



Enhancing Student Creativity through Ai-Driven Learning Ecosystem: A Comparative Study of Off-Line and Online Teaching

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DOI : <https://doi.org/10.5281/zenodo.18257033>

ARTICLE DETAILS

Research Paper

Accepted: 27-12-2025

Published: 10-01-2026

Keywords:

Artificial Intelligence (AI), Collaborative learning, Creativity, Digital technologies, Hybrid pedagogical framework, Innovation, Learner engagement, Online education, Pedagogical efficacy, Teaching methods, Traditional skills

ABSTRACT

The transformation of educational practices over the past decade has been significantly accelerated by the rise of digital technologies. The COVID-19 pandemic catalyzed a global shift from traditional classroom methods to online and remote teaching, establishing online education as the new norm. This paper compares traditional and online teaching approaches, focusing on their pedagogical efficacy, learner engagement, and adaptability—particularly in relation to fostering student creativity. It further explores the evolving role of Artificial Intelligence (AI) in education, emphasizing its application in enhancing creativity through AI-driven collaborative learning ecosystems. Drawing on empirical evidence and case studies, the paper proposes a hybrid pedagogical framework that integrates AI to promote creativity and collaboration across diverse educational settings. While AI offers numerous benefits, it also raises ethical concerns surrounding originality. Critics caution that AI-generated content may compromise human touch and traditional teaching skills, challenging established notions of authenticity. The future of AI in education depends on navigating these challenges responsibly. Striking a balance between innovation and ethical stewardship is essential to fully harnessing AI's potential. As AI continues to evolve, it presents unprecedented



opportunities for synergy between human intuition and computational precision. In conclusion, while AI holds the promise of revolutionizing education and expanding creative horizons, its adoption must be guided by thoughtful consideration of its ethical, cultural, and economic implications. The key challenge lies in cultivating a symbiotic relationship between AI and human creativity, ensuring that technological innovation enriches rather than diminishes the educational experience.

1. Introduction

The global educational landscape is undergoing a significant paradigm shift, driven by rapid technological advancements and the growing need for adaptive learning methods. Traditional classroom teaching—long considered the foundation of formal education—relies on face-to-face interaction, structured curriculum delivery, and teacher-guided instruction. In contrast, online learning uses digital platforms to offer flexible, learner-centred experiences that transcend the limitations of physical classrooms.

Amid this transformation, Artificial Intelligence (AI) has emerged as a powerful enabler, capable of personalizing learning pathways and fostering student creativity. According to Chen *et al.* (2020), AI is both a field of study and a suite of innovations that enable computers, machines, and other systems to exhibit human-like intelligence, characterized by cognitive abilities, adaptability, learning, and decision-making. Fan *et al.* (2024) reported that AI-based strategies can significantly enhance students' creativity and critical thinking in higher education settings.

This paper aims to: (i) compare traditional and online teaching methodologies, (ii) examine the role of AI in promoting collaborative and creative learning, and (iii) propose a proper AI-driven collaborative learning ecosystem.

2. The Educational Pedagogies

2.1 Traditional Teaching Methods

Traditional classroom instruction is characterized by in-person interactions, standardized assessments, and curriculum-focused delivery. Numerous studies have shown that this method supports social development, availability of immediate feedback, and structured learning habits (Vygotsky, 1978; Piaget,



1952). However, it can be limited in personalizing learning experiences and promoting out-of-the-box thinking.

2.2 Online/Remote Learning

Online education offers flexibility, scalability, and access to global content. Platforms such as Coursera, edX, and Google Classroom exemplify their widespread application. Despite these benefits, online learning often suffers from reduced engagement, isolation, and limited spontaneous collaboration (Anderson, 2008; Hodges *et al.*, 2020).

2.3 The Emergence of AI in Education

AI technologies, including machine learning (ML), natural language processing (NLP), and data analytics (DA), are increasingly being integrated into educational platforms. Intelligent Tutoring Systems (ITS), AI-powered feedback tools, and adaptive learning environments provide individualized support to students, enabling creativity and critical thinking (Luckin *et al.*, 2016). Chen *et al.* (2020) assessed the impact of AI on education by premising their analysis on a narrative and framework for evaluating AI identified from a preliminary analysis. They used a qualitative research approach, leveraging a literature review as a research design and strategy, which effectively facilitated the realization of the study's purpose.

Although AI has showcased enormous benefits, it has evoked mixed feelings across different nations (Neudert *et al.*, 2020). These include AI-related concerns and issues, such as the likelihood of unemployment, job replacement, and other apprehensions and risks (Frank *et al.*, 2019). Nevertheless, AI has impacted society in a way that sparks positive potential (Park and Woo, 2022; Wollny *et al.*, 2021).

3. Materials and Methods

The present study employs a mixed-methods approach, integrating both qualitative and quantitative techniques to analyze and interpret the collected data. Descriptive qualitative inferences were drawn from the data analysis. Data were collected through the following methods:

3.1 Comparative Analysis of Traditional and AI-driven Methods

Comparative analysis of 100 peer-reviewed articles by reviewing the pertinent journals covering a period of 10 years (2015–2024). This approach has been followed by other researchers (Chen *et al.*, 2020).



3. Surveys of Students and Educators

Surveys were conducted among 300 students and 50 educators from schools offering different programs at the Undergraduate (UG) level across Ontario-based educational boards in Canada, including the TDS School Board, the Dufferin School Board, and the Peel Education Board. Care has been taken that the subjects elected cover the relevant elements of creativity and sports.

3.3 Case Studies

Case studies were conducted in AI-integrated learning environments across Canada and India, with a particular focus on fostering students' creative writing skills.

- To achieve this objective, students were divided into groups of five through random selection and assigned to one of two categories:
 - (i) the traditional learning group and
 - (ii) the AI-assisted learning group.
- Each group was provided with creative writing assignments tailored to their respective learning environments.
- The assignments aimed to assess students' engagement, creativity, and skill development through different modalities.

3.3.1 Traditional learning group

- For the traditional learning group, evaluation parameters included:
 - a. Physical reading flow and fluency
 - b. Sentence structure and coherence
 - c. Use of proverbs and idiomatic expressions
 - d. Brevity and clarity of expression
 - e. Inclusion of sketches or hand-drawn illustrations

3.3.3 AI-assisted learning group

For the AI-assisted learning group, the evaluation criteria focused on:

- a. Originality and relevance of AI-generated content



- b. Effective use of diverse AI prompts
- c. Integration of AI tools in enhancing narrative structure and vocabulary

The collected data were subjected to comparative analysis to examine the impact of AI integration on students' creative expression and language development.

3.4 Statistical Analysis of Data

Standard statistical tools and content analysis techniques were used to assess student engagement, creativity development, and collaboration outcomes across different teaching modalities.

4. Results and Discussion

Based on data collected through surveys and other sources, a comparative analysis was conducted between traditional classroom pedagogical delivery and AI-driven teaching and learning ecosystems. The primary objective was to assess their respective impacts on students' creativity. The study highlights the urgent need to integrate creativity into the prevailing education system, which has long emphasized rote learning over critical and innovative thinking.

India's National Education Policy (NEP-2020) also aims to revamp the country's educational framework by replacing outdated curricula with more contemporary, inclusive, and creativity-oriented approaches (Venkata *et al.*, 2025). The policy emphasizes not only academic learning but also the development of vocational skills, cognitive abilities, and emotional intelligence. Central to NEP-2020 is the concept of nurturing young minds during their formative years through a strong Early Foundation stage.

Furthermore, the policy promotes a blended learning model that combines traditional classroom instruction with online and distance education. This hybrid approach is intended to ensure broader access to quality instruction and personalized mentoring. The inclusion of AI-driven pedagogy is seen as a transformative element that will shape the future of learning, offering students interactive, adaptive, and enriched educational experiences (Redecker and Punie, 2013).

4.1 Comparative Analysis

Various pedagogical parameters—including interaction, creativity support, institutional collaboration, accessibility, and assessment mechanisms—were systematically analyzed across different teaching–learning modes. The comparative overview of these modes is presented in Table 1.



4.1.1 Traditional Classroom-Based Teaching-Learning

In the traditional classroom model, interaction occurs through direct, face-to-face communication, allowing for real-time dialogue and engagement. However, the scope for creativity is often constrained by a rigid, textbook-oriented curriculum and time-bound instructional delivery. Institutional collaboration primarily takes the form of in-class group discussions and localized academic interactions. Furthermore, accessibility in this model is limited by temporal (fixed schedules) and spatial (physical presence) constraints (Table 1). Assessments are typically manual, periodic, and summative, offering limited real-time feedback and limited opportunities for adaptation.

Yi *et al.* (2021) conducted a comparative study of teaching behaviours in traditional and innovative classrooms in China. The study revealed significant differences in teacher–student interaction, group cooperation, autonomous learning, and evaluation feedback between the two settings. While initial data analysis found no significant differences in resource sharing and teacher-centred instruction, subsequent video observation and qualitative analysis revealed distinctions in classroom practice. Overall, the findings suggest that AI-based teaching and learning methods are likely to gain prominence in the future.

4.1.1 Online and Hybrid Teaching-Learning Modes

The online or virtual learning environment is characterized mainly by asynchronous interaction, where learners can access instructional content at their convenience (Table 1). Following the COVID-19 pandemic, the hybrid model, which integrates both online and offline modalities, gained significant traction across educational institutions globally.

In these settings, digital tools and technologies offer moderate creative support, such as multimedia content creation, collaborative platforms, and discussion forums. Accessibility is significantly enhanced, as students can engage from diverse geographic locations and time zones. Institutional collaboration is broadened through virtual partnerships, webinars, and international academic exchanges. Additionally, these systems often incorporate automated, platform-based assessment tools, enabling faster evaluation of student performance and progress.

4.1.3 AI-Driven Teaching-Learning Ecosystem

The AI-driven ecosystem represents a transformative shift in educational practice. It is a real-time, AI-mediated system that fosters personalized feedback loops between learners, educators, and platforms (Table 1). By frequently using AI-generated prompts, students receive dynamic, responsive stimuli that



promote high levels of creativity. These prompts are also adaptable to individual learner profiles, ensuring inclusivity and engagement across diverse learning styles.

Table 1: Interaction, creativity support, collaboration, accessibility, and assessment of different teaching – learning modes

| Feature | Traditional Teaching- Learning In the Classroom | Online/Virtual Remote Learning mode | AI-Driven Learning Ecosystem |
|---------------------------------|--|--|---|
| Interaction | Direct, face-to-face | Virtual, often asynchronous | Real-time + AI-mediated personalized feedback |
| Creativity Support | Limited by structure | Moderate via digital tools | High due to personalized and adaptive prompts |
| Collaboration with institutions | Group work, peer discussions | Virtual collaboration tools | Intelligent grouping, adaptive collaboration |
| Accessibility | Limited to location and time | High flexibility and global access | Enhanced via AI-based content customization |
| Assessment | Standardized, teacher-driven | Automated, platform-based | Continuous, adaptive, formative assessments |

Groups formed with careful consideration of learner characteristics exhibited stronger performance in collaborative, adaptive tasks (Table 1). Accessibility within the AI-driven model is significantly enhanced, particularly through institutional collaboration, as AI platforms can seamlessly integrate stakeholders across multiple institutions and geographies.

One of the most distinct advantages is AI systems' ability to customize content based on individual performance, thereby supporting continuous, adaptive, and formative assessment processes. These features allow educators to adjust teaching strategies in real time, while students receive guidance that is aligned with their unique learning pace and progress.

Empirical findings reveal that AI is redefining education, making it more innovative, inclusive, and engaging. From personalized lessons to virtual tutoring systems, AI is equipping educators with tools to meet learners' diverse needs and enabling students to master content at their own pace (Srinivasa *et al.*,



2022). This AI-enhanced ecosystem is expected to become a cornerstone of future education, particularly in teaching, learning, and assessment for the emerging digitally native generation.

According to Chen *et al.* (2022), AI has been extensively adopted by educational institutions in various forms—from basic computer-based tools to advanced web-based intelligent systems. Recent advancements include embedded AI technologies, such as humanoid robots and intelligent chatbots, which now assist or independently perform teaching and administrative functions. These systems enable instructors to automate administrative tasks such as grading and feedback, allowing them to focus on higher-quality teaching. Furthermore, with the support of machine learning (ML), AI systems personalize curriculum and content, aligning instruction with the learners' interests and needs. This adaptability has significantly enhanced learner engagement, retention, and overall educational outcomes.

5. Enhancing Student Creativity through AI

5.1 Personalized Learning Paths

AI tailors content and pace based on individual learner profiles. Creative tasks can be customized to match students' interests, promoting engagement and originality. Artificial Intelligence (AI) has revolutionized various sectors, and its impact on education, specifically in personalized learning, is increasingly significant. Personalized learning aims to cater to individual students' unique needs, learning styles, and abilities, enabling them to achieve better educational outcomes (Kaswan et al., 2024).

5.2 Intelligent Feedback Systems

AI tools have emerged as transformative assets in modern education, offering real-time, constructive feedback on student outputs such as essays, design projects, and creative assignments. This immediate, personalized feedback helps students iteratively refine their ideas, fostering divergent thinking, creativity, and deeper cognitive engagement. Unlike traditional methods, where feedback may be delayed or limited in scope, AI-powered systems can continuously assess content, providing insights into structure, coherence, originality, and alignment with learning objectives.

Moreover, in an AI-integrated educational ecosystem, feedback collection and analysis become both efficient and intelligent. These systems can identify individual learning gaps, suggest targeted improvements, and help educators reprioritize content delivery based on real-time learner data. This dynamic approach facilitates the creation of a more responsive and customized learning environment,



one that is not only need-based but also aligned with evolving global competencies and workforce demands.

Such intelligent feedback mechanisms ensure that educational experiences are not static but adaptive, helping students prepare for complex, real-world challenges. In this context, AI plays a critical role in shifting education from a one-size-fits-all model to a learner-centric, flexible, and globally relevant one (Ham and Lu, 1938).

5.3 Collaborative Problem-Solving Platforms

AI facilitates collaboration in educational settings by intelligently forming groups based on complementary skills, monitoring group dynamics, and even mediating conflicts or misunderstandings. This education system offers collaborative problem-solving (CPS) platforms that foster teamwork, critical thinking, and innovation among learners. These platforms enable students to work together in virtual environments, guided by intelligent algorithms that track progress, suggest adaptive solutions, and customize tasks based on group behaviour and individual learning profiles.

CPS not only promotes effective communication among students but also enhances creativity and critical thinking. New digital technologies, powered by AI, offer innovative opportunities to cultivate CPS from an early age. However, a crucial challenge lies in designing these technologies to be engaging, developmentally appropriate, and pedagogically responsive to the unique needs of young learners (Aslan *et al.*, 2025; Charisi *et al.*, 2020).

Aslan *et al.* (2025) found significant correlations between effective CPS behaviours and (1) the joint engagement of students working collaboratively, and (2) pedagogical interventions provided by instructional assistants facilitating the learning experience. These findings suggest that, with appropriate design enhancements, platforms such as Kid Space have the potential to meaningfully support the CPS development of young learners (Charisi *et al.*, 2020).

By simulating real-world scenarios and supporting peer-to-peer learning, AI-enhanced CPS platforms cultivate essential 21st-century skills—communication, cooperation, and collaborative decision-making—thus preparing students for future academic, social, and professional challenges.

5.4 Gamification and Simulation

AI-powered gamified environments and simulations are transforming contemporary education by promoting experiential learning, imagination, and creative exploration across disciplines—including



STEM, the arts, and the humanities. These tools facilitate engaging, hands-on learning experiences that foster curiosity and encourage deeper cognitive engagement. By integrating AI, educators can address various limitations of traditional pedagogical models through personalized learning pathways, adaptive assessments, and intelligent tutoring systems (Banik and Gullapelly, 2025).

AI has the unique capacity to tailor instruction to each learner's pace, style, and preferences, thereby enhancing educational outcomes and empowering students to realize their full potential. Furthermore, AI-powered gamification and interactive learning tools are redefining the learning experience. By transforming education into an engaging, game-like environment, these innovations accommodate diverse learning styles while improving motivation, retention, and comprehension (Rana and Chicone, 2025).

Gamification techniques make learning enjoyable and memorable, while interactive tools, such as learning management systems (LMS), educational apps, and immersive simulations, create opportunities for deeper understanding and long-term knowledge retention. This chapter explores the potential of AI to address the enduring challenges of traditional education, elevate learning outcomes, and reshape pedagogical practices for the 21st century.

6. Case Studies

6.1 Case Study 1: AI-Integrated Learning in Ontario, Canada

A public school in the district recently implemented an AI tool for creative writing, resulting in a remarkable 40% improvement in student originality and engagement scores over six months. Building on this success, I am now extending this approach to other Canadian schools, including Morton Way Public School, Jean Augustine Secondary School, Centennial Secondary School, and Cécile Marceline Secondary School—all located in Brampton, Ontario. The focus was on the subject of music and physical education.

As we advance, it is essential to recognize that the goal is not merely to replicate isolated success stories but to cultivate environments where each teacher, school, and district can craft its narrative of AI integration—one that reflects its distinctive community, addresses local challenges, and aligns with its aspirations. Beyond creative writing, AI plays a significant role in enhancing instruction and understanding in subjects such as mathematics and science (Karampelas, 2025).



6.2 Case Study 2: AI in Rural Punjab, India

An NGO implemented an AI-powered collaborative learning platform for underprivileged students, leading to a 33% improvement in creativity scores—as measured by the Torrance Tests—and a 21% reduction in dropout rates. The initiative was rolled out in institutions such as BZSFS Public School, Khizrabad; Sunfields Public School, Jhanjeri; Brook Field Public School, Kurali; National Public School, Goslan; and several other schools across the Mohali district of Punjab.

While these AI-driven educational tools have been successfully utilized in urban schools in Punjab, there remains a pressing need to assess and map their adaptation and implementation in rural schools across the region (Singh *et al.*, 2024). Innovative technology is rapidly advancing various sectors, and artificial intelligence has emerged as a pivotal force driving innovation and transformation in education.

7. Challenges and Ethical Considerations

Although the integration of Artificial Intelligence (AI) in education presents numerous opportunities, ranging from personalized learning to administrative efficiency, it also brings with it a range of challenges and ethical considerations that must not be overlooked (Eden *et al.*, 2024). The present study identifies several critical concerns in the context of contemporary educational systems:

Data Privacy: AI systems often rely on the collection and analysis of sensitive student data from various sources. Ensuring the confidentiality and ethical use of this data is paramount, as any breach can significantly compromise student trust and institutional integrity.

Bias in AI Algorithms: AI models are prone to inheriting and amplifying biases present in their training data. If these models are not carefully curated using diverse and representative datasets, they risk perpetuating existing social and educational inequalities. This underscores the need for constant oversight and the involvement of multidisciplinary experts to ensure fairness and inclusivity.

Teacher Training and Professional Development: As AI tools become more integrated into classroom environments, educators must be adequately trained to use them effectively. Upskilling teachers is essential to ensure they are not only technologically proficient but also able to critically evaluate AI tools to support pedagogical goals.



8. Proposed Framework: AI-Driven Collaborative Learning Ecosystem (AI-CLEx)

The integration of Artificial Intelligence (AI) in education is rapidly transforming learning methodologies and redefining the dynamics of teaching and knowledge acquisition (Islam et al., 2024). Technologies such as intelligent tutoring systems and automated assessment tools are enhancing personalized learning experiences, making education more adaptive and efficient. However, these advancements also raise concerns—particularly regarding the potential overreliance on AI and the consequent reduction in meaningful human interaction within the learning environment.

In response to these concerns, several emerging platforms aim to bridge the gap between AI-driven insights and human collaboration, emphasizing the importance of peer-to-peer learning and interpersonal engagement. Building on this perspective, the present study proposes the development of a novel framework titled the AI-Driven Collaborative Learning Ecosystem (AI-CLEx). This platform is designed to foster collaborative learning and skill-sharing among students, leveraging both AI capabilities and human interaction.

Proposed Components of AI-CLEx are:

8.1 AI-Powered Learning Management System (LMS):

An adaptive LMS that personalizes curriculum pathways based on individual learner profiles, performance data, and learning styles.

8.2 Creativity Engine:

A suite of tools to support ideation, brainstorming, and project-based learning activities, encouraging innovation and problem-solving.

8.3 Collaborative Dashboard:

A real-time interface for peer interaction, group work monitoring, communication tools, and continuous feedback mechanisms.

8.4 Mentorship Module:

AI-assisted mentoring through digital avatars or chatbots that provide guidance, resources, and motivation tailored to each learner's goals.

9. Core Principles of the AI-CLEx Framework:



9.1 Student-Centeredness:

Prioritizing students' individual needs, interests, and learning paths.

9.2 Creativity by Design:

Integrating opportunities for creative expression and innovation into every aspect of the learning process.

9.3 Equity and Inclusion:

Ensuring that AI tools are accessible and beneficial to all learners, regardless of background or ability.

9.4 Human-AI Partnership:

Promoting a balanced collaboration between human educators and AI systems to enrich learning rather than replace human roles.

10. Conclusions

AI is rapidly transforming numerous domains, and education stands at the forefront of this revolution. Traditional education models, often characterized by teacher-centred approaches and a strong emphasis on rote memorization, are no longer sufficient to meet the diverse needs of 21st-century learners. As we move further into the digital age, it becomes essential to design educational systems that integrate the strengths of traditional pedagogy—such as structured learning and human mentorship—with the adaptability, scalability, and intelligence of AI technologies.

An AI-driven collaborative learning ecosystem offers a promising path forward. By fostering creativity, enabling personalized learning experiences, and promoting equitable access to educational resources, such systems can fundamentally reshape the way knowledge is acquired and shared. These ecosystems not only support academic achievement but also nurture critical thinking, collaboration, and innovation—skills vital for future-ready learners.

However, realizing the full potential of AI in education requires a deliberate and ethical approach. Future research should explore the long-term impacts of AI on learning outcomes, investigate scalable models for diverse educational contexts, and prioritize the responsible design and deployment of AI systems that respect data privacy, reduce algorithmic bias, and preserve the human element in teaching.

In essence, the goal is not to replace educators but to empower them with intelligent tools that enhance their teaching effectiveness and support students in becoming more engaged, self-directed, and



collaborative learners. With thoughtful implementation and continuous research, AI can create a more inclusive, dynamic, and future-forward educational landscape.

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