Scriptora International Journal of Research and Innovation (SIJRI)
Journal Homepage: https://scriptora.org

# From Chalkboards to Chatbots: The Transformation of Teaching Methodologies

**Dr. Radhadevi Vadapalli,**
Professor of English
Department of Basic Sciences and Humanities,
Dr Lankapalli Bullayya College of Engineering, Visakhapatnam

## Abstract

The fast adoption of online technologies has greatly posed a challenge to the approaches of teaching and re-framed the traditional classroom as an interactive technology-mediated classroom. The paper will analyze the pedagogical change of traditional chalkboard-based education to the introduction of smart digital learning devices, chatbots, learning management systems, and artificial intelligent-based educational platforms. The research will examine the effects of these technological interventions on the practice of instruction, involvement of learners and the entire teaching learning process in various learning institutions. The paper presents the review of available models of pedagogy and traces the development of the teaching approaches as a response to the technological progress with the help of the conceptual and analytical approach. Rather, the main emphasis is made on the contrast between teacher-centered and learner-centered and adaptive learning models on the basis of digital technologies. It also discusses the ways in which chatbots and AI-driven solutions can be applied to make education more accessible by providing customized learning, instant feedback and 24/7 academic assistance. It is implied that the teaching practice of technology makes it easier to learn, student motivation, and differentiated instruction by fulfilling diverse students needs. However, the transition has problems. The issues of digital literacy, the infrastructure restriction, data privacy, and the changing role of teachers are mentioned as the priority areas of concern that have to be planned and facilitated on a institutional level. The article outlines the relevance of applying technology innovation and pedagogical integrity in an effort to attain meaningful learning outcomes. The paper will discover that the substitution of chalkboard by chatbots is a change in technology as well as paradigm shift in the philosophy of education. By applying proper utilization of digital technology alongside proper pedagogical theory, learning institutions can develop more dynamic, interactive, and progressive learning.

**Keywords**: Teaching methodologies; Educational technology; Artificial intelligence in education; Chatbots in learning; Digital pedagogy; Learner-centered instruction; Smart classrooms; Technology-enhanced learning

## 1. Introduction

The radical alteration of the teaching methods has been witnessed over the past several decades which have been repositioned with the technological advancement, shifting the expectations of the learners and the growing necessity to deliver personalized education. Old methods of classroom where the teaching and learning activities focused on use of chalk boards, text books, and teacher directed instruction focused on a uniformity of delivery of knowledge with little interaction or flexibility. Although these techniques served as a basis in the formal education, they frequently failed to meet the needs of different learning styles, different cognitive capabilities, and real-time feedback in more complicated learning settings. Digital technologies integration has dramatically transformed the pedagogic practices and brought in multimedia tools, online learning platforms and data-driven teaching models. Artificial intelligence has become a revolutionary technology in education in recent years and created intelligent tutoring systems and adaptive learning platforms as well as conversational AI in the form of chatbots. These technologies have opened up to the educators the role of transmission of knowledge to the role of facilitating learning, which has been made possible through providing more student-centred, interactive, and flexible instructional models. Specifically, chatbots and AI-based applications have been noted as such that have the potential to promote instant

response, individualized learning experiences, and 24-hour long-term academic assistance due to their capacity to work outside of conventional classroom hours. Their use has affected the lesson planning, forms of assessment, and learner interactions particularly in the blended and remote learning environments. Nevertheless, the change also provokes quite relevant questions concerning the effectiveness of the pedagogical process, teacher readiness, moral aspect, and compromise between human interaction and automated learning. This research paper will discuss how teaching methods and approach have changed over time since the traditional classroom teaching to the AI-assisted teaching approaches with the emphasis being put on the importance of chatbots in education today. Through the analysis, the research will identify the opportunities, challenges and implications of adopting intelligent technologies in teaching activities and this will help in better understanding the modern-day education transformation.

## 2. Background of the study

The ways of teaching have been constantly changing alongside the social change, technological revolution, and changed educational philosophies. The conventional classroom learning methods that had always focused on chalkboards, textbooks, and teacher lectures, were instrumental in developing the basic systems of knowledge and systematic learning conditions. Nevertheless, these traditional approaches tended to focus on the one-way delivery of knowledge, which does not provide chances to personalize the learning experience, think critically, and socially interact with the other learners. The end of the twentieth and the beginning of the twenty-first century were characterized by the extensive shift in the educational practice due to the emergence of digital technologies. Combining computers, multimedia devices, and internet-based resources slowly changed the classrooms into a more interactive and learner-centered classroom. E-learning systems, smart boards and learning management systems gave the teacher the ability to vary instructional methods, promote team learning as well as to education outside the physical classroom. This technological change was also consistent with constructivist theories of learning which positions active involvement, learning experiences, and learner control. Over the last few years, the advent of artificial intelligence has become a new stage in the evolution of the teaching technologies. Chatbots, intelligent tutoring systems, adaptive learning environments, and automated assessment technologies are examples of AI-driven tools that are transforming the manner in which instruction is offered and the way that students interact with material. These tools provide real-time feedback, individual learning tracks and ongoing encouragement that meets various needs of learners unlike the traditional homogeneous modes of teaching. The use of AI in the educational process was greatly accelerated due to the world disruption factors like the COVID-19 pandemic that emphasized the need to have versatile, technology-driven teaching programs. Although the use of AI-powered instruction tools becomes more widespread, the introduction of the intelligent system into the traditional one causes significant pedagogical, ethical, and practical issues. The issues of evolving roles of teachers, reliance of students on automated assistance, data privacy, and access equity to digital resources continue to be the focus of the modern educational discourse. In addition, AI-assisted teaching methods also require not only the technological capacity but also a careful implementation in the curriculum development and classroom learning. It is in this context that the current research is aimed at considering how the teaching practices that are based on a chalkboard could be changed to the AI-powered applications like chatbots. In developing an interest in this switch, the research seeks to learn how new technologies are changing the mode of teaching, students involvement, and the general learning experience in contemporary learning settings.

## 3. Justification

The high adoption of digital technologies in the learning process has essentially transformed the nature of teaching and learning in every level of learning. The way learning is conducted is experiencing a radical change, whether by the use of old-fashioned chalkboard-based training or by taking advantage of smart technology like chatbots, learning management systems, and AI-based tutoring services. Global disruptions, increased access to digital infrastructure and the growing need of personalized, flexible and learner-centric education have increased this change of direction. Nevertheless, the gap in such a comprehensive analysis of the aspects, which allegorically considers the impact of such changing methodologies on the pedagogical practices, teacher roles, student engagement and learning outcomes remains.

Though nowadays research may be classified into two categories: the ones that focus on the traditional approach to pedagogy, and the ones that deconstruct a particular technological intervention, there is a lack of studies that can be viewed as being integrative and tracing the trajectory of the teaching methodology between the traditional approach to one classroom lesson and the AI-assisted approach to teaching. This is imperative to learning processes among educators, institutions and policymakers to enable them make sound judgment in curriculum content design, teacher education and integration of technology in institutions. Along with that, the ethical, cognitive, and pedagogical implications of the use of AI-based technologies such as chatbots should be critically examined such that the technological advancement will help to enhance but not to weaken the quality and inclusiveness of the educational process.

This study is therefore justified since it seeks to provide a holistic understanding of how the teaching practices are

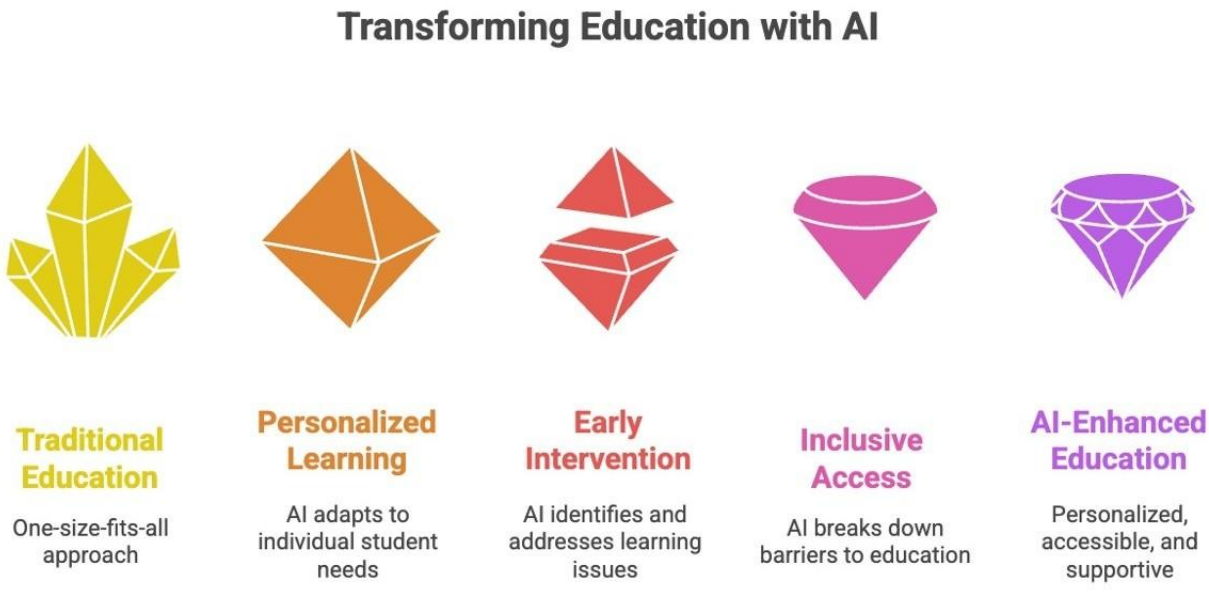
changing in the digital age. The comparison of the pedagogical transformation chalkboard vs chatbots will make the research pertinent to the contemporary educational environment and offer valuable lessons as to how to develop an effective and futuristic approach to teaching. It can be expected that the results will help to develop the evidence-based policies, promote the responsible use of educational technologies, and help teachers to strike the golden mean between the old educational pedagogy and the new digital technologies.

**4. Objectives of the Study**

1. To analyze how technology and AI-provided instruction methodology have changed the traditional teaching methods in classrooms.
2. To examine the variables that influence the integration of digital tools and artificial intelligence in the modern teaching and learning settings.
3. To determine how the use of rising technologies, such as chatbots and intelligent tutoring systems, can change the effectiveness of teaching and student interaction.
4. To draw parallels between the old-fashioned teacher-centered approach and the recent learner-centered and technology-based pedagogies.
5. To assess the attitude and perception of the educators regarding the implementation of AI-based teaching tools in universities.

**5. Literature Review**

Investigation of the development of teaching methodology, it is apparent that a general trend of substituting the old paradigm of teacher centered teaching paradigms with the newer, learner-centered and technology mediated paradigms. The most common teaching techniques like chalk-and-talk, mentoring, or guided practice used to prevail in formal education because of their simplicity and direct interpersonal communication (Panchal, 2025). But as digital technologies continue to become more available, the changes in the practices of teaching have been recorded by educators and researchers at large. The comparative survey conducted by Panchal (2025) shows that traditional methods focus on structure and relationship interaction, whereas the modern methodologies incorporate the AI-based instruction and customized learning, which announces a significant pedagogical shift that can be linked to the long-term goals of educational innovation. This confirms previous arguments within the education technology literature that educators have to change their teaching practices to meet the quickly evolving needs and technological abilities of learners.




***Source:*** ***https://www.linkedin.com/***

The literature is particularly devoted to the specific topic of AI chatbots as one of the most significant technological innovations that are changing the teaching and learning processes. A systematic review of the literature by Labadze, Grigolia, and Machaidze (2023) reveals that AI chatbots are becoming more common in giving immediate information, personalized assistance, and virtual teaching aids in a higher education context. Their review is a synthesis of the results of many empirical studies, which demonstrate that chatbots can make students more engaged,

assist with homework as well as differentiated instruction. Nevertheless, they also note the issues of reliability, the ethical considerations and the willingness of educators to adopt these tools. Additionally, scholarship highlights the fact that one of the best-known positive outcomes of AI integration is personalization and student autonomy. To illustrate, according to the narrative review by Marcos (2025), intelligent tutoring systems and adaptive learning platforms are AI technologies that assist in customizing teaching to the unique learning profile of a learner, assisting a broad range of learners and promoting conceptual knowledge. Meanwhile, the paper warns that the success of the implementation is based on the ethical implementation and keeping the central pedagogical role of the teacher. The qualitative case studies of teacher practice underscore the integration of chatbots into a particular model of teaching. The authors of the study conducted by the Universiti Malaya found that English teachers utilized chatbots in the flipped classroom environment and discovered that educators used conversational agents strategically as tools to support vocabulary, provide grammar explanations, practice dialogues, and engage in collaborative learning activities. This fact implies that newer technologies are not retroductive, but the elements of pedagogical designs that warrant the promotion of active learning and learner autonomy. Wider contexts of AI chatbots in literature are also given in connection with the context of smart education and intelligent pedagogies. Research has suggested that digital technologies, including IoT, big data, and AI, are transforming not only the manner in which it is delivered, but entire learning environments, more broadly, rendering the process of teaching flexible, connected, and informed by the data. These are smart pedagogical models as compared to the olden day non interactive and one direction lectures by teachers. In addition to the mentioned benefits, several researchers highlight weaknesses and dangers of AI in education. The study on chatbot accuracy, operational concerns says that one is concerned about the fact that these technologies can generate misinformation or can generate content that is outrightly wrong, and it should be noted that such technological solutions should be utilized with a lot of care and being mindful of quality control and ethical factors. Overall, the literature is a representation of some process of transformation. The old methods are not being replaced but are being re-configured using the digital tools to form hybrid pedagogical ecosystems where artificial intelligence will co-exist with the educators. This is in concurrence with the larger research showing that transformative educational technologies most effectively serve to complement rather than be used to replace human instruction require ongoing teacher learning, thoughtful integration and institutional support.

## 6. Material and Methodology

### 6.1 Research Design

The current research takes the form of descriptive and analytical research design by investigating how teaching practices that involve traditional classroom methods have evolved to include technology facilitated and AI facilitated teaching methods. The study is qualitative and quantitative in style, which makes it possible to gain a refined insight into pedagogical change in various learning environments. The descriptive part describes the current trends in teaching methods and the use of technology, whereas the analytical one assesses the perceived efficiency, flexibility, and the issues related to the use of contemporary digital and AI-based teaching resources. The mixed-method design will allow comparing the traditional practices (chalkboard-based teaching) systematically with the innovative practices (such as virtual classrooms, learning management systems, and conversational AI tools).

### 6.2 Data Collection Methods

Primary and secondary sources have been used to gather the data to be utilized in the study. The primary data were collected by the use of a questionnaire that was structured to be used on the teachers and educators of various schools, colleges and institutions of higher learning. The questionnaire has contained closed-ended and Likert-scale questions to measure the change in the teaching practice, the degree of technological integration and perceptions toward student engagement and learning outcomes. Published journals, academic books, conference proceedings, policy documents, and reports published by educational institutions and government bodies were used as the sources of secondary data. These sources presented some contextual grounds and some theoretical backgrounds to the comprehension of historical evolution and recent tendencies in the methodology of teaching. The combination of primary and secondary data provided depth and validity and triangulation of results.

### 6.3 Inclusion and Exclusion Criteria

The participants of the study were teachers actively involved in the teaching practice at the school, undergraduate, and postgraduate levels who had been subjected to both traditional and technology-assisted teaching. The respondent who had at least one year of teaching experience was regarded as qualified to be not misinformed in terms of their responses. The study did not include the administrative staff, non teaching staff, and teachers who have not been exposed to the digital or online teaching platforms. Data reliability and accuracy were also upheld by excluding incomplete responses and in coherent or missing data in questionnaires.

### 6.4 Ethical Considerations

The ethical principles were followed to the letter during the research process. All the respondents took part in the study as it was voluntary and informed consent was given before the data collection started. The anonymity and confidentiality of the participants was ensured and no personal identifiers were carried out or disclosed. The information gathered was only to be used academically and in research, therefore there was transparency and integrity in the analysis and reporting. No misrepresentation, biasness, and manipulation of data were engaged in the study, and it adhered to the accepted standards of scholarly honesty and research ethics.

## 7. Results and Discussion

### 7.1 Demographic Profile of Respondents

The research involved 210 educators and higher education students in schools and colleges that have undergone both the conventional and technology-based teaching practices. The demographic distribution of the respondents is shown in Table 1.

**Table 1: Demographic Profile of Respondents (N = 210)**

| Variable | Category | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 96 | 45.7 |
| | Female | 114 | 54.3 |
| Age Group | Below 25 years | 58 | 27.6 |
| | 25–40 years | 92 | 43.8 |
| | Above 40 years | 60 | 28.6 |
| Educational Level | Undergraduate | 72 | 34.3 |
| | Postgraduate | 98 | 46.7 |
| | Doctoral/Professional | 40 | 19.0 |
| Teaching/Learning Mode Experienced | Traditional only | 48 | 22.9 |
| | Blended | 96 | 45.7 |
| | AI-supported | 66 | 31.4 |

**Discussion:**

According to the demographic distribution, there is proper representation in terms of age, academic level, which allows assessing the changing teaching methodologies in a balanced way. The penetration of digital tools in the modern education systems has been evident with a considerable percentage of the respondents (77.1%) having encountered blended or AI-assisted learning.

### 7.2 Comparison of Teaching Methodologies

The respondents were requested to rate the various teaching methodologies based on engagement, clarity, personalization and accessibility. The mean scores were obtained based on a five-point Likert scale.

**Table 2: Mean Scores of Teaching Methodologies**

| Teaching Method | Engagement | Concept Clarity | Personalization | Accessibility | Overall Mean |
|---|---|---|---|---|---|
| Chalkboard-based | 3.12 | 3.45 | 2.41 | 2.98 | 2.99 |
| Smart Classroom | 3.78 | 3.89 | 3.12 | 3.67 | 3.62 |
| Online Platforms | 4.02 | 3.76 | 3.68 | 4.15 | 3.90 |
| AI-enabled Tools (Chatbots, Tutors) | 4.36 | 4.21 | 4.45 | 4.28 | 4.33 |

**Discussion:**

The outcomes show a definite change in the perceived effectiveness of the traditional chalkboard instruction to the AI-based teaching approaches. AI-based tools made the best overall mean rating (4.33), especially in the area of personalization and engagement. This implies that adaptive learning systems and chatbots can strengthen learner autonomy and offer personalized learning support to students in a way that imposes fewer restrictions than classroom-based learning.

### 7.3 Impact of AI Tools on Learning Outcomes

In order to investigate the question of whether AI-supported teaching can enhance learning outcomes, the respondents

rated their perceived increase in understanding, motivation, and academic achievement.

**Table 3: Perceived Impact of AI-Enabled Teaching on Learning Outcomes**

| Learning Outcome | Agree (%) | Neutral (%) | Disagree (%) |
|---|---|---|---|
| Improved concept understanding | 72.4 | 18.6 | 9.0 |
| Increased learner motivation | 68.1 | 21.9 | 10.0 |
| Better academic performance | 64.8 | 23.3 | 11.9 |
| Faster doubt resolution | 79.5 | 14.3 | 6.2 |

**Discussion:**

A significant larger percentage of the respondents concurred that AI tools had a positive effect on learning outcomes, particularly in resolving doubts and conceptual learning. These results can be supported by constructivist learning theory in which instantaneous feedback and interactive support are paramount in the process of constructing knowledge.

### 7.4 Teacher Perceptions Toward AI-Driven Pedagogy

Teacher attitudes were analyzed to understand acceptance and readiness toward AI integration in teaching.

**Table 4: Teacher Perception Toward AI Integration**

| Statement | Mean Score |
|---|---|
| AI reduces routine teaching workload | 4.12 |
| AI supports differentiated instruction | 4.28 |
| AI threatens teacher autonomy | 2.31 |
| AI enhances teaching effectiveness | 4.35 |

**Discussion:**

Teachers were mostly attracted to AI as an enabling and not disruptive aspect. The low level of agreement with the statement that AI is a threat to autonomy suggests that people believe in the autonomy-based pedagogy, in which technology serves to facilitate and support but is not to replace.

### 7.5 Challenges in Transitioning to AI-Based Teaching

Despite positive outcomes, respondents identified several challenges.

**Table 5: Challenges in Adopting AI-Enabled Teaching**

| Challenge | Percentage (%) |
|---|---|
| Lack of digital infrastructure | 41.9 |
| Insufficient training | 38.6 |
| Data privacy concerns | 34.3 |
| Resistance to change | 29.5 |

**Discussion:**

A significant obstacle was infrastructure constraints and lack of training especially within the government institutions. Such problems demonstrate that institutional investment and lifelong learning are necessary to promote a fair and ethical use of AI in education.

## 8. Limitations of the study

This research is not without shortcomings, even though it has led to the development of knowledge about the changing nature of teaching methodologies using the conventional classroom tools to the AI-based instructional technologies. To begin with, the research is mostly based on the secondary sources of data including published literature, policy documents and existing empirical studies. Although these sources offer great information, lack of large-scaled primary data gathering might restrain the data regarding real-time classroom work and various stakeholder impressions.

Second, the study area is limited to some educational settings which might not well reflect differences across regions, levels of education as well as institutional settings. The generalizability of the findings can be affected by the inequity in the infrastructure, digital preparedness, and access to technology in schools and institutions of higher education.

Third, the high-speed development of learning technology is also a weakness since chatbots, adaptive learning systems, and AI tutors are constantly developing. Therefore, certain observations and interpretations might be less

relevant with the appearance of new technologies and models of pedagogy.
Fourth, the research centers on teaching approaches and instructional strategies largely and has little concentration on long term learning, effectiveness of assessment, and cognitive or emotional influences on students. These dimensions should be more empirically examined.
Lastly, ethical issues of data privacy, algorithmic bias and teacher autonomy are addressed in a more theoretical manner as opposed to empirical validation, which can limit the breadth of conclusions reached on responsible AI integration in education.

## 9. Future Scope

The shift in the system of teaching to the AI-based chatbots and intelligent learning systems provides numerous opportunities to conduct a future study. Although the current paper aims at the conceptual and practical change in the field of pedagogy, future research could build on the existing work by creating large-scale empirical research to quantify the long-term effect of chatbot-based teaching on student learning outcomes, levels of engagement, and critical thinking skills by various levels of education.
The next study can also investigate specific applications of chatbots and AI tools in different fields and how effective they become in other areas like science, humanities, professional training, and skill training. The comparative analysis of city and rural institutions and of the setting of academic institutions, both public and private, can help bring a deeper understanding of the problem of access, digital equity, and the readiness of infrastructure.
The other significant line of enquiry is the ethical, psychological, and socio-cultural consequences of teaching through AI. The emerging issues of data privacy, algorithmic bias, excessive reliance on technology, and the shifting role of teachers in AI-assisted classrooms can be evaluated in future studies. Exploration of the preparedness of teachers, digital competence, and the need to develop will be an additional policy and curriculum development strength.
To learn how the constant exposure to chatbots affects motivation, creativity, and life-long learning abilities, longitudinal research on the adaptability of students and their learning autonomy in AI-driven environment can be utilized. Furthermore, new technologies like adaptive learning systems, generative AI, virtual reality and emotional AI can be incorporated in future studies to determine their synergy in defining teaching practices of the next generation.
All in all, widening the range of study in the field will help immensely in the creation of inclusive, ethical, and learner-centered pedagogic models such that technological solutions are not in the end substituting the human aspect of teaching and learning.

## 10. Conclusion

The fact that chalkboards have been replaced by chatbots demonstrates a radical change in the teaching practices that has altered the way of knowledge delivery, access, and experience. In this paper, the fact that digital tools, interactive environments, and systems designed by AI have augmented the pedagogical arsenal and made it more personalized, flexible, and learner-centered, is highlighted. centered approaches. The interactivity has been improved by technology and has also facilitated teaching differentiation and the teaching offered real time feedback, and this is in a better position to serve the diverse learners, unlike the many methods (including traditional methods). At the same time, the findings indicate that technological advancement does not reduce the effort of the teachers, on the contrary, it reinvents the work of the teachers. The educators remain important models as facilitators, mentors and critical thinkers who help the students to sieve data, learn skills and use knowledge on higher levels and apply them in a morally upright manner. chatbots, learning analytics, and digital resources are to be considered intelligently and become an element of the entirety depending on pedagogical intentions and curriculum planning, as well as, situational realities. Issues that may persist, including digital divides, the willingness of teachers and data privacy are also pointed out in the paper, and the risk of dependency on automated processes. The answer to these issues is the continuous professional development, the hospitality infrastructure and the certain moral code. In its entirety, the revolution in the teaching methodology is not the replacement of the old ones but the transition to the hybrid approach to education, which incorporates human knowledge with technological discoveries and introduces substantial and long-term learning outcomes.

## References

1. Ali, D., Fatemi, Y., Boskabadi, E., Nikfar, M., Ugwuoke, J., & Ali, H. (2024). ChatGPT in teaching and learning: A systematic review. *Education Sciences, 14*(6), 643. https://doi.org/10.3390/educsci14060643
2. Allen, I. E., & Seaman, J. (2020). *Digital learning compass: Distance education enrollment report*. Babson Survey Research Group.

3. Anderson, T., & Dron, J. (2011). Three generations of distance education pedagogy. *International Review of Research in Open and Distributed Learning, 12*(3), 80–97.
4. Baskara, F. R. (2024). Machine learning meets pedagogy: ChatGPT's transformative potential in higher education learning spaces. *ELS Journal on Interdisciplinary Studies in Humanities, 7*(1), 228–237.
5. Bates, A. W. (2015). *Teaching in a digital age: Guidelines for designing teaching and learning*. Tony Bates Associates Ltd.
6. Belda-Medina, J., & Kokošková, V. (2023). Integrating chatbots in education: Insights from the Chatbot-Human Interaction Satisfaction Model (CHISM). *International Journal of Educational Technology in Higher*
7. Bonk, C. J., & Graham, C. R. (Eds.). (2006). *The handbook of blended learning: Global perspectives, local designs*. Pfeiffer Publishing.
8. Brown, J., & Martinez, L. (2023). Assessing the impact of emerging technologies on teaching and learning: A review of technology-based learning environments. *International Journal of Research and Innovation in Social Science*.
9. A. Chauhan and L. Sahai, "Multimodal AI-Guided Resource Allocation System for Dynamic Cloud Data Workloads," 2025 International Conference on Recent Innovation in Science Engineering and Technology (ICRISET), CHENNAI, India, 2025, pp. 1-7, doi: 10.1109/ICRISET64803.2025.11252489.
*Education, 20*, Article 62.
10. Garrison, D. R., & Vaughan, N. D. (2008). *Blended learning in higher education: Framework, principles, and guidelines*. Jossey-Bass.
11. Ilyas, I., & Muchsin, M. (2025). The future of education: Integrating technology with interactive teaching methods. *Journal of Pedagogi*. https://doi.org/10.62872/p3hxqz12
12. L. Sahai and A. Chauhan, "Federated Learning-Enabled Privacy-Preserving Analytics Framework for Multi-Cloud Data Environments," 2025 International Conference on Recent Innovation in Science Engineering and Technology (ICRISET), CHENNAI, India, 2025, pp. 1-7, doi: 10.1109/ICRISET64803.2025.11251884.
13. Labadze, L., Grigolia, M., & Machaidze, L. (2023). Role of AI chatbots in education: Systematic literature review. *International Journal of Educational Technology in Higher Education, 20*, Article 56.
14. Latif, R. (2021). Teachers' digital technology use after a period of online teaching. *ELT Journal, 77*(4), 445–456.
15. Laurillard, D. (2012). *Teaching as a design science: Building pedagogical patterns for learning and technology*. Routledge.
16. Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054.
17. Mohamed, A., Ghazali, N., & Mokhtar, M. M. (2024). Chatbots: A new digital teaching tool paradigm in AI technology among secondary school teachers. *Journal of Public Administration and Governance, 13*(4).
18. R. M. Devi, K. C. Cheekuri, A. K. Yadav, S. Sharma, Anjali and A. Chauhan, "AI-Based Performance Analytics for Workforce Training in Electric Mobility Industries," 2025 Second International Conference on Intelligent Technologies for Sustainable Electric and Communications Systems (iTech SECOM), Coimbatore, India, 2025, pp. 1-6, doi: 10.1109/iTechSECOM64750.2025.11307635.
19. Reeves, T. C., & Hedberg, J. G. (2003). *Interactive learning systems evaluation*. Educational Technology Publications.
20. Selwyn, N. (2011). *Education and technology: Key issues and debates* (2nd ed.). Bloomsbury Academic.
21. Sharma, P., & Barrett, B. (2007). *Blended learning: Using technology in and beyond the language classroom*. Macmillan Education.
22. Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning, 2*(1), 3–10.
23. Tegero, M., & Mabini, J. P. (2025). AI chatbot simulations in teacher training: Core teaching competencies developed through virtual practice. *Journal of Teaching and Learning, 19*(4), 10087.