in education remains ambiguous, necessitating instructors to be adequately equipped for the integration of cutting-edge technologies in the educational setting (Salas-Pilco et al., 2022). Insufficient comprehension of the use and consequences of developing technologies for students' learning compromises higher education's ability to keep up with the requirements of modern learners (Sembey et al., 2024). That's why the systematic review of the studies on emerging technologies in teaching and learning is compulsory which facilitates the teachers and students to enhance learning capabilities at school, college and university level. Hence, the objective of this systematic review article is to analyze the impact of emerging technologies on educational standards and forecast how classrooms will adapt to these changes.

1.2. Objectives

The primary aim of this study is to analyze the existing researches on emerging technologies in order to determine the potential impact of these technologies on the future of education. Additional objectives include:

- To evaluate the impact of emerging technologies on contemporary learning environment
- To identify the latest emerging technologies in teaching and learning
- To predict the future of education in the light of emerging technologies

1.3. Research Questions

1. What is the impact of emerging technologies on learning environment?
2. Which type of emerging technologies can be integrated in classrooms?
3. What will be the shape of future classroom?

2. Methodology

This systematic review of emerging technologies in teaching and learning environment was carried from 2019 to 2024 using the electronics databases such as IEEE Xplore, ScienceDirect and Google Scholar. The process of this systematic review consisted on 4 phases. In the 1st one the inclusion and exclusion criteria determined, in the 2nd strategy to search articles was implemented, in the 3rd screening process of the articles was performed and, in the 4th the analysis of the selected studies was performed.

2.1. Inclusion and Exclusion Criteria

The inclusion criteria for this systematic review study pertain to the primary focus on emerging technologies inside the formal educational setting for teaching and learning purposes. The publications selected for this purpose must be from the years 2019 to 2024 in the field of social sciences, and they must be primary and secondary research articles both qualitative and quantitative in English language only. The exclusion criteria involved the exclusion of the conference articles, as well as the exclusion of emerging technologies used in non-formal education.

2.2. Search Strategy

The search strategy based on terms or key words such as: emerging technologies, new technologies, teaching and learning from electronic databases such as IEEE Xplore, ScienceDirect and Google Scholar.

2.3. Screening Process

In the view of the inclusion and exclusion criteria, 60 articles were obtained by searching from electronic databases such as IEEE Xplore, ScienceDirect and Google Scholar. These articles reviewed again by reading abstracts to find the relevance with the study. The most relevant 10 articles were selected for systematic review which are mentioned in table 1.

Table 1: Selected Articles

No	Author(s)	Year	Journal	Title	Volume DOI	(Issue)No./ DOI
1	Almufarreh et al.	2023	Sustainability	Promising Emerging Technologies for Teaching and Learning: Recent Developments and Future Challenges	15(8) doi.org/10.3390/su15086917	
2	Onyema	2020	Central Asian Journal of Mathematical Theory and Computer Sciences	Integration of emerging technologies in teaching and learning process in Nigeria: the challenges	01(01)	
3	Garlinska et al.	2023	Electronics	The Influence of Emerging Technologies on Distance Education	12(7) doi.org/10.3390/electronics12071550	
4	Abbas et al.	2021	Australasian Journal of Educational Technology	Emerging technologies in education for innovative pedagogies and competency development	37(5)	

5	Palanivel	2020	International Journal of Computer Trends and Technology	Emerging Technologies to Smart Education	68(2)
6	Oliveira et al.	2019	Human Behavior and Emerging Technologies,	Emerging technologies as pedagogical tools for teaching and learning science: A literature review	1(2) 10.1002/hbe2.141
7	Li et al.	2022	International Journal of Educational Research Open	Using emerging technologies to promote creativity in education: A systematic review	doi.org/10.1016/j.ijedro.2022.100177
8	Sembey et al.	2024	Journal of Systems and Software	Emerging technologies in higher education assessment and feedback practices: A systematic literature review	doi.org/10.1016/j.jss.2024.111988
9	Faig	2023	International Journal of Innovative Technologies in Social Science	Exploring the role of technology integration in twenty-first century education	4(40) doi.org/10.31435/rsglobal_ijitss/30122023/8089
10	Kalyani	2024	International Journal of Scientific Research in Modern Science and Technology	The Role of Technology in Education: Enhancing Learning Outcomes and 21st Century Skills	3(4) doi.org/10.59828/ijrmst.v3i4.199

2.4. Data Extraction and Analysis

Data extracted from the selected studies for systematic review in table form mention below.

Table 2: Data Extraction

Study	Objectives	Key Findings
Almufarreh et al.	Objective of the study is to examine the current state of emerging technologies in teaching and learning, and potential educational benefits with future challenges	Emerging technologies have potential to update teaching and learning process, and all the stakeholders of education should remove hurdles to integrate emerging technologies in teaching and learning process
Onyema (2020)	To identify current Emerging Technologies in teaching and learning and their challenges of integration	Integration of emerging technologies in teaching and learning process improves students' learning experiences and interactivity between teacher and student which improve achievements of teaching objective
Garlinska et al. (2023)	To identify the influence of emerging technologies on efficiency of the learning process and psychological impact on user	Emerging technologies provide new ways of learning, management and assessment which improve the students learning and make experiences enjoyable and effective.
Abbas et al. (2021)	To explore the practical and theoretical implications of the current developments in Information and communication Technologies, and innovative pedagogical techniques	Adaptation and integration of emerging technologies in education provide opportunities to introduce novel and innovative pedagogical strategies to improve existing educational structure in higher educational institutions
Palanivel (2020)	To study the emerging technologies that are used to design smart education system	Modern technologies can enhance teaching and learning and change the educational platform to offer real-time, advanced search, sharing, collaboration, communication and to improve classroom experiences. These technologies provide smart education solution includes smart teaching, smart learning, smart pedagogue, smart analytics, smart monitoring, smart reporting and smart learning environment.
Oliveira et al. (2019)	Objectives of study to summarize the current state of research on	Integration of Emerging Technologies in K 12 classrooms provide natural or physical world for the students to learn science education

	emerging technologies in science education	
Li et al. (2022)	To investigate the use of emerging technologies to promote creativity in learning process	Emerging technologies have a positive impact on students' creativity effectively, particularly in interactive learning environments.
Sembey et al. (2024)	To identify the use of emerging technologies in assessment and feedback at higher education	Extended reality among emerging technologies received least attention in computing education and there is a lack of frameworks for design, evaluation and use of emerging technologies in higher education
Faig (2023)	To explore the multifaceted role of technology in classrooms and their impact on teaching-learning	Integration of technology raise teacher confidence, increase academic performance and critical thinking among students
Kalyani (2024)	Explores the profound impact of technology integration in educational settings	Technology's integration in educational settings has revolutionized traditional teaching methodologies, empowering both educators and learners with innovative possibilities

2.5. Identification of Emerging Technologies

In-depth analysis of the selected studies performed to extract the types of emerging technologies which are used in teaching and in-depth review of selected studies was conducted to identify the types of emerging technologies employed in the teaching and learning process. The most prominent emerging technologies mentioned in these studies include artificial intelligence, virtual reality, augmented reality, machine learning, the internet of things, cloud computing, learning analytics, deep learning, data science, robots, 5G, and blockchain. The incorporation of these emerging technologies in education improves learning performance and personalized learning.

3. Findings

The teaching and learning process is positively impacted by emerging technologies. Technology-based learning is replacing conventional teaching and learning techniques. These technologies enable the learning environment real time, collaborative, interactive and the whole pedagogical setting to be smart due to incorporation of technology. Tasks of teachers are performed through intelligent tutors and assessment and feedback systems. Physical classrooms will be replaced by virtual classrooms which are interactive and improve students learning experiences. Therefore, incorporation of emerging technologies in teaching and learning process is compulsory to meet the demand of modern world and these technologies have excellent positive impact on learning experiences.

4. Limitations

The study has some limitations as well. There was a problem in the excess of some latest references. Mostly, the journals gave excess by paying lots of money or from university affiliations. The researcher was unable to purchase paid version of journals. That's why reviewed only 10 most related articles. The future researchers may overcome these limitations and find more emerging technologies in teaching and learning process. Furthermore, there was limited time to complete this study. Although, about 60 articles were screened to search for the most related articles for systematic review, yet it required more time to reach the more valuable findings.

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