**Gamification and student motivation**

The literature suggests that gamified learning interventions may increase student engagement and enhance learning. We empirically investigate this by exploring the impact of intrinsic and extrinsic motivation on the participation and performance of over 100 undergraduate students in an online gamified learning intervention. The paper makes a number of contributions. First, by synthesizing the literature the central concepts required for a learning intervention to be considered gamified are mapped and the development of an online gamified learning intervention is described. Second, the effect of gamification on learning outcomes is examined using a pre- and post-intervention survey. We find that gamified learning interventions have a positive impact on student learning. Third, our results show that while generally positive, the impact of gamified intervention\*ns on student participation varies depending on whether the student is motivated intrinsically or extrinsically. These findings will be of practical interest to teaching and learning practitioners working in a range of educational contexts, and at all levels of education, who wish to increase student engagement and enhance learning.

**Teaching and learning artificial intelligence: Insights from the literature**

Artificial Intelligence (AI) has been around for nearly a century, yet in recent years the rapid advancement and public access to AI applications and algorithms have led to increased attention to the role of AI in higher education. An equally important but overlooked topic is the study of AI teaching and learning in higher education. We wish to examine the overview of the study, pedagogical outcomes, challenges, and limitations through a systematic review process amidst the COVID-19 pandemic and public access to ChatGPT. Twelve articles from 2020 to 2023 focused on AI pedagogy are explored in this systematic literature review. We find in-depth analysis and comparison of work post-COVID and AI teaching and learning era is needed to have a more focused lens on the current state of AI pedagogy. Findings reveal that the use of self-reported surveys in a pre-and post-design form is most prevalent in the reviewed studies. A diverse set of constructs are used to conceptualize AI literacy and their associated metrics and scales of measure are defined based on the work of specific authors rather than a universally accepted framework. There remains work and consensus on what learning objectives, levels of thinking skills, and associated activities lead to the advanced development of AI literacy. An overview of the studies, pedagogical outcomes, and challenges are provided. Further implications of the studies are also shared. The contribution of this work is to open discussions on the overlooked topic of AI teaching and learning in higher education.

**Generative AI and Gamification for Personalized Learning: Literature Review and Future Challenges**

The integration of Artificial intelligence (AI) in education (AIEd) opens the possibilities for creating new content, virtual teaching, and personalized learning experiences. This paper studies the different innovative methods used in education where we investigate the integration of Generative Artificial Intelligence (GAI) into education, and its transformative influence in producing personalized learning experiences through the use of its models like BERT, ChatGPT and GANs that have unique role in creating new content like text, image, and video, unlike discriminative algorithms that focus only on classification tasks. Also, the paper explores the power of gamification to enhance academic systems by generating new dynamic and interesting learning environments by using specific design that make learner learn and have fun which adjusts their needs, their personality, values and motivation. Even though the importance,The development of a dynamic adaption engine model for GAI and adaptive gamification is a pressing matter in this particular domain. Thus, This review aims the incorporation of generative AI into gamification to generate personalized content and improve the quality of the entire learning experience.

**Adapting gamified learning systems using educational data mining techniques**

Artificial intelligence (AI) provides opportunities to improve the effectiveness of e-learning by increasing students' engagement. Adaptive e-learning uses AI to support individual learners by responding to their different learning needs which can be determined by analyzing their navigation history of e-learning systems using data mining methods. Educational data mining (EDM) discovers new patterns of learning and teaching to facilitate the process of decision-making to serve education improvement. Gamification is another way of increasing students' engagement by using game elements in a nongame context. In this paper, the gamification technique and EDM methods were used in combination with adaptive learning to increase the students' engagement and learning performance. An adaptive gamified learning system (AGLS) was developed which combines gamification, classification, and adaptation techniques to increase the effectiveness of e-learning. This paper studies the impact of gamification and adaptive gamification on the effectiveness of e-learning through increasing students' engagement and learning performance. AGLS was applied to the data structure course. Results showed that adaptive gamification has a positive effect on students' engagement and learning performance compared to just gamification.

**Gamifying Online Training in Management Education to Support Emotional Engagement and Problem-solving Skills**

Online training to improve problem-solving skills has become increasingly important in management learning. In online environments, learners take a more active role which can lead to stressful situations and decreased motivation. Gamification can be applied to support learner motivation and emotionally boost engagement by using game-like elements in a non-game context. However, using gamification does not necessarily result in supporting positive learning outcomes. Our analysis sheds light on these aspects and evaluates the effects of points and badges on engagement and problem-solving outcomes. We used an experimental approach with a fully randomized pre-test/post-test design of a gamified online management training program with 68 participants. The results demonstrate that points and badges do not directly improve problem-solving skills but are mediated by emotional engagement to positively influence problem-solving skills. Additionally, satisfaction with the gamification learning process positively relates to emotional engagement. Thus, when creating online training programs, it is essential to consider how to engage students and to think about the design of the learning environment. By identifying the limitations of gamification elements, the study’s results can provide educators with information about the design implications of online training programs for management learning.

**Acquisition of English Vowel Sounds at Nursery Level: An Empirical Study Based on the Application of Gamification Strategy**

The current empirical study aimed to stimulate and measure the competence level of children for learning vowel sounds at nursery level at Right School, Model Town, Sillanwali. Sound-bingo strategy was used for distinguishing and learning vowel sounds in the context of gamification efficacy. Gamification frameworks can boost dedication, while also developing learning execution at the same time. In any case, only a few studies have been undertaken to address the constructs used to analyse the effects of gamification on people. The current study implemented Mathew Nudds and Casey Callaghan’s ‘Theory of Auditory Perception’ as its theoretical framework. According to the theory, the information we hear is comprehensible. The researchers used the purposive sampling technique and an achievement test to obtain data for this study. Data was collected from two distinct groups of twenty-five students apiece, named Iqbal and Quaid, respectively. Quaid group was designated as the control group and Iqbal group as the experimental group. Utilising the gamification technique, both groups were subjected to a test without learning. Sound-bingo technique was utilised to deliver a specific corpus of vowel sounds to Iqbal group. The results revealed that when an activity is gamified, a meaningful goal needs to be provided before the action can be adequately rated. An all around organised game could help to enhance children’s motivation, commitment, and mental turn of events. The current study concludes that gamification can influence the students’ attitudes toward language learning and its effective application can help them learn better.

Demographic differences in perceived benefits from gamification

In recent years, “gamification” has been proposed as a solution for engaging people in individually and socially sustainable behaviors, such as exercise, sustainable consumption, and education. This paper studies demographic differences in perceived benefits from gamification in the context of exercise. On the basis of data gathered via an online survey (N = 195) from an exercise gamification service Fitocracy, we examine the effects of gender, age, and time using the service on social, hedonic, and utilitarian benefits and facilitating features of gamifying exercise. The results indicate that perceived enjoyment and usefulness of the gamification decline with use, suggesting that users might experience novelty effects from the service. The findings show that women report greater social benefits from the use of gamification. Further, ease of use of gamification is shown to decline with age. The implications of the findings are discussed.

**Towards a new conceptual model of AI-enhanced learning for college students: The roles of artificial intelligence capabilities, general self-efficacy, learning motivation, and critical thinking awareness.**

In the aftermath of the COVID-19 pandemic, college students have faced various challenges that could negatively impact their critical thinking abilities due to disruptions to education, increased stress and anxiety, less social interaction, and the advancement of distance learning relying more heavily on digital tools. With the increasing integration of AI technology across sectors, higher education institutions have deployed various AI capabilities for intelligent campuses and modernized teaching. However, how to fully utilize AI capabilities to promote students’ thinking awareness on learning effectiveness is still not clear, as critical thinking is an essential skill set holding significant implications for college students’ development. This research adopts the resource-based theory (RBT) to conceptualize the university as a unified entity of artificial intelligence (AI) resources. It aims to investigate whether AI capabilities can foster critical thinking awareness among students by enhancing general self-efficacy and learning motivation. In particular, it examines the causal relationships between AI capabilities, general self-efficacy, motivation and critical thinking awareness. Primary data was collected through a questionnaire administered to 637 college students. Structural equation modeling was employed to test hypotheses pertaining to causality. The results showed that AI capabilities could indirectly enhance students’ critical thinking awareness by strengthening general self-efficacy and learning motivation, but the effect on critical thinking awareness was not significant. Meanwhile, general self-efficacy significantly affected the formation of learning motivation and critical thinking awareness. This indicates that AI capabilities are able to reshape the cognitive learning process, but its direct influence on thinking awareness needs to be viewed with caution. This study explored the role of AI capabilities in education from the perspective of organizational capabilities. It not only proves how AI facilitates cognition, but also discovered the important mediating role of general self-efficacy and motivation in this process. This finding explains the inherent connections between the mechanism links. Furthermore, the study expands research on AI capabilities research from the technical level to the educational field. It provides a comprehensive and in-depth theoretical explanation theoretically, guiding the practice and application of AI in education. The study is of positive significance for understanding the need for the future development of the cultivation of critical thinking awareness talents needed for future development through AI capabilities in education.

### Incorporating Gamified Elements into Mobile Learning to Enhance Critical Thinking Skills

This study explores the potential of gamified mobile learning in fostering critical thinking skills among learners. The objective is to investigate how gamified learning environments can provide engaging challenges, opportunities for decision-making, constructive feedback, collaborative experiences, adaptive pathways, and immersive narratives to promote the development of critical thinking skills.  **Methods**: The research employed a descriptive qualitative approach to explore how gamified learning environments influence the development of critical thinking skills. This method aimed to express experiences, perceptions, and behaviors within their natural context. It was informed by a review of existing literature on gamified learning and critical thinking, establishing a theoretical framework and grounding the research in established theories and findings. Thematic analysis was used to identify patterns and themes in the data, which were then integrated with relevant literature to gain comprehensive insights into the relationship between gamified learning and critical thinking. **Findings:** The findings suggest that gamified mobile learning can indeed be a powerful tool for fostering critical thinking skills. By harnessing the motivational power of games, educators can create dynamic learning environments that inspire learners to think critically, solve problems, and achieve deeper understanding. Gamified challenges, decision-making scenarios, collaborative experiences, adaptive pathways, and immersive narratives provide learners with meaningful learning experiences that promote active engagement and reflection. **Conclusion**: Overall, gamified mobile learning has the potential to revolutionize education by cultivating the skills and dispositions necessary for success in the 21st century.

# INTEGRATING GAMIFICATION INTO CURRICULUM DESIGN: ENHANCING ADOLESCENT STUDENTS' DECISION MAKING, PROBLEM SOLVING AND CRITICAL THINKING CAPACITIES

According to research, the new age student, Gen Z, differs from his or her predecessors, and educators must develop new age pedagogical interventions to cater to this set of learners. With the changing manner the new generation learns, the education system must be revamped to include tools that meet the learner's demands. Gamification is an effective learning technique for today's generations, who are accustomed to using digital media. Gamification may also help students build critical thinking, decision-making, and problem-solving abilities by immersing them in dynamic and immersive learning experiences. Thus, the current study attempts to find out if incorporating the usage of gamification might promote critical thinking, decision making, and problem solving capabilities in adolescents.

# Evaluation of Problem Based Gamification Learning (PBGL) Model on Critical Thinking Ability with Artificial Intelligence Approach Integrated with ChatGPT API: An Experimental Study

The purpose of this research is to evaluate the effectiveness of Problem Based Gamification Learning (PBGL) model integrated with Artificial Intelligence (AI) through ChatGPT API in improving participants' critical thinking skills. The study used an experimental design with two groups, namely control and experimental, each consisting of 120 students (240 in total) from two countries (Timor Leste and Indonesia) studying basic Python programming. The main issues were complex system integration with ChatGPT API, technical challenges in AI implementation for automated feedback, and maintaining test consistency and fairness. Results showed the experimental group had a significant improvement in critical thinking skills, with an average score improvement of 23.57 points compared to 9.04 points in the control group, showing a mean difference of 14.53 points. Content Validity Ratio (CVR) testing showed good content validity with CVR values > 0.75 for all items. Construct Validity (CV) testing confirmed the instrument measured the desired construct with significant correlation coefficients. Test-retest Reliability testing showed excellent reliability with a Pearson correlation coefficient of 0.960. The findings confirm that the integration of AI in gamified learning can provide automatic feedback and additional relevant information, improving critical thinking and motivation of participants. The contribution of the research is the development and testing of an AI-supported PBGL model, which can serve as a reference in digital learning curriculum design and improve critical thinking skills. Practical implications show that the integration of AI in learning enriches the material and provides flexibility to participants and teachers. Overcoming the technical challenges and adaptability of AI models will be key to increasing the effectiveness of PBGL in various educational contexts in the future. This research provides new insights in the development of more effective and adaptive learning methods in the digital era.

Gamifying AI Education for Young Minds: The TransAI Adventure in Learning

In the dynamic landscape of educational technology, the imperative to introduce young learners to Artificial Intelligence (AI) in a compelling and digestible manner has never been more critical. This paper delineates the novel Integrated Gamification-AI Learning Theory (IGALT), a pedagogical framework that synergizes gamification with AI education to foster engaging and effective learning experiences. At the heart of demonstrating IGALT’s practical application is “TransAI,” an inventive Lego-Transformer-like character that serves as an educational tool bridging sophisticated AI concepts with playful learning. Equipped with vision for environmental interaction, a brain for analytical processing, and additional modules like “PetScada” for data gathering and “Scooper” for action-based learning, TransAI exemplifies how gamification can make AI education accessible and captivating for children. Set within a smart city context, TransAI embarks on various missions that translate abstract AI concepts into concrete, hands-on experiences, thus enabling children to explore, understand, and apply AI in problem-solving. This educational approach not only ignites creativity and imagination but also instills a foundational understanding of AI, preparing young minds for future technological landscapes. By integrating IGALT with the TransAI platform, this paper proposes a groundbreaking method to acquaint the younger generation with AI, nurturing an early interest in STEM fields through an engaging, imaginative, and practical learning journey.

**TEACHER PERSPECTIVES ON AI-DRIVEN GAMIFICATION: IMPACT ON STUDENT MOTIVATION, ENGAGEMENT, AND LEARNING OUTCOMES**

This study delves into the insights and experiences of teachers regarding the influence of AI-driven gamification on student motivation, engagement, and learning outcomes. Through qualitative research methods, teacher perspectives are explored to unravel the multifaceted aspects of AI-enhanced gamification within educational settings. The study identifies several significant themes, including positive perceptions of AI-driven gamification, challenges in implementation, elevated motivation and engagement, enhanced learning experiences, improved learning outcomes, and the complexities of assessing long-term effects. The findings underscore the transformative potential of AI-driven gamification, as educators highlight its ability to create democratic, effective, and transformative learning environments. Nevertheless, the study also uncovers challenges related to professional development, technical glitches, and curriculum alignment in the implementation of this innovative approach. Moreover, the study reveals a resounding consensus among teachers regarding the positive impact of AI-driven gamification on student motivation, participation, and learning experiences. Teachers emphasize how AI-driven gamification can turn ordinary learning into enjoyable and meaningful journeys, offering students autonomy and real-time feedback. Furthermore, teachers believe that AI-driven gamification contributes to improved learning outcomes, fostering a deeper understanding of subject matter, knowledge retention, and enhanced problem-solving skills. Despite these short-term gains, teachers acknowledge the need for longitudinal studies to comprehensively assess the long-term effects of AI-driven gamification on learning outcomes.

Hybrid Gamification and AI Tutoring Framework using Machine Learning and Adaptive Neuro-Fuzzy Inference System

Although technology has significantly improved the teaching and learning process, it has not been able to increase students' self-motivation and engagement at the same level. The lack of self-motivation and intermittent engagement is currently one of the primary challenges faced by educators. This new approach to learning called the hybrid gamification framework uses a combination of artificial intelligence (AI), machine learning (ML), and the Adaptive Neuro-Fuzzy Inference System (ANFIS) to create a more engaging and personalized learning experience. By tracking students' interactions and performance, the system can allocate rewards based on their progress, which helps to increase their motivation and engagement. This technology makes it possible for educators to collect and analyse data related to students' engagement patterns, quiz scores, time spent on learning activities, participation in discussion forums, and much more. This data analysis enables educators to identify struggling students and high achievers, allowing them to provide tailored support and instruction to maximize student success. A pilot implementation of this system involving 200 computer science students successfully demonstrated the effectiveness of this technology. This research provides a comprehensive understanding of gamification's impact by combining quantitative data with qualitative insights.

**Gamification and Computational Thinking in Education: A systematic literature review**

The rapid development of gamification and computational thinking seems to open up new educational horizons by providing new opportunities for students to acquire the basic digital skills needed for their cognitive development. Gamification, on the side, flourishes because it brings about high degree of participants’ engagement in an activity. Accordingly, on the other side, the growing scientific interest in computational thinking centers on the fact that it provides a fruitful field of dialogue in the research community for the development of critical and analytical thinking of students. Hence, this paper aims to synthesize knowledge about gamification and computational thinking for improving education for the benefit of students. Specifically, this paper describes: (a) the theoretical background of gamification in learning and education, (b) relevant studies in literature and their findings, and (c) specific gamified applications of STEM [Science, Technology, Engineering, Mathematics] which have been developed to this subject area. Four databases were searched, and 37 papers were finally selected for this review. The findings from the presented learning theories set the foundation on how students obtain knowledge, and the relevant studies in the field of gamification and computational thinking showed some first positive outcomes stemming some first research attempts which need further examination. Furthermore, it seems that with the right use of game mechanics and elements, well-designed applications of STEM gain students’ interest to learn through gameplay and motivate them to cultivate computational thinking and problem-solving skills.

# Can gamification help to improve education? Findings from a longitudinal study

A goal of any educational measure is to improve students' capability to retain teaching content. In this paper, we investigate the potential of [gamification](https://www.sciencedirect.com/topics/social-sciences/gamification) to foster knowledge retention using an [action research](https://www.sciencedirect.com/topics/social-sciences/action-research) approach. We present the results from a [longitudinal study](https://www.sciencedirect.com/topics/social-sciences/longitudinal-analysis) including 617 secondary and tertiary education students conducted over a period of two years. Various workshop designs that incorporated numerous [gamification](https://www.sciencedirect.com/topics/computer-science/gamification) elements were compared with non-gamified workshop designs, tested and refined over time. The improved workshop designs led to increased levels of knowledge retention that exceeded the benchmark values from educational literature. We found that [gamification](https://www.sciencedirect.com/topics/psychology/gamification) exerts a positive impact on knowledge retention. We tested for the moderating [effects of gender](https://www.sciencedirect.com/topics/social-sciences/effect-of-gender) and age and found no effect of the former and inconsistent results for the latter. The steady increase in students’ [learning performance](https://www.sciencedirect.com/topics/social-sciences/learning-performance) resulting from constant refinement of the workshops demonstrates the usefulness of incorporating [gamification](https://www.sciencedirect.com/topics/social-sciences/gamification) principles into educational activities.

The effects of over-reliance on AI dialogue systems on students' cognitive abilities: a systematic review

The growing integration of artificial intelligence (AI) dialogue systems within educational and research settings highlights the importance of learning aids. Despite examination of the ethical concerns associated with these technologies, there is a noticeable gap in investigations on how these ethical issues of AI contribute to students’ over-reliance on AI dialogue systems, and how such over-reliance affects students’ cognitive abilities. Overreliance on AI occurs when users accept AI-generated recommendations without question, leading to errors in task performance in the context of decision-making. This typically arises when individuals struggle to assess the reliability of AI or how much trust to place in its suggestions. This systematic review investigates how students’ over-reliance on AI dialogue systems, particularly those embedded with generative models for academic research and learning, affects their critical cognitive capabilities including decision-making, critical thinking, and analytical reasoning. By using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, our systematic review evaluated a body of literature addressing the contributing factors and effects of such over-reliance within educational and research contexts. The comprehensive literature review spanned 14 articles retrieved from four distinguished databases: ProQuest, IEEE Xplore, ScienceDirect, and Web of Science. Our findings indicate that over-reliance stemming from ethical issues of AI impacts cognitive abilities, as individuals increasingly favor fast and optimal solutions over slow ones constrained by practicality. This tendency explains why users prefer efficient cognitive shortcuts, or heuristics, even amidst the ethical issues presented by AI technologies.

**A Qualitative Investigation of Team-Based Gamified Learning in an Online Environment**

**Background**/**purpose** – This study examined how team-based gamified learning influenced students’ attitudes towards the gamification of learning, online collaboration, and competition. Furthermore, the study explored what factors contributed to the students’ positive or negative experiences with gamified learning.

**Materials**/**methods** – Game elements used for the team-based gamified learning experience included challenges, points, peer feedback and voting (social influence), and inter-team competition. Qualitative data were collected from pre- and post-surveys and participants’ reflections.

**Results** – Overall, the gamified learning experience had a positive influence on the participants’ attitudes toward the gamification of learning. The major factors that contributed to the positive change included (1) fun and enjoyment, (2) motivation and engagement, (3) relevance, and (4) choice and freedom. Most participants reportedly enjoyed the online collaboration in the study. The major factors that contributed to the positive online collaboration experience were effective teamwork, benefits of collaboration, and game elements. While the majority of the participants found the inter-team competition to be fun, friendly, and motivating, a few did not enjoy the inter-team competition. Teamwork was a major factor that led to either a positive or negative team-based competition experience.

**Conclusion** – The findings of the study provide practical insight into what should be considered when designing and implementing team-based gamified learning in online environments.

**Interface design in gamification based mobile applications**

Game, is an aspect to help all living creatures to be able to prepare for life in a fun and volunteer way. Gamification, which emerges with the idea of increasing motivation by using game elements, is used in many fields such as work, education, health, personal development and marketing. In people's real lives, they can loss weight, learn language, sales increase and so on motivation in line with many goals and take action and change behavior. Gamification; especially, in the growing mobile application market with the increase in the use of smart phones is the new choice of companies. Gamification is a technique which used to increase the loyalty, motivation and productivity of users in mobile applications. In this way, a more interesting and enjoyable experience for the user can be provided. Gamification, which attracted the attention of researchers and academics, has been the subject of many researches and studies. The purpose of this is the benefits of gamification over the engagement between users and the interface design and the experience. In line with this aim, elements related to the concept of gamification, models and related motivational theories are explained in detail and the elements that should be considered for a qualified and usable user interface (UI) design are examined. The usage rate and appreciation rate of educational mobile applications using gamification were selected and the effect of gamification on the usability of interface design was evaluated. As a result of this study, the interface design of a new application called "Quistudy", which uses the elements of gamification in order to improve usability and development, has been designed. The usability tests of the application were performed and the success rate of the interface design was measured. In this manner, the effect of gamification usage on interface design in educational mobile applications and the contribution of interface design to effective use of gamification elements were evaluated.

**Gamification Misunderstood?**

Gamifi cation (FROMANN, 2017), as an alternative evaluation method, is gaining more and more attention in today’s Hungarian educational trends. The method coming from game development is an optional practice already used in international educational practices (KAPP, 2012; SHELDON, 2012), but it has a novel effect in Hungary. The misconceptions and conceptual confusion prevailing in pedagogical practice justify a closer examination of the concept of gamifi cation and its Hungarian pedagogical practice. The present study aims to clarify the concept, elements, and criteria of gamifi cation, thus helping to develop a more well-founded educational discourse on gamifi cation and its use for pedagogical purposes. This study provides an overview of the discourse of the concept of gamifi cation and its Hungarian aspects. The analysis of some gamification models implemented in Hungarian pedagogical practice based on the Bunchball model is investigated (BUNCHBALL, 2010), with special regard to the  
system created by Tibor Prievara (PRIEVARA, 2015). In addition, based on the works of pedagogical and psychological authors, it is intended to apply the narrative as a game mechanic element in Hungarian gamifi cation practice. The critical issues related to gamifi cation through the works of international and Hungarian authors are also presented in the study.

**Advancements in Educational Technology: Cultivating Critical Thinking Proficiency among Students Through Innovative Learning Models**

This research article explores the recent advancements in educational technology and their impact on fostering critical thinking proficiency among students through innovative learning models. In the ever-evolving landscape of education, technology has become an indispensable tool in enhancing pedagogical approaches. This study investigates how integrating innovative learning models driven by educational technology can effectively cultivate critical thinking skills among students.

The research employs a mixed-methods approach, combining quantitative assessments and qualitative analyses to evaluate the effectiveness of various innovative learning models. The findings reveal a positive correlation between the use of cutting-edge educational technology and the development of critical thinking abilities. Innovative learning models such as gamified education, virtual reality simulations, and collaborative online platforms create immersive and engaging experiences that stimulate students' analytical thinking and problem-solving skills.

Furthermore, the study discusses the importance of teacher training programs to ensure effective implementation of these technologies in the classroom. Professional development for educators is crucial to harness the full potential of educational technology, maximizing its impact on students' critical thinking proficiency.

This article contributes to the ongoing discourse on educational technology by providing insights into practical strategies for cultivating critical thinking skills. As educational institutions strive to prepare students for the challenges of the 21st century, understanding the symbiotic relationship between technology and pedagogy is paramount. The implications of this research extend beyond the classroom, emphasizing the role of educational technology in shaping a generation of learners equipped with essential critical thinking abilities.

**Impact of artificial intelligence on human loss in decision making, laziness and safety in education**

This study examines the impact of artificial intelligence (AI) on loss in decision-making, laziness, and privacy concerns among university students in Pakistan and China. Like other sectors, education also adopts AI technologies to address modern-day challenges. AI investment will grow to USD 253.82 million from 2021 to 2025. However, worryingly, researchers and institutions across the globe are praising the positive role of AI but ignoring its concerns. This study is based on qualitative methodology using PLS-Smart for the data analysis. Primary data was collected from 285 students from different universities in Pakistan and China. The purposive Sampling technique was used to draw the sample from the population. The data analysis findings show that AI significantly impacts the loss of human decision-making and makes humans lazy. It also impacts security and privacy. The findings show that 68.9% of laziness in humans, 68.6% in personal privacy and security issues, and 27.7% in the loss of decision-making are due to the impact of artificial intelligence in Pakistani and Chinese society. From this, it was observed that human laziness is the most affected area due to AI. However, this study argues that significant preventive measures are necessary before implementing AI technology in education. Accepting AI without addressing the major human concerns would be like summoning the devils. Concentrating on justified designing and deploying and using AI for education is recommended to address the issue.

**Leveraging ChatGPT for Enhancing Critical Thinking Skills**

This article presents a study conducted at Georgia Gwinnett College (GGC) to explore the use of ChatGPT, a large language model, for fostering critical thinking skills in higher education. The study implemented a ChatGPT-based activity in introductory chemistry courses, where students engaged with ChatGPT in three stages: account setup and orientation, essay creation, and output revision and validation. The results showed significant improvements in students’ confidence to ask insightful questions, analyze information, and comprehend complex concepts. Students reported that ChatGPT provided diverse perspectives and challenged their current ways of thinking. They also expressed an increased utilization of ChatGPT to enhance critical thinking skills and a willingness to recommend it to others. However, challenges included low-quality student comments and difficulties in validating information sources. The study highlights the importance of comprehensive training for educators and access to reliable resources. Future research should focus on training educators in integrating ChatGPT effectively and ensuring student awareness of privacy and security considerations. In conclusion, this study provides valuable insights for leveraging AI technologies like ChatGPT to foster critical thinking skills in higher education.

**Gamification for student engagement: a framework**

Gamification, the application of game elements to non-game situations, has gained traction in education as a mechanism for improving motivation and/or learning outcomes. Although it is widely accepted that gamification enhances these aspects of engagement in business and education settings, there is equivocal supporting evidence. Research has emphasised behavioural responses to gamification, although there is some evidence that gamification can support deeper cognitive and affective aspects. It continues to remain unclear how gamification influences student engagement and leads to learning, a significant gap in the literature to date. In this conceptual article, we fill the gap between practice and theory through the synthesis of student engagement and gamification literature into a new Gamification for Student Engagement Framework. The provisional Framework should, for the first time, enable practitioners to systematically design gamified learning experiences, through the purposeful selection of game attributes according to the desired student experience, and consequence of, engagement. Although we focus on learning outcomes, the Framework has the potential to improve others such as student satisfaction and wellbeing across many settings and disciplines. It can also be used to gather much needed empirical evidence about the effectiveness of the approach on desired outcomes.

Gamification resources in education: a theoretical approach

Introduction. The modern education system has undergone significant changes in recent years - the content of educational programs is being revised, electronic, blended, mobile learning is being actively introduced; the practical activities of future specialists are being strengthened. The use of computer networks, web applications, interactive services makes education more accessible, stimulating students' cognitive interests, increasing motivation for education. One of the most significant innovative trends in modern education is gamification, which is most often considered as a system that uses computer game components in non-game situations.

The purpose of this paper is to analyze the conceptual foundations of gamification in education, to determine a system of tools that can present unique opportunities for gamification, the features of its promising use for turning it into an innovative experience in the development of higher professional education.

Methodology, methods and techniques of research. The study of the gamification problem involves the analysis of pedagogical and psychological literature by foreign and domestic authors; systematization and generalization of pedagogical concepts, practice-oriented materials, facts.

The methodology of gamification includes system, personality-oriented, and activity-based approaches. An attempt was made to determine the components of the gamification system and their role in the organization of modern education. Analysis of gamification resources allows us to reveal approaches to increasing motivation and involvement of students, and, in addition, to find out ways to include elements of game design (definition of tasks, feedback, levels, creativity), computer games in the educational environment.

Based on the personality-oriented approach, the influence of gaming technologies on the development of the personality of students is considered. The activity-based approach allows us to identify the foundations of organizing and managing the initiative of educational entities, to establish the features of using educational technologies, practices, and methodological techniques. The activity-based approach in the context of gamification determines active, increasingly complex activity as a source of personal development of students.

Results. In the course of the study, theoretical foundations for using gamification in modern higher education were formulated, tools for the prospective inclusion of gaming practices in the personnel training system were determined, mechanisms of internal and external motivation of students, regulation of the behavior of future specialists when using game elements were identified.

Scientific novelty. The concept of gamification of education is part of the concept of the game and reflects modern trends in the development of education based on the strategy and tactics of gaming activities, specially structured taking into account the resources of gaming principles, mechanics, methods and techniques. Gamified learning can become the leading one in the process of training specialists using innovative practices, stimulating motivation, regulating behavior, implementing ideas of friendly competition and creative cooperation in various educational contexts.

Practical significance. In the context of determining the promising foundations for the development of modern higher education, ideas for original technological support for training personnel are proposed. The implementation of practical measures to develop the involvement of students in the educational process, regulate motivation, behavior and practical activities of students, emotional self-realization, and the system of relationships will contribute to improving the quality of education in higher education. An important result of the study was the conclusion about the appropriate combination of traditional and innovative options for conducting classes with students, the inclusion of various gaming practices in the educational process.

# The impact of gamification on learning and instruction: A systematic review of empirical evidence

The adoption of [gamification](https://www.sciencedirect.com/topics/social-sciences/gamification) in learning and instruction is perceived to have mass appeal among the learners in stimulating motivation, [learner engagement](https://www.sciencedirect.com/topics/psychology/learner-engagement) and social influence. This study is an attempt to present a summary of the empirical findings of state-of-the-art literature in the emerging field of [gamification](https://www.sciencedirect.com/topics/psychology/gamification) within the educational domain of learning and instruction. It reveals the latest scientific research evidence on the emerging trends of learning technologies and [gamification](https://www.sciencedirect.com/topics/social-sciences/gamification) plugins along with extending the possibilities for future research directions in revolutionizing learning and instruction through [gamification](https://www.sciencedirect.com/topics/psychology/gamification). A [systematic literature review](https://www.sciencedirect.com/topics/social-sciences/systematic-review) examined the thematic and content analysis of 46 empirical research papers published in the Web of Science database between 2016 and 2019. The review critically appraised and evaluated the various contradictions found in the literature along with setting the stage for the significance of future research studies to re-examine the theoretical foundations of gamification, its methodological approaches, theoretical models, gaming platforms and apps, game mechanics and learning outcomes. This study not only attempts to shed light on the novelty of gamified learning perceived as a game-changer and key enabler of motivation, engagement, and user experience but also sought to outline the key challenges and barriers of gamification.

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**Role of Artificial Intelligence Tools in Enhancing Students' Educational Performance at Higher Levels**

The abstract of the study titled "Role of Artificial Intelligence Tools in Enhancing Students' Educational Performance at Higher Levels" explores the integration of artificial intelligence (AI) tools into higher education and their impact on students' educational performance. The study investigates various AI applications such as personalized learning systems, intelligent tutoring systems, and automated assessment tools, and their potential to enhance learning outcomes, engagement, and overall academic achievement. Through a comprehensive review of existing literature and empirical research, the abstract highlights the benefits and challenges associated with AI adoption in education. It also underscores the need for effective implementation strategies, teacher training, and ethical considerations to ensure the responsible and effective use of AI technologies in higher education. The findings of this study contribute to a deeper understanding of how AI tools can be leveraged to optimize educational experiences and outcomes for students in higher education settings.

**Creativity, Critical Thinking, Communication, and Collaboration: Assessment, Certification, and Promotion of 21st Century Skills for the Future of Work and Education**

This article addresses educational challenges posed by the future of work, examining “21st century skills”, their conception, assessment, and valorization. It focuses in particular on key soft skill competencies known as the “4Cs”: creativity, critical thinking, collaboration, and communication. In a section on each C, we provide an overview of assessment at the level of individual performance, before focusing on the less common assessment of *systemic support* for the development of the 4Cs that can be measured at the institutional level (i.e., in schools, universities, professional training programs, etc.). We then present the process of official assessment and certification known as “labelization”, suggesting it as a solution both for establishing a publicly trusted assessment of the 4Cs and for promoting their cultural valorization. Next, two variations of the “International Institute for Competency Development’s 21st Century Skills Framework” are presented. The first of these comprehensive systems allows for the assessment and labelization of the extent to which development of the 4Cs is supported by a formal educational program or institution. The second assesses informal educational or training experiences, such as playing a game. We discuss the overlap between the 4Cs and the challenges of teaching and institutionalizing them, both of which may be assisted by adopting a dynamic interactionist model of the 4Cs—playfully entitled “Crea-Critical-Collab-ication”—for pedagogical and policy-promotion purposes. We conclude by briefly discussing opportunities presented by future research and new technologies such as artificial intelligence and virtual reality.

**Artificial Intelligence in Education: A Review**

The purpose of this study was to assess the impact of Artificial Intelligence (AI) on education. Premised on a narrative and framework for assessing AI identified from a preliminary analysis, the scope of the study was limited to the application and effects of AI in administration, instruction, and learning. A qualitative research approach, leveraging the use of literature review as a research design and approach was used and effectively facilitated the realization of the study purpose. Artificial intelligence is a field of study and the resulting innovations and developments that have culminated in computers, machines, and other artifacts having human-like intelligence characterized by cognitive abilities, learning, adaptability, and decision-making capabilities. The study ascertained that AI has extensively been adopted and used in education, particularly by education institutions, in different forms. AI initially took the form of computer and computer related technologies, transitioning to web-based and online intelligent education systems, and ultimately with the use of embedded computer systems, together with other technologies, the use of humanoid robots and web-based chatbots to perform instructors' duties and functions independently or with instructors. Using these platforms, instructors have been able to perform different administrative functions, such as reviewing and grading students' assignments more effectively and efficiently, and achieve higher quality in their teaching activities. On the other hand, because the systems leverage machine learning and adaptability, curriculum and content has been customized and personalized in line with students' needs, which has fostered uptake and retention, thereby improving learners experience and overall quality of learning.

**Possibilities and Apprehensions in the Landscape of Artificial Intelligence in Education**

Artificial intelligence (AI) may be utilized outside of traditional computer settings and is also readily available in low-cost smart devices, making AI easily accessible to general population. Built-in capabilities for conducting complicated computer operations (edge computing), cloud-based services for collaboratively addressing difficult issues, access to huge quantities of open and closed data resources, and conciliatory accession for agile network connections are all available on these low-cost devices. Education is helped by AI in at least two ways: (1) the educational process – assistance and modifications to pedagogy and educator's routine function; and (2) the educational ambit and content – what kind of education is needed. Author, in this article, explores the challenges and potentialities that AI offers in the field of education. While the focus is on AI's participation, it may be difficult to differentiate it from other technological advancements, especially when it comes to work life. Author conclude that AI (and associated technological advancements) will substitute some professions (didactics will not be required), that other professions will transform impressively (didactic materials will need to be updated), and that a significant number of novel vocations will be created (new-fangled didactics must be constituted). In educational operations – the task itself – AI will be a reformer as well as a facilitator, altering the characteristics and division of labor.

**Generative AI and Gamification for Personalized Learning: Literature Review and Future Challenges**

The integration of Artificial intelligence (AI) in education (AIEd) opens the possibilities for creating new content, virtual teaching, and personalized learning experiences. This paper studies the different innovative methods used in education where we investigate the integration of Generative Artificial Intelligence (GAI) into education, and its transformative influence in producing personalized learning experiences through the use of its models like BERT, ChatGPT and GANs that have unique role in creating new content like text, image, and video, unlike discriminative algorithms that focus only on classification tasks. Also, the paper explores the power of gamification to enhance academic systems by generating new dynamic and interesting learning environments by using specific design that make learner learn and have fun which adjusts their needs, their personality, values and motivation. Even though the importance,The development of a dynamic adaption engine model for GAI and adaptive gamification is a pressing matter in this particular domain. Thus, This review aims the incorporation of generative AI into gamification to generate personalized content and improve the quality of the entire learning experience.

**Gamification in the Learning Process**

Recently, learning environments have transformed from traditional, lecture-based learning environments to team-based, experiential and problem based learning to prepare learners for a more complex and collaborative world. One teaching approach that embodies these essential characteristics of learning is gamification. Gamification is the application of gamified thinking and game mechanics to solve problems and increase engagement (Çeker & Özdam, 2017). Gamification is characterized by its ability to achieve cognitive, emotional, and behavioural effects by giving students opportunities to improve their critical thinking skills, arouse their feelings of curiosity, and increase active participation, respectively. However, giving consideration to gamification as an approach for education and learning is still a controversial subject. It is our position of this paper that as educators, we believe that gamification engages learners, motivates them to learn, satisfy their needs, and transfers knowledge by fun tasks

**Strategies for Teaching Students to Think Critically: A Meta-Analysis**

Critical thinking (CT) is purposeful, self-regulatory judgment that results in interpretation, analysis, evaluation, and inference, as well as explanations of the considerations on which that judgment is based. This article summarizes the available empirical evidence on the impact of instruction on the development and enhancement of critical thinking skills and dispositions and student achievement. The review includes 341 effects sizes drawn from quasi- or true-experimental studies that used standardized measures of CT as outcome variables. The weighted random effects mean effect size (*g*+) was 0.30 (*p* < .001). The collection was heterogeneous (*p* < .001). Results demonstrate that there are effective strategies for teaching CT skills, both generic and content specific, and CT dispositions, at all educational levels and across all disciplinary areas. Notably, the opportunity for dialogue, the exposure of students to authentic or situated problems and examples, and mentoring had positive effects on CT skills.

**A Framework for Implementing Higher-Order Thinking Skills (Problem-Solving, Critical Thinking, Creative Thinking, and Decision-Making) in Engineering & Humanities**

Learning skill is the ability to acquire basic knowledge and concepts across multiple dimensions (e.g., affective, psychomotor, and cognitive). Thinking is the ability to challenge and eventually develop acquired knowledge to a higher attainment level.The proposed framework models here are intended for developing, stimulating, and engaging students' complex thinking process skills. This is a higher-order thinking level and consists of four subthinking skills, i.e., problem-solving, critical thinking, creative thinking, and decision-making. Common and supporting thinking skills of these four levels are identified and derived from the literature, and additional sublearning skills are defined as general capacities to perform a set of tasks and further development of students' higher-order thinking abilities. Furthermore, questions for focusing thinking or learning activities are developed to transform learned knowledge and skills into practical activities. Hence, course assignments (e.g., homework and quizzes) and learning tools (e.g., mind map, flowchart) were developed to engage students in developing their skills in these four thinking levels. Learning assignments and tasks, as related to complex thinking and related subthinking skills, can be mapped to students' learning outcomes, assessed, and eventually allow evaluating learning skills. Proposed teaching activities' initial assessments show high improvement in student learning and were applied successfully in higher education and partially tested first-grade students. Furthermore, it is implemented using a blended learning approach through providing skills-based assignments (e.g., homework, quizzes), interactive lectures, and using learning tools such as mind maps. Initial assessment of students' outcomes showed an improvement by 20% as compared with course sections with typical course delivery mode.

Teaching and learning artifcial intelligence: Insights from

the literature

Artifcial Intelligence (AI) has been around for nearly a century, yet in recent years

the rapid advancement and public access to AI applications and algorithms have led

to increased attention to the role of AI in higher education. An equally important but

overlooked topic is the study of AI teaching and learning in higher education. We

wish to examine the overview of the study, pedagogical outcomes, challenges, and

limitations through a systematic review process amidst the COVID-19 pandemic

and public access to ChatGPT. Twelve articles from 2020 to 2023 focused on AI

pedagogy are explored in this systematic literature review. We and in-depth analysis

and comparison of work post-COVID and AI teaching and learning era is needed

to have a more focused lens on the current state of AI pedagogy. Findings reveal

that the use of self-reported surveys in a pre-and post-design form is most prevalent

in the reviewed studies. A diverse set of constructs are used to conceptualize AI

literacy and their associated metrics and scales of measure are dened based on

the work of specic authors rather than a universally accepted framework. There

remains work and consensus on what learning objectives, levels of thinking skills,

and associated activities lead to the advanced development of AI literacy. An over-

view of the studies, pedagogical outcomes, and challenges are provided. Further

implications of the studies are also shared. The contribution of this work is to open

discussions on the overlooked topic of AI teaching and learning in higher education

**Critical Thinking in the Management Classroom: Bloom's Taxonomy as a Learning Tool**

*This article discusses the use of Bloom's taxonomy as a metacognitive framework for the student-centered management class, or what contemporary education researchers call scaffolding. The taxonomy is a six-level classification system that uses observed student behavior to infer the level of cognitive achievement. The article surveys thinking within general education and within management education, which draws on Bloom's taxonomy, and then describes suggested uses of the taxonomy. Empirical evaluation of its effect on student achievement follows, as do thoughts about ways colleagues might use this tool to empower their management students as self-responsible learners in the classroom.*

**Critical Thinking and Education**

The skills of 'critical thinking' occupy a contentious place in debates on education. It is of course widely recognised that education must consist of more than an unreasoning accumulation of facts and skills, and that modern society demands a highly-developed critical awareness to cope with its ever-increasing complexities. Yet the very term 'critical thinking' threatens to become a vague and unexamined slogan, displayed more in party tricks than in useful knowledge.

**Thinking critically about critical thinking: Assessing critical thinking of business students using multiple measures**

Critical thinking is a skill that potential employers expect all graduates to possess. Hence, most business management programs consider critical thinking as an important student learning goal. Unfortunately, there is ambiguity about how to best assess critical thinking, both as a skill and a learning outcome. The authors empirically demonstrate how they measure the critical thinking ability of their students in different settings, and how their critical thinking ability improves as they progress through the business program.

The Effect of Critical Literacy-Based Literature Reading on Critical Thinking Skills: A Study on the First-Year Students in University

This study aimed to investigate the effect of critical literacy-based literature reading on first-year students’ critical thinking skills. For this purpose, twelve learning sessions were attended by thirty-six first-year students, ages 16 to 18, from the Department of Indonesian Language and Literature Teaching, Indonesia. After passing the Indonesian Language Competency Test (UKBI), they were chosen, and their results, which ranged from 75 to 79.9 percent, were quite high. The selection of participants was done via non-random sampling. This study’s quasi-experimental pretest–posttest control group design. Half the students were taught through critical literacy-based literature reading (experimental group). The other half were taught conventional learning methods (control group). Data collection was carried out after practicing critical literacy-based literature reading. Data were obtained from the pretest and posttest activities in the control and experimental groups using the critical thinking test sheet developed from the Facione and Gittens model. SPSS for Windows version 25 was used for data analysis. The study’s findings show that the experimental group outperformed the control group in terms of score. This means that critical literacy-based literature reading has a significant effect on the critical thinking skills of first-year students. The findings of this research show that the process of critical literacy-based literature reading can develop students’ critical awareness and critical thinking skills in facing all forms of reality that represent dominance, abuse of power, oppression, injustice, social marginalization, ethnic issues, racial issues, and all systems that shackle them contained in literary texts and real life. Future research may be able to compare the findings of this study in terms of cognitive abilities, various educational backgrounds, literary text reading habits, and gender.

Development of Scoring Rubric of Writing Literacy Criticism Based on Critical Thinking Skills for Senior High School Student in Indonesia

Literary criticism emphasizes the students to be able to think critically for identifying, interpreting, describing, analyzing, evaluating, and assessing a literature. Literary criticism needs to be assessed to find out whether the critical thinking skills are being met for the students and one of the methods for the teacher to be assessed is using a scoring rubric. The problem with this method is, especially for a rubric assessment for evaluating the literary criticism of a student's writings, have not described the clear component aspects. The rubric used so far tends to contain the same components in assessing other texts in learning of Indonesian language. This condition is the basis for the need to develop special scoring rubrics for literary criticism writing competencies. This literary criticism scoring rubric was developed with a three-stage research and development of literature study research, those are research and information collecting, planning, and develop preliminary form of product. The rubric of writing literary criticism-which developed by Finken and Ennis (1993)-adopts a six-stage critical thinking test. These six stages are focus, supporting, reasoning, organization, convention, and integration. They are then modified and adjusted to the criteria for a literary criticism. This research is only limited to making products, so it is necessary to do a product feasibility test to determine the feasibility of the literary criticism scoring rubric. Thus, further research is needed in this study.

**Developing Project-Based Learning-Based eBook “Critical and Creative Reading”**

**to Improve Students' Critical Thinking Skills**

This study aims to examine the feasibility and effectiveness of the

development of electronic-book-based Critical and creative reading project to

improve students ' critical thinking skills. This study was developed based on

the Research and Development (R&D) model by Brog and Gall. The stages

conducted in this study were (1) needs analysis, (2) planning, (3) development,

(4) product validity, (5) revision, (6) response test, (7) revision, and (8) final

product development. The product validity was assessed by two experts in

teaching materials and graphs as the validators. The result of the validity

assessment was then processed using the five-scale formula. The revision was

done to meet the validators’ suggestions. Response test was conducted with

students of the Indonesian Language Education Department of Universitas

Ahmad Dahlan. The test results were processed using the AIKEN V formula. A

revision was then made to meet students’ suggestions obtained from the test. At

last, a trial was carried out to measure the effectiveness of the product in order

to become the guideline to develop the final product.The research findings were

as follows: (1) the lecturers and students in learning critical and creative reading

in higher education expected teaching materials that were easily accessible,

electronic, and collaborated with one of the learning models so that they were

able to measure the success rate of the critical and creative reading process; (2)

product development was carried out through the activities of designing

materials, models and evaluations that were developed in a product, as well as

designing electronic books in accordance with the results of the needs analysis;

(3) the appropriateness test results by the material experts obtained 3.40 in the

good category and the layout expert scored 4.65 with a very good category. The

results of the response test for students after being calculated with the Aiken V

formula obtained a score of 0.85– 1.00 with a very good category. The results

of the experimental test showed that the posttests of the control and

experimental classes obtained results of 0.001, which showed <0.05, so H0 was

rejected. Students' critical thinking skills after the treatment were significantly

different. Therefore, the teaching material developed was effectively used to

improve students' critical thinking skills.

Development of an E-Book Based on STEM-Integrated Creative Problem Solving on Environmental Change Material to Improve Students’ Critical Thinking and Creative Thinking

Critical and creative thinking skills are very important in the 21st century. The creative problem-solving learning model and the STEM approach are suitable for training critical and creative thinking skills in learning. This study aims to: 1) analyze the need for an e-book based on creative problem solving integrated with STEM, hereinafter referred to as BOTIPOSTEM and 2) analyze the eligibility of BOTIPOSTEM. This type of research is research and development (R&D) using the ADDIE model. Research data were obtained through interviews, questionnaires, validation sheets, and readability sheets. The data were analyzed descriptively quantitatively and using Aiken's V. The results showed that: 1) the development of BOTIPOSTEM is in the very needed category based on the teacher's response; 2) BOTIPOSTEM obtained an average Aiken score of 0.96 by material experts and 0.92 by media experts, the percentage of readability obtained an average score of 96% by teachers and 93% by students. Data analysis shows that BOTIPOSTEM has a high level of validity and readability. Thus it can be concluded that BOTIPOSTEM is very much needed and eligible to used in learning to train students' critical and creative thinking skills at school.

Assessing critical thinking in business education: Key issues and practical solutions

Developing critical thinking is an important goal in higher education and, more importantly, in business education. Yet, it is uncertain to what extent assessment influences students' critical thinking development and enhancement. This paper presents data from a study that applied a framework we developed to identify evidence of students’ ability to think critically and whether students face challenges at applying critical thinking. A sample of 100, 2000-word group reports from a masters business analysis subject were evaluated using a critical thinking assessment rubric. We followed this with a content analysis of 49 reports using our developed framework to identify the demonstration of critical thinking dispositions and abilities. The findings from both analyses indicate a difference between student reports on how critical thinking is demonstrated. Most importantly, our developed framework provides a novel way to analyse student reports that inform whether they demonstrate the specific components of critical thinking dispositions and abilities. The evaluation using our established framework enables us to offer practical suggestions that university instructors can use to address the issues and challenges raised that hinder critical thinking acquisition via assessment practice in business education.

The Influence of Artificial Intelligence Tools on Student Performance in e-Learning Environments: Case Study

This study investigated the impact of AI-powered personalized learning tools on the academic performance and perceptions of pre-service student teachers enrolled in the Educational Technology course, a compulsory component of the Professional Postgraduate Diploma in Teaching program at Ajman University. A quasi-experimental design was employed with 55 students in the experimental group and 55 in the control group. The experimental group utilized AI-powered tools within the Moodle platform, while the control group received traditional instruction. Pre- and post-tests, along with a rubric-based assessment and a questionnaire, were administered to assess performance, knowledge retention, critical thinking, motivation, and engagement. Statistical analysis revealed significant differences between the groups, favoring the experimental group in terms of academic performance and knowledge retention. Additionally, students in the experimental group demonstrated higher levels of critical thinking, motivation, and engagement. These findings underscore the transformative potential of AI-powered personalized learning tools in teacher education. By integrating AI into educational practices, institutions can revolutionize e-learning by providing personalized instruction, intelligent tutoring, automated grading, and adaptive learning experiences. This can enhance student engagement, improve learning outcomes, and reduce the workload of educators. Ultimately, AI empowers institutions to create more effective and inclusive learning environments that cater to the diverse needs of students and prepare them for the future.

AI Powered Book Recommendation System

The purpose of this study is to demonstrate the development of book recommendation systems through the usage of Artificial Intelligence (AI). Models of recommender systems displayed in the study are popularity-based, correlation-based (otherwise known as collaborative filtering), and content-based. Another type implemented in this study is the Lexile recommender, which suggests books based on similar Lexile levels. For the dataset, the researcher used a sample of books and user information from the public site Goodreads. The target audience for these books in the sample was high school students. As prior research shows that there is no single best way to create reading lists for students, the results of this study would encourage both leisure and educational reading to these students and allow readers to be able to create reading lists of their own that are personalized to their preferences. The researcher used Python libraries to implement these recommender structures. The results of this study showed that creating recommendation systems through AI was successful, but there is still much room for improvement in the complexity of these structures.

Enhancing ESL Education with AI: Innovations in Teaching Methods and Au-thentic Materials

This article explores the integration of Artificial Intelligence (AI) in English as a Sec-ond Language (ESL) education, focusing on innovative teaching methods and authen-tic materials. AI-powered gamification is discussed, highlighting the use of AI tools like ChatGPT to enhance the gamification of key terms and concepts in ESL educa-tion. The interactive and enjoyable nature of gamified learning, combined with AI-driven content curation, deepens student understanding, critical thinking skills, and retention. By personalizing the learning experience, AI tools cater to individual stu-dent needs, allowing for flexibility in difficulty and fostering a love for the subject. Reflection and self-assessment play a crucial role in solidifying knowledge and pro-moting deeper learning. The article also discusses the importance of authentic materials in ESL education, emphasizing the use of AI-driven content curation to select and organize relevant and meaningful language content. AI-powered tools can analyze vast amounts of data, un-derstand patterns, and make accurate predictions, enhancing the user experience and delivering content that is most relevant and valuable to each individual student. The integration of AI in ESL education offers numerous benefits, including increased engagement, improved retention and application of key terms and concepts, personal-ized learning experiences, and enhanced critical thinking skills. By embracing AI-powered gamification and content curation, educators can create dynamic, interactive, and engaging learning experiences that foster a love for language learning and pro-mote deeper understanding.

Uncurtaining windows of motivation, enjoyment, critical thinking, and autonomy in AI-integrated education: Duolingo Vs. ChatGPT

Artificial intelligence (AI) has become increasingly integral to second language learning due to its outstanding advantages, such as personalized learning experiences, real-time feedback, and increased engagement. Despite the growing popularity of AI-powered platforms like Duolingo and ChatGPT, there is limited empirical research comparing their effectiveness in fostering key educational outcomes. This study addressed this gap by investigating the impact of Duolingo and ChatGPT on the motivation, enjoyment, critical thinking (CT), and autonomy of English as a Foreign Language (EFL) learners in China. Employing a true-experimental design, the study involved three groups: two experimental groups (EGs) using Duolingo (n = 81) and ChatGPT (n = 81) and a control group (CG) (n = 82). The outcomes of a one-way MANOVA indicated that both experimental groups significantly outperformed the control group in terms of motivation, enjoyment, CT, and autonomy. Furthermore, the results demonstrated no significant differences between the Duolingo and ChatGPT groups, suggesting both platforms are equally effective in the constructs under investigation in this study. These findings indicated the potential of AI-driven platforms to transform second language education by providing engaging, personalized, and cognitively enriching experiences.

Exploring the potential of generative AI in democratizing English language education

This study investigates the transformative potential of Generative Artificial Intelligence (GenAI), particularly ChatGPT, in addressing educational challenges faced by Iranian English language teachers (N = 23). Drawing on qualitative data from focus group sessions, semi-structured interviews, and reflective essays, the study reveals five key themes: accessible learning materials, personalized learning experiences, addressing ideological influences, overcoming technological barriers, and combating isolation from global trends. The findings highlight GenAI’s capacity to provide diverse and up-to-date learning materials tailored to individual learners' needs, address ideological biases, and facilitate cross-cultural communication. Moreover, GenAI offers personalized professional development opportunities for teachers, bridging the digital divide and empowering teachers with diverse levels of digital literacy. By integrating GenAI into English language instruction, teachers can overcome longstanding challenges, foster critical thinking, and promote intellectual freedom and open-mindedness among students. The study demonstrates GenAI’s potential to promote inclusive education by providing tailored learning experiences that accommodate diverse cultural backgrounds and learning needs.

ChatGPT in education: A blessing or a curse? A qualitative study exploring early adopters’ utilization and perceptions

To foster the development of pedagogically potent and ethically sound AI-integrated learning landscapes, it is pivotal to critically explore the perceptions and experiences of the users immersed in these contexts. In this study, we perform a thorough qualitative content analysis across four key social media platforms. Our goal is to understand the user experience (UX) and views of early adopters of ChatGPT across different educational sectors. The results of our research show that ChatGPT is most commonly used in the domains of higher education, K-12 education, and practical skills training. In social media dialogues, the topics most frequently associated with ChatGPT are productivity, efficiency, and ethics. Early adopters' attitudes towards ChatGPT are multifaceted. On one hand, some users view it as a transformative tool capable of amplifying student self-efficacy and learning motivation. On the other hand, there is a degree of apprehension among concerned users. They worry about a potential overdependence on the AI system, which they fear might encourage superficial learning habits and erode students’ social and [critical thinking skills](https://www.sciencedirect.com/topics/psychology/critical-thinking-skills). This dichotomy of opinions underscores the complexity of Human-AI Interaction in educational contexts. Our investigation adds depth to this ongoing discourse, providing crowd-sourced insights for educators and learners who are considering incorporating ChatGPT or similar generative AI tools into their pedagogical strategies.

ChatGPT for good? On opportunities and challenges of large language models for education

[Large language models](https://www.sciencedirect.com/topics/social-sciences/large-language-model) represent a significant advancement in the field of [AI](https://www.sciencedirect.com/topics/computer-science/artificial-intelligence). The underlying technology is key to further innovations and, despite critical views and even bans within communities and regions, large language models are here to stay. This commentary presents the [potential benefits](https://www.sciencedirect.com/topics/computer-science/potential-benefit) and challenges of educational applications of large language models, from student and teacher perspectives. We briefly discuss the current state of large language models and their applications. We then highlight how these models can be used to create educational content, improve student engagement and interaction, and personalize [learning experiences](https://www.sciencedirect.com/topics/computer-science/learning-experiences). With regard to challenges, we argue that large language models in education require teachers and learners to develop sets of competencies and literacies necessary to both understand the technology as well as their limitations and unexpected brittleness of such systems. In addition, a clear strategy within educational systems and a clear pedagogical approach with a strong focus on critical thinking and strategies for fact checking are required to integrate and take full advantage of large language models in learning settings and teaching curricula. Other challenges such as the potential bias in the output, the need for continuous human oversight, and the potential for misuse are not unique to the application of [AI](https://www.sciencedirect.com/topics/computer-science/artificial-intelligence) in education. But we believe that, if handled sensibly, these challenges can offer insights and opportunities in education scenarios to acquaint students early on with potential societal biases, [criticalities](https://www.sciencedirect.com/topics/computer-science/criticality), and risks of AI applications. We conclude with recommendations for how to address these challenges and ensure that such models are used in a responsible and ethical manner in education.

Implementing a proposed framework for enhancing critical thinking skills in synthesizing AI-generated texts

Since the development of open and low-cost generative artificial intelligence (GenAI), the higher education community has witnessed high use of AI-generated texts in scholarly research and academic assignments, attracting ongoing debate about whether such practices constitute cheating. While scholars argue that integrating GenAI tools can enhance productivity, critics raise concerns about the negative effect of such integration on critical thinking (CrT). This study therefore proposed a framework for enhancing students’ CrT skills in synthesizing AI-generated information. The proposed framework is underpinned by various theoretical foundations, encompassing five interconnected step-wise phases (familiarizing, conceptualizing, inquiring, evaluating, and synthesizing). The study was conducted under two separate experiments. The first experiment (Study 1) validated the effectiveness of the proposed framework, providing CrT training to 179 postgraduate students. In the second study (n = 125), additional experiments were undertaken to confirm the effectiveness of the framework in different contexts. An experimental procedure involving pretest and posttest design was implemented wherein participants were randomly allocated to one of three groups: experimental group 1 (exposed to our framework), experimental group 2 (exposed to an alternative self-regulated learning framework), and a control group (exposed to a non-structured framework). Results from Study 1 revealed that the framework enhances students’ CrT skills to synthesize AI-generated texts. However, these CrT skills manifested through various rigorous training aimed at reinforcing learning. While the proposed framework holds considerable value in cultivating CrT skills, significant differences arise across various personality traits. In Study 2, the framework proved to be effective in different contexts. However, it did not make a difference, particularly in its capacity to enhance students’ self-regulated learning compared to other frameworks. We discussed the implications of the findings and recommended it to educators seeking to prepare students for the challenges of the AI-driven knowledge economy.

Artificial intelligence and human behavioral development: A perspective on new skills and competences acquisition for the educational context

Despite the significant emphasis placed on incorporating [21st century skills](https://www.sciencedirect.com/topics/social-sciences/21st-century-skill) into the educational framework, particularly at the primary level, recent scholarly works indicate considerable variation in the implementation of these skills across different countries and regions, suggesting a demand for further research specifically focusing on [primary education](https://www.sciencedirect.com/topics/social-sciences/primary-education). The indications of the Digicomp framework and 21st-century skills in Europe have outlined the key competences for lifelong learning needed for all citizens, including teachers and students. In this perspective, Education plays a fundamental role in ensuring that citizens acquire the required skills. The objective in the common European framework is clear: to initiate a transition from the culture of knowledge to the culture of competence. Nowadays, technological advancement allows the researchers to create and combine different frameworks with the perspective of an even more tailored, and engaged education, some examples derived from the implementation of Virtual Reality (VR) and [Augmented Reality](https://www.sciencedirect.com/topics/social-sciences/augmented-reality) (AR), in the combination of [Gamification](https://www.sciencedirect.com/topics/social-sciences/gamification) and AI, or the development of [Intelligent Tutoring Systems](https://www.sciencedirect.com/topics/psychology/intelligent-tutoring-system) (ITS) to foster and create an even more [personalized learning](https://www.sciencedirect.com/topics/social-sciences/personalized-learning) and teaching. Following these premises, in this paper, we want to point out new research reflections and perspectives that could help researchers, teachers, educators (and consequently students) to reflect on the introduction of new technologies (e.g., artificial intelligence, robot tutors) and on how these can affect on human behavioral development and on the acquisition of new skills and competences (Specifically: Creativity, Critical Thinking, Problem Solving, and Computational Thinking) for the educational context. The analysis carried on, suggests a perspective on how creativity, critical thinking, and problem-solving can be effective in promoting computational thinking, and how Artificial Intelligence (AI) could be an aid instrument to teachers in the fostering of creativity, critical thinking, and problem-solving in schools and educational contexts.

Evaluating AI's impact on self-regulated language learning: A systematic review

AI technology is reshaping language classrooms, prompting students to adopt flexible roles exhibiting linguistic competence and self-regulated learning (SRL) skills. Considerable studies explore the necessary integrated learning perspectives, emphasizing AI's adaptive role as a mind tool. In AI-mediated language learning, the technology's metacognitive importance enables students to learn with AI as a partner, encouraging independent critical thinking. Within Zimmerman's SRL model, AI as a mind tool is integrated for improving language students' strategic employment in a cyclical process. A systematic review, following PRISMA protocols, examines the intersection of AI and self-regulated language learning (SRLL) over 2000–2022. Findings highlight AI's evolving role, predominantly through algorithms and systems, aiming for micro and macro integration. Interactive AI has not fully engaged in two-way directions, despite a familiar process approach in reviewed studies. In the favored ESL/EFL research context, task-specific AI is utilized to encourage cyclical improvement with learner autonomy enhancement mainly among higher education students at intermediate level or above. Pedagogical values are possible when major SRL phases are fully practiced, even without highly autonomous AI. Future research is directed toward adaptive personalized technology by exploring the dynamic interplay between AI technologies and SRLL as educational practices under Education 4.0 principles.

A critical review of teaching and learning artificial intelligence (AI) literacy: Developing an intelligence-based AI literacy framework for primary school education

Artificial intelligence (AI) literacy education mainly targets secondary and university students, often overlooking the unique needs of younger students. This gap in AI literacy primary school education presents theoretical and pedagogical challenges. Despite the pervasive influence of AI, which can exacerbate inequalities and raise ethical challenges, primary students often lack an understanding of AI principles and mechanisms. Recent developments in age-appropriate AI learning tools have extended AI literacy to primary schools, but AI literacy frameworks for this age group remain underdeveloped. This study aims to conceptualize AI literacy by analyzing existing theoretical frameworks and proposing a new inclusive AI literacy framework for young students. A scoping review is employed using four credible index databases, and 19 articles are selected, with 17 AI literacy frameworks identified across all educational levels, from early childhood to university. This study reveals that the predominant methodologies for developing AI literacy frameworks involve empirical research studies and literature reviews, adhering to national government or institutional standards. These frameworks commonly incorporate 1) Bloom's taxonomy or a similar progression framework, such as Use-Create-Modify, 2) constructionism, and 3) computer science perspectives such as theories of computation. The findings reveal that AI literacy is situated at the intersection of digital literacy, data literacy, computational thinking, and AI ethics, emphasizing the need for a transdisciplinary and interdisciplinary approach that encompasses both technological and societal impacts. However, the study argues that the current paradigms of AI literacy frameworks for young students often emphasize constructionist perspectives without fully considering the interactions between human and technological agents. This gap highlights the necessity for a new conceptual framework that acknowledges both human and non-human agents in AI literacy education for young students. The research contributes by conceptualizing AI literacy and guiding policymakers and curriculum designers to implement holistic AI literacy education for young students.

The mediating effects of critical thinking on the motivation and creativity of Business English learners in the age of AI: Cognitive flexibility theory

With the advancement and promotion of AI in the education domain, learning motivation (MO), critical thinking (CT) and creativity (CR) have drawn immense attention both at home and abroad. To ensure that these skills permeate the education sector in the age of artificial intelligence (AI), the Chinese government proposed the sustainability of multi-disciplinary subjects in higher vocational education to upgrade its industries. Nonetheless, despite this emphasis, the association among MO, CT and CR—deemed essential sustainable skills in the age of AI—remains unclear. This research was aimed at investigating the structural relationship among MO, CT and CR in business English learners from higher vocational colleges in Shanxi in the age of AI. This research was designed as a non-experimental correlational study. Data were collected from 153 business English learners from higher vocational colleges. Furthermore, [structural equation modelling](https://www.sciencedirect.com/topics/social-sciences/structural-equation-modeling) was employed to test the validity and reliability of the motivation model and the path relationships among MO, CT and CR. The findings indicated that the instruments utilized were valid and reliable in this research context. In addition, the structural model revealed the significant direct effect of MO on CT and the positive and significant direct effect of CT on CR. Regarding the mediating effect, the total effect of MO on CR and the indirect effect were significant. However, the direct effect of MO on CR was non-significant. Therefore, CT plays a complete mediating role between MO and CR. The findings are expected to contribute domestically and also have key implications for international research.

**Influence of AI-driven educational tools on critical thinking dispositions among university students in Malaysia: a study of key factors and correlations**

This research examines the factors that affect critical thinking disposition (CTD) in Malaysian university students using AI-based educational technologies. It analyzes the impact of AI literacy (AIL), perceived ease of use (PEOU), perceived usefulness (PU), and motivation (MO) through the lens of the Technology Acceptance Model (TAM) and Self-Determination Theory (SDT). Using a cross-sectional survey design, data were collected from 483 participants and analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM). The results reveal that AIL, PU, and MO positively and significantly impact CTD, with motivation being the most critical factor. Contrary to expectations, PEOU was found to influence CTD negatively, thus suggesting that while ease of use is important, it may lead to superficial engagement, hindering the deep cognitive processing necessary for critical thinking. The study also confirms significant correlations among the predictors, highlighting that AI literacy enhances perceived ease of use, influencing perceived usefulness and ultimately boosting motivation. These findings underscore the importance of designing AI tools that balance user-friendliness with complexity to encourage critical engagement. Additionally, the study emphasizes the need to integrate AI literacy into higher education curricula to better prepare students for future challenges. The research contributes to the growing body of knowledge on AI-driven learning environments and fosters critical thinking skills. Future research is suggested to explore these relationships in different cultural contexts and to include qualitative approaches for a more comprehensive insight.

Perceived impact of generative AI on assessments: Comparing educator and student perspectives in Australia, Cyprus, and the United States

The growing use of generative AI tools built on large language models (LLMs) calls the sustainability of traditional assessment practices into question. Tools like OpenAI's ChatGPT can generate eloquent essays on any topic and in any language, write code in various programming languages, and ace most standardized tests, all within seconds. We conducted an international survey of educators and students in higher education to understand and compare their perspectives on the impact of generative AI across various assessment scenarios, building on an established framework for examining the quality of online assessments along six dimensions. Across three universities, 680 students and 87 educators, who moderately use generative AI, consider essay and coding assessments to be most impacted. Educators strongly prefer assessments that are adapted to assume the use of AI and encourage critical thinking, while students' reactions are mixed, in part due to concerns about a loss of creativity. The findings show the importance of engaging educators and students in assessment reform efforts to focus on the process of learning over its outputs, alongside higher-order thinking and authentic applications.

A shape of play to come: Exploring children's play and imaginaries with robots and AI

We are rapidly moving into an era where AI and robots are part of everyday interactions in society and education, and there are immense discussions today about current and future technologies. Still, children are often not included in this discussion, while there is much to learn from current uses and children's understandings of AI and robotics. The study is based on a seven-month ethnographical work that details the implementation of a robot in two preschool groups of children aged 1–2 and 3–5 (n = 38). The study descriptively combines a framework for children's play analysis with explorative qualitative child interviews (n = 6) with the 3-5-year-olds to examine how children play with the robot and their thinking about a future with robots and AI. The results show how children's play with robots spans all of Hughes's (2011) sixteen play types and integrates robots into play in ways specific to child-robot interaction. The interviews indicate that children have well-formed knowledge about the current uses of robots and AI and elaborate imaginaries about a future with them, including critical boundaries toward robots and AI agents. The evidence shows emerging ways children relate to these. The potential of including children's actions and voices in the ongoing societal and educational debates on AI is discussed.

Examining the effect of ChatGPT usage on students’ academic learning and achievement: A survey-based study in Ajman, UAE

This research examines the use of ChatGPT among university-level students in the United Arab Emirates (UAE) and its effects on their learning experiences. The precise focus remains on the effects of ChatGPT usage on Student Engagement, Critical Thinking Abilities, and Academic Achievement. Using the cross-sectional design, the Constructivism Learning Theory supports this research. Data gathered using 353 structured questionnaires is analyzed using Partial Least Square-Structural Equation Modelling (PLS-SEM). Results showed that ChatGPT usage positively affects student engagement in the learning process. The effect of ChatGPT usage on Critical Thinking Abilities also remained significant. Finally, the findings indicated the positive effect of ChatGPT usage on the Academic Achievement of Emirati students. These results imply a robust, positive, and constructive role of AI technology, particularly ChatGPT, in the education and learning journey of university students in the UAE. It is concluded that ChatGPT is a useful tool that helps students by providing resources and suggestions throughout their learning process. It increases engagement, effort, and ambition in academic tasks, enhancing academic achievement. ChatGPT supports educational progress and motivates students to obtain knowledge by improving their interest in learning. Finally, the study's implications and limitations are discussed. Also, recommendations for future studies are proposed.

Role of activity-based learning and ChatGPT on students' performance in education

### **Purpose**

This study investigates the impact of activity-based learning and the utilization of [ChatGPT](https://www.sciencedirect.com/topics/computer-science/chatgpt" \o "Learn more about ChatGPT from ScienceDirect's AI-generated Topic Pages) on students' [academic performance](https://www.sciencedirect.com/topics/economics-econometrics-and-finance/academic-performance) within the educational framework.

### **Objectives**

The study aims to assess the effectiveness of activity-based learning in comparison to traditional methods, while also evaluating the [potential benefits](https://www.sciencedirect.com/topics/computer-science/potential-benefit) and drawbacks of integrating ChatGPT as an educational tool.

### **Methods**

The study employs a comparative approach, analyzing the outcomes of students exposed to activity-based learning versus those using conventional methods. Additionally, the study examines the usage of ChatGPT in education through surveys and trials to determine its contribution to personalized feedback, interactive learning, and innovative teaching methods.

### **Results**

The findings reveal that activity-based learning enhances students' engagement, motivation, and [critical thinking skills](https://www.sciencedirect.com/topics/psychology/critical-thinking-skills). Students participating in activity-based learning demonstrate improved academic achievement, which is attributed to their active involvement and practical application of knowledge. Similarly, the integration of ChatGPT offers novel avenues for interactive learning and individualized assistance, fostering students' understanding and exploration of complex concepts.

### **Conclusion**

In conclusion, activity-based learning proves to be a student-centered approach that enhances [learning outcomes](https://www.sciencedirect.com/topics/computer-science/learning-experiences) by fostering active participation and practical engagement. The utilization of ChatGPT in education showcases its potential to enhance educational experiences through interactive conversations and innovative teaching methodologies, despite considerations regarding potential limitations and ethical implications.

Analyzing the students' views, concerns, and perceived ethics about chat GPT usage

Artificial Intelligence has greatly revolutionized education in many aspects. Today, AI-enabled [language models](https://www.sciencedirect.com/topics/social-sciences/language-modeling), such as ChatGPT, are gaining popularity due to their characteristics and benefits. However, users also consider them a threat to educational integrity and purposes. This research examined ChatGPT usage among students in the United Arab Emirates (UAE), their views, concerns, and perceived ethics. The data was gathered from 388 students from two universities in Al Ain city using Yamane's formula. Findings showed that students consider ChatGPT a revolutionary technology that helps students in many ways. The gathered data showed that the effect of ChatGPT Usage remained significant on students' views. The [path analysis](https://www.sciencedirect.com/topics/social-sciences/path-analysis) also supported the second hypothesis, proposing the significant effect of ChatGPT on Students' Concerns. Finally, the findings also indicated the validation of the final hypothesis, showing the significant effect of ChatGPT Usage on the Perceived Ethics among the students in the UAE. Therefore, this study concluded that using ChatGPT in education has useful and concerning effects on educational integrity. However, implementing practical guidelines can assist in making informed decisions and shaping policies within educational institutions. Recognizing the complexities and importance of ChatGPT usage, teachers and policymakers can keep a balance by leveraging Artificial Intelligence technology to improve education while upholding ethical practices that promote critical thinking, originality, and integrity among students.

Artificial intelligence in early childhood education: A scoping review

Artificial intelligence (AI) tools are increasingly being used in the field of [early childhood education](https://www.sciencedirect.com/topics/social-sciences/early-childhood-education) (ECE) to enhance learning and development among [young children](https://www.sciencedirect.com/topics/psychology/toddlers). Previous proof-of-concept studies have demonstrated that AI can effectively improve teaching and learning in ECE; however, there is a scarcity of knowledge about how these studies are conducted and how AI is used across these studies. We conducted this [scoping review](https://www.sciencedirect.com/topics/psychology/scoping-review) to evaluate, synthesize and display the latest literature on AI in ECE. This review analyzed 17 eligible studies conducted in different countries from 1995 to 2021. Although few studies on this critical issue have been found, the existing references provide up-to-date insights into different aspects (knowledge, tools, activities, and impacts) of AI for children. Most studies have shown that AI has significantly improved children's concepts regarding AI, machine learning, computer science, and robotics and other skills such as creativity, emotion control, collaborative inquiry, literacy skills, and computational thinking. Future directions are also discussed for researching AI in ECE.

Unveiling the efficacy of ChatGPT in evaluating critical thinking skills through peer feedback analysis: Leveraging existing classification criteria

This study investigates the potential of using ChatGPT, a large language model, to assess students' critical thinking in online peer feedback. With the rapid development of technology, big language models, such as ChatGPT, have made significant progress in natural language processing in recent years and have good potential for application in teaching evaluation and feedback. However, can generative AI help educational practitioners in teaching and learning? How to accurately assess students' critical thinking using generative AI remains a challenging task. This study investigates whether ChatGPT can effectively evaluate critical thinking using established coding systems. By comparing the consistency and accuracy of manual coding with ChatGPT coding in online peer feedback texts, it clarifies how ChatGPT processes online peer feedback data and conducts assessments. Through a comprehensive analysis employing various metrics including precision, recall, F1 score, and a confusion matrix, we assess ChatGPT's performance. Additionally, we group students and analyze how ChatGPT's assessments relate to their critical thinking levels. Our findings suggest that the ChatGPT demonstrated some ability to assess higher dimensions of critical thinking, but showed limitations in assessing the more granular secondary dimensions under the higher dimensions of critical thinking. However for this kind of granular assessment will more accurately capture the level of learning critical thinking. Surprisingly, ChatGPT's evaluations are not influenced by students' critical thinking levels. This study underscores ChatGPT's potential in automating critical thinking assessment at scale, alleviating the burden on educators and enhancing understanding of critical thinking in peer feedback.

Investigating pedagogical, technological and school factors underpinning effective ‘critical thinking curricula’ in K-6 education

### **Objective**

This study investigated factors underpinning a successful technology-supported classroom curriculum, specifically designed to promote K-6 students’ critical thinking.

### **Methods**

Video and audio data illustrating 41 students’ application of critical thinking were collected using a unique display recording app installed on iPads. These were timeline analysed using a literature-generated framework comprising Indicators of critical thinking. Interview data were thematically analysed to build knowledge of teacher pedagogical and school factors supporting the curriculum.

### **Results**

Data indicated students mostly applied critical thinking for defining and clarifying concepts, presenting reasoned arguments and conclusions, questioning and challenging others’ perspectives, seeking evidence for claims made, and identifying and critiquing assumptions. Results highlight the important contribution of teacher theoretical knowledge, school-wide commitment to a ‘critical thinking’ curriculum, and common understanding of the broader purpose schooling, as foundational to the curriculum's success.

### **Conclusion**

Teaching for critical thinking was facilitated by close alignment between pedagogical, technological, and school environment factors. It was underpinned by a school-wide learning virtues and values framework emphasising students’ future competencies developed from extensive reading of research and learning theory, and was deliberately planned for. It reflected in theory-informed task design, technology selection, and pedagogy.

### **Practice**

Critical thinking has been identified in school curricula as an important capability. However, while imperatives and general principles promoting critical thinking in schools are detailed in official documents, few examples exist illustrating how critical thinking can be fostered in K-6 education.

### **Implications**

Explicit teaching for critical thinking should be considered a priority by teachers at all school levels. Given rapid technological advances such as AI, and implications these hold for students’ critical information literacy, this study provides timely guidance on how explicit teaching for critical thinking might be approached in K-6 education.

Development of a design course for medical curriculum: Using design thinking as an instructional design method empowered by constructive alignment and generative AI

Doctors are nowadays experiencing many struggles in their daily practice, mainly due to new intricate challenges of the twenty-first century. However, despite the efforts of traditional [medical education](https://www.sciencedirect.com/topics/social-sciences/medical-education), it falls short in providing them with the required tools to effectively overcome these difficulties. In light of these shortcomings, this paper suggests the development of a new educational framework designed to guide medical educators in creating student-centered [learning experiences](https://www.sciencedirect.com/topics/social-sciences/learning-experience). Which may be ensured by using Design Thinking (DT) as an instructional design method, merged with constructive alignment principles, and generative artificial intelligence. To demonstrate the effectiveness of this new educational approach, a case study is showcased wherein the framework was applied to design a new medical curriculum. The case study specifically focuses on first-year students in a Moroccan medical faculty and was developed based on DT principles, allowing students to engage in a transformative learning process that encourages innovation and creativity. The new curriculum includes lecture sessions, hands-on workshops, and project coaching where teams of medical students learn the design process and are given the opportunity to prototype and test their proposed solutions at local university hospital units. Overall, the showcased case study provides evidence of the framework's effectiveness in designing a new medical curriculum, illustrating its potential for enhancing medical education and engaging future doctors in impact-focused projects with long-term benefits for their career development.

Integrating Critical thinking and embracing Artificial Intelligence: Dual Pillars for advancing dental education

Among various clinical skills, critical thinking (CT) is foundational for quality patient care. However, existing literature suggests deficiencies in applying analytical reasoning skills in healthcare education. As CT integration gains momentum in dentistry, the rapid advancement of artificial intelligence (AI) technologies introduces new dynamics. This article explores the potential impacts of emerging technologies of AI on the development and application of CT in the dental profession.

Making sense of generative AI for assessments: Contrasting student claims and assessor evaluations

The rapid growth of generative AI usage in higher education has left educators looking urgently for insights into student usage and guidance on good practice. This case study examines an experiential exercise involving 118 postgraduate management students at a UK business school, where students were asked to write a 500-word reflection on their use of AI for a 2500-word essay-style assessment. Using sensemaking as a theoretical lens, we compare students' claims with assessors' evaluations of students' AI usage. Our findings indicate that students predominantly use generative AI for writing, paraphrasing, and rephrasing, rather than for fostering critical thinking or engaging in the more advanced stages of sensemaking, a level achieved by only one-tenth of the cohort. The consistency between this study's findings and pre-generative AI research suggests that higher education has yet to adapt adequately in ways to integrate AI to mitigate, rather than exacerbate, current sector deficiencies. We call on university leaders to develop institutional strategies that allow for effective and responsible integration of generative AI, and on educators to develop students' critical evaluation and academic writing skills that build on generative AI's affordances, with several specific recommendations made in this article.

**Impact of Gamification on Students’ Learning Outcomes and Academic Performance: A Longitudinal Study Comparing Online, Traditional, and Gamified Learning**

This study aims to examine the influence of gamification in students’ learning outcomes and academic performance. A longitudinal study was conducted to compare students’ academic performance in online learning (2020–2021), traditional learning (2021–2022), and gamified learning (2022–2023). The longitudinal study lasted 3 years and a total of 1001 higher education students were involved. Three research questions were set to be explored and students’ viewpoints and experiences were also examined through a questionnaire of 20 questions. This study follows a quantitative research approach. The data refers to students’ academic performance, success rate, excellence rate, withdrawal rate, engagement, motivation, and perspectives. In the laboratory part of the course, gamified learning yielded better outcomes over online learning and traditional learning in success rate (39% and 13%), excellence rate (130% and 23%), average grade (24% and 11%), and retention rate (42% and 36%) respectively. In the theoretical part of the course, gamified learning resulted in better outcomes over online learning and traditional learning in success rate (19% and 14%), in excellence rate (125% and 79%), and in average grade (25% and 12%) respectively. In the overall course, gamified learning yielded better outcomes over online learning and traditional learning in success rate (14% and 14%), in excellence rate (122% and 70%), and in average grade (25% and 17%) respectively. The highest increase was observed in students’ excellence rate. Students highly regarded gamification as an effective educational approach that can increase their learning outcomes, engagement, productivity, and motivation and trigger both their both intrinsic and extrinsic motivation. The learning experience become more enjoyable and students’ basic needs in terms of autonomy, competence and sufficiency, and relatedness and sense of belonging were met. Traditional learning also resulted in better learning outcomes when compared to online learning. Gamification emerged as an effective learning approach which leads to improved learning outcomes and academic performance, learning motivation, engagement, and retention rate over online learning and traditional learning in both theoretical and applied course settings.

**Does Generative Artificial Intelligence Improve the Academic Achievement of College Students? A Meta-Analysis**

The use of generative artificial intelligence (Gen-AI) to assist college students in their studies has become a trend. However, there is no academic consensus on whether Gen-AI can enhance the academic achievement of college students. Using a meta-analytic approach, this study aims to investigate the effectiveness of Gen-AI in improving the academic achievement of college students and to explore the effects of different moderating variables. A total of 28 articles (65 independent studies, 1909 participants) met the inclusion criteria for this study. The results showed that Gen-AI significantly improved college students’ academic achievement with a medium effect size (Hedges’s g = 0.533, 95% CI [0.408,0.659], p < .05). There were within-group differences in the three moderator variables, activity categories, sample size, and generated content, when the generated content was text ( g = 0.554, p < .05), and sample size of 21–40 ( g = 0.776, p < .05), the use of independent learning styles ( g = 0.600, p < .05) had the most significant improvement in college student’s academic achievement. The intervention duration, the discipline types, and the assessment tools also had a moderate positive impact on college students’ academic achievement, but there were no significant within-group differences in any of the moderating variables. This study provides a theoretical basis and empirical evidence for the scientific application of Gen-AI and the development of educational technology policy.

**The who, why, and how of ai-based chatbots for learning and teaching in higher education: A systematic review**

The integration of technology in higher education is constantly evolving, and the recent emergence of generative artificial intelligence (AI), particularly AI-based chatbots, presents both opportunities and challenges. This rapid advancement raises crucial questions about the effective and appropriate implementation of these tools in learning and teaching. This study addresses this evolving landscape by investigating the who, why, and how of AI-based chatbot integration in higher education. Through a systematic review of 37 studies, informed by activity theory, we found that undergraduates are the primary users, leveraging chatbots for skill and thinking development, knowledge acquisition, and motivation enhancement. Drivers for adoption include the need for personalized learning experiences, simulation of human interaction, and the creation of safe learning environments. Currently, single, third-party, unimodal AI-based chatbots are predominantly used, primarily for academic support, writing assistance, and speaking practice, often as supplements to self-directed learning and online courses outside the traditional classroom setting. While facilitation strategies like gamification and multimodal integration aim to optimize learning, the observed positive impacts on student attitudes, motivation, and cognitive performance suggest the potential of these tools. However, inconsistencies in outcomes underscore the need for ongoing research and careful consideration by educators, administrators, and policymakers navigating this dynamic technological shift in higher education.

A smarter perspective: Learning with and from AI-cases

Artificial intelligence (AI) has only partially (or not at all) been integrated into medical education, leading to growing concerns regarding how to train healthcare practitioners to handle the changes brought about by the introduction of AI. Programming lessons and other technical information into healthcare curricula has been proposed as a solution to support healthcare personnel in using AI or other future technology. However, integrating these core elements of computer science knowledge might not meet the observed need that students will benefit from gaining practical experience with AI in the direct application area. Therefore, this paper proposes a dynamic approach to case-based learning that utilizes the scenarios where AI is currently used in clinical practice as examples. This approach will support students' understanding of technical aspects. Case-based learning with AI as an example provides additional benefits: (1) it allows doctors to compare their thought processes to the AI suggestions and critically reflect on the assumptions and biases of AI and clinical practice; (2) it incentivizes doctors to discuss and address ethical issues inherent to technology and those already existing in current clinical practice; (3) it serves as a foundation for fostering interdisciplinary collaboration via discussion of different views between technologists, multidisciplinary experts, and healthcare professionals. The proposed knowledge shift from AI as a technical focus to AI as an example for case-based learning aims to encourage a different perspective on educational needs. Technical education does not need to compete with other essential clinical skills as it could serve as a basis for supporting them, which leads to better medical education and practice, ultimately benefiting patients.

**Extended Reality (XR) and Gamification in the context of the Internet of Things (IoT) and Artificial Intelligence (AI) - Michigan State University**

The present research develops a holistic framework for and way of thinking about Deep Technologies related to Gamification, eXtended Reality (XR), the Internet of Things (IoT), and Artificial Intelligence (AI). Starting with the concept of gamification and the immersive technology of XR, we create interconnections with the IoT and AI implementations. While each constituent technology has its own unique impact, our approach uniquely addresses the combinational potential of these technologies that may have greater impact than any technology on its own. To approach the research problem more efficiently, the methodology followed includes its initial division into smaller parts. For each part of the research problem, novel applications were designed and developed including gamified tools, serious games and AR/VR implementations. We apply the proposed framework in two different domains: autonomous vehicles (AVs), and distance learning. Specifically, in chapter 2, an innovative hybrid tool for distance learning is showcased where, among others, the fusion with IoT provides a novel pseudo-multiplayer mode. This mode may transform advanced asynchronous gamified tools to synchronous by enabling or disabling virtual events and phenomena enhancing the student experience. Next, in Chapter 3, along with gamification, the combination of XR with IoT datastreams is presented but this time in an automotive context. We showcase how this fusion of technologies provides low-latency monitoring of vehicle characteristics, and how this can be visualized in augmented and virtual reality using low-cost hardware and services. This part of our proposed framework provides the methodology of creating any type of Digital Twin with near real-time data visualization. Following that, in chapter 4 we establish the second part of the suggested holistic framework where Virtual Environments (VEs), in general, can work as synthetic data generators and thus, be a great source of artificial suitable for training AI models. This part of the research includes two novel implementations the Gamified Digital Simulator (GDS) and the Virtual LiDAR Simulator. Having established the holistic framework, in Chapter 5, we now “zoom in” to gamification exploring deeper aspects of virtual environments and discuss how serious games can be combined with other facets of virtual layers (cyber ranges, virtual learning environments) to provide enhanced training and advanced learning experiences. Lastly, in chapter 6, “zooming out” from gamification an additional enhancement layer is presented. We showcase the importance of human-centered design of via an implementation that tries to simulate the AV-pedestrian interactions in a virtual and safe environment.

**Gamification and Immersive Learning with AI**

This chapter explores how artificial intelligence transforms cybersecurity training through gamification and immersive learning experiences. As traditional training methods become increasingly inadequate, AI enables more engaging and effective approaches through game-like elements such as rewards, leaderboards, badges, and narrative storytelling. The chapter examines how these gamification techniques promote active learning and skill acquisition through interactive simulations, immediate feedback, gradual progression, and collaborative exercises. It further investigates AI-powered immersive learning experiences that leverage realistic threat scenarios, real-world intelligence, and virtual/augmented reality applications to create dynamic training environments. Additionally, the chapter addresses the critical balance between educational value and entertainment in training design, emphasizing how AI can optimize learning outcomes while maintaining engagement through personalized content, adaptive pacing, and continuous analytics-driven improvements. This comprehensive analysis demonstrates how AI-enabled gamification and immersive technologies can revolutionize cybersecurity training, making it more interactive, effective, and better suited to prepare professionals for evolving cyber threats.

**Artificial Intelligence (AI) and Gamification in Blended Learning: Enhancing Language and Literacy in Shanxi, China**

This study investigates the implementation and efficacy of blended learning integrating artificial intelligence (AI) and gamification in language and literacy instruction in Shanxi Province, China. Blended learning, combining traditional face-to-face teaching with online education, has been acknowledged for improving educational outcomes. This research evaluates the impact of AI-driven personalized learning paths and gamification features on students’ language acquisition and literacy skills. Using a quasi-experimental design grounded in constructivist, adaptive learning, and gamification theories, the study involves 200 students aged 6–12, equally divided into experimental and control groups. The experimental group receives blended learning enhanced with AI and gamification, while the control group follows traditional teaching methods. Data collection includes surveys and test scores, analyzed through descriptive statistics, correlation, and regression analyses. Results reveal significant improvements in language and literacy outcomes in the experimental group compared to the control group. Students in the experimental group achieved a 25% higher improvement in vocabulary learning and a 30% increase in reading comprehension. AI-driven learning paths boosted engagement by 20%, while gamification elements enhanced motivation by 15%. These findings highlight the potential of AI and gamification to transform blended learning environments. Practical implications suggest incorporating AI for personalized learning and gamification for increasing student motivation. The study concludes with recommendations for integrating these technologies into educational practices and exploring long-term impacts and scalability in future research.

**System Thinking in Gamification**

People spend a lot of time and energy playing videogames (Kapp in The gamification of learning and instruction: game-based methods and strategies for training and education. Pfeiffer an imprint of Wiley, San Francisco, 2012), and as a result, gamification has grown from a buzzword into a discipline. Since 2012, the authors have experimented with system thinking as a methodology for developing gamification and will present examples in this article. The primary objectives are to study how system thinking can be used to understand, design, develop and document gamifications, and how psychology and pedagogics can be integrated in the process to enhance the learning. This is an observational case study that gives examples of how students (i) use system thinking to understand and clarify the gamification case using system analysis and (ii) use system dynamics to simulate cases and predict user responses. Students begin system analysis once the gamification idea is developed and their goals and the case parameters are established, and it includes making casual loop diagrams, flow charts, and reference behavior patterns. Students then find and experiment with numerical data for the case and use system dynamics to simulate the gamification and predict the user results. The pedagogy is problem based and grounded in traditional problem-based learning and situated learning. This article shows how system thinking allows students and professionals to develop a deeper and more tangible understanding of the research materials and presumptions they have when engaging in any given gamification scenario. System thinking also provides tools to test research material and hypotheses in a more structured, manageable, and palpable way. Although we have discovered several ways system thinking can benefit gamification design, the research has also revealed new areas where system thinking could be explored further.

**AI Tools in Society: Impacts on Cognitive Offloading and the Future of Critical Thinking**

The proliferation of artificial intelligence (AI) tools has transformed numerous aspects of daily life, yet its impact on critical thinking remains underexplored. This study investigates the relationship between AI tool usage and critical thinking skills, focusing on cognitive offloading as a mediating factor. Utilising a mixed-method approach, we conducted surveys and in-depth interviews with 666 participants across diverse age groups and educational backgrounds. Quantitative data were analysed using ANOVA and correlation analysis, while qualitative insights were obtained through thematic analysis of interview transcripts. The findings revealed a significant negative correlation between frequent AI tool usage and critical thinking abilities, mediated by increased cognitive offloading. Younger participants exhibited higher dependence on AI tools and lower critical thinking scores compared to older participants. Furthermore, higher educational attainment was associated with better critical thinking skills, regardless of AI usage. These results highlight the potential cognitive costs of AI tool reliance, emphasising the need for educational strategies that promote critical engagement with AI technologies. This study contributes to the growing discourse on AI’s cognitive implications, offering practical recommendations for mitigating its adverse effects on critical thinking. The findings underscore the importance of fostering critical thinking in an AI-driven world, making this research essential reading for educators, policymakers, and technologists.

**The Use of AI in Improving Student's Critical Thinking Skills**

The use of artificial intelligence (AI) in education has the potential to significantly enhance students' critical thinking skills. This study explores how AI tools can improve critical thinking among students majoring in English Education at X University. Utilizing a mixedmethods approach, the research combines quantitative surveys and qualitative interviews to assess the frequency and contexts of AI usage and its impact on critical thinking. Survey results reveal that 64% of respondents use AI tools several times a week, predominantly in educational settings. A smaller percentage of respondents use AI daily (14%), while another 14% use AI rarely, and 7% use it several times a month. Interviews with frequent AI users indicate that AI assists in expanding ideas and providing deeper insights, but its effectiveness depends on the users' ability to ask precise questions and critically interpret AI-generated content. The findings highlight that while AI can significantly aid in developing critical thinking skills through personalized learning experiences and interactive simulations, challenges such as potential biases and the need for foundational understanding persist. Ultimately, this research underscores the importance of thoughtful and critical use of AI in education to foster improved critical thinking skills.

**Exploring the impact of AI threats on originality and critical thinking in academic writing**

This research aims to provide an in-depth understanding of the impact of AI in academic writing on critical thinking ability, originality of scientific work, intellectual integrity in academia, and AI dependency leading to no improvement in individual thinking ability. Using a qualitative research design focusing on case studies and employing semi-structured interviews, seven undergraduate students in Indonesia were purposively selected to be sampled. The research findings revealed First, AI can threaten the development of individual critical thinking ability, as dependency on this technology reduces active engagement in the process of thinking and reflection, and inhibits creativity. Second, AI has the potential to reduce the originality of academic work, trigger plagiarism, and reduce the analytical quality and creativity of writers. Third, AI can undermine intellectual integrity in academic settings by leading to violations of ethical codes. Fourth, reliance on AI inhibits the improvement of individual thinking skills, as cognitive processes that should be done independently are reduced. Future research could consider more objective measures such as observation or psychometric tests, and investigate more intensive threats in the use of AI in the academic writing environment.

**Development of a Theoretical Framework of MOOCs with Gamification Elements to Enhance Students’ Higher-Order Thinking Skills: A Critical Review of the Literature**

Aim/Purpose: This study aims to develop a theoretical framework for enhancing students’ higher-order thinking skills (HOTS) by integrating massive open online courses (MOOCs) with gamification elements. Background: There is a growing demand to develop students’ innovative thinking abilities through MOOCs, focusing on higher-order thinking skills (HOTS), which are essential for 21st-century challenges. While gamification has shown potential in enhancing HOTS, its integration within MOOCs to improve these skills remains underexplored. Enhancing students’ HOTS through MOOCs combined with gamification is crucial for developing advanced skills like analysis, evaluation, and creativity. Therefore, there is an urgent need for a robust theoretical framework that effectively merges MOOCs and gamification to enhance students’ HOTS. Methodology: This research used a qualitative research approach employing critical analysis techniques. The research procedures were guided by the SALSA framework. A total of 19 articles from the SCOPUS and Google Scholar databases were selected based on specific criteria: articles published between 2013-2023, articles with keywords such as MOOCs, gamification, higher-order thinking, or engagement, and articles written in English. Thematic analysis was conducted to identify common themes in the selected articles. The proposed framework was developed by drawing upon well-established theories in the fields of educational technology, online learning, collaborative learning, connectivism, student engagement, and Bloom’s taxonomy. Contribution: This study not only synthesizes existing research on MOOCs but also presents a holistic and integrated framework for leveraging learning theories, gamification elements, student engagement dimensions, and HOTS to enhance the effectiveness of MOOC-based education. The proposed framework aims to provide researchers and educators with a comprehensive model for integrating gamification elements into MOOCs to enhance students’ higher-order thinking skills. By utilizing this framework, educators can design more engaging and effective online courses, while researchers can further investigate the impact of gamification on learning outcomes and student engagement. Findings: This study proposes a framework that integrates three main components: connectivism, online collaborative learning, and gamification principles. Implementing these components in the MOOC learning environment aims to enhance digital higher-order thinking as proposed by Churches and improve students' feelings and perceptions towards MOOC learning. Recommendations for Practitioners: By recognizing the unique challenges of maintaining students’ attention in the context of MOOC learning, practitioners can incorporate gamification elements into MOOC learning environments to enhance students’ HOTS. Recommendation for Researchers: Researchers can further explore the understanding and measurement of the dynamics of interactions and engagement within MOOCs. Additionally, they should aim to identify which gamification elements effectively capture students’ attention and contribute to their overall engagement. Impact on Society: By focusing on HOTS, especially through gamification, society can anticipate a generation of individuals with improved critical thinking, problem-solving, and innovative capabilities. Furthermore, the implementation of connectivism in MOOCs can promote a global exchange of knowledge, resulting in diverse perspectives and a shared pool of information. This, in turn, will contribute to a more interconnected and collaborative world to address complex challenges. Future Research: The future direction of research in MOOC learning contexts should prioritize guaranteeing and fostering student engagement. It should also involve exploring the potential of gamification within MOOCs and refining instructional designs to specifically enhance higher-order thinking skills. By addressing these critical aspects, researchers can contribute to the ongoing evolution of online education and ensure its effectiveness and relevance in the ever-changing landscape of digital learning.

**Can critical thinking and AI work together? Observations of science, Mathematics, and language instructors**

AI tools, such as intelligent tutoring systems, chatbots, and adaptive learning platforms, allow instructors to design teaching strategies based on individual student needs, learning styles, and progress. This exploratory study discussed the implications of AI use in classrooms for student’s critical thinking. Science, mathematics, and language instructors (n=40) were purposively sampled to be interviewed in the study. Narrative data was analyzed for recurring themes through reflexive thematic analysis. Findings indicated that AI has an alternate purpose in developing and possibly obstructing students’ critical thinking skills. AI tools like chatbots and personalized learning systems can enhance critical thinking by promoting cognitive flexibility, reflective thinking, and systematic analysis. Teachers use AI to encourage students to analyze AI-generated results and compare them to theoretical frameworks, developing deeper engagement with content across subjects like science, mathematics, and language. However, the study also observed that over-reliance on AI can lead to superficial understanding and uncritical acceptance of information. Students sometimes bypass the cognitive work necessary for critical thinking, treating AI as a shortcut rather than a tool for deeper learning. As such, while AI can significantly enhance learning when used appropriately, instructors must guide its use carefully to avoid negative impacts on critical thinking.

**Unraveling the Motivational Tapestry of AI-Driven Gamification in Education**

This study explores the integration of AI and gamification in education. AI in gamified learning enhances learner motivation, engagement, and performance. It taps into psychological drivers like intrinsic and extrinsic motivation, goal orientation, and self-efficacy, leading to better learning outcomes, increased participation, risk - taking, and social interaction. The mechanics involve gamification elements like points, badges, storytelling, and AI technologies such as machine learning, NLP, and computer vision. However, there are challenges. Technologically, glitches, compatibility issues, and data privacy concerns exist. Pedagogically, balancing entertainment and education and addressing individual differences are crucial. Socially and culturally, equity, accessibility, and cultural relevance need attention. Looking ahead, emerging trends like integrating with AR/VR and other learning modalities offer promise. Recommendations include following design principles, providing teacher training, and getting policy and institutional support to create more effective learning environments for 21st - century learners.

**EFL Students' Perceptions on the Integration of AI in Fostering Critical Thinking Skills**

A developing discussion over the effects of Artificial Intelligence (AI) on students' critical thinking skills has emerged with their introduction into the classroom. Even if AI can provide several advantages, some worries depending too much on these technologies could impede the growth of critical thinking abilities. This research aims to analyze how students perceive the influence of AI on their critical thinking abilities. This research is descriptive qualitative research that involves collecting data from direct interviews. The respondents are 15 (fifteen) students from the English Literature study program, Letter Faculty, Sawerigading University Makassar. The research found that students perceive the following impact of AI use on their critical thinking abilities: 1) Hindering the development of critical thinking skills. 2) Assisting in the retrieval of information, data analysis, and the resolution of everyday issues. 3) Causing dependence on technology. 4) Helping to evaluate the information quickly; 5) Exploring alternative ideas; and 6) Improving reasoning ability. Overall, we need to balance the use of AI while prioritizing students' critical thinking. It is important to encourage students to use AI responsibly and judiciously, while also emphasizing the importance of critically evaluating the information provided by AI systems

**Gamification and academic ability impact on students' meta-cognition and critical thinking skills**

In educational settings, the metacognitive skills and critical thinking abilities of students often show room for improvement. This research aims to find out the influence of gamification methods and academic ability on metacognitive skills and critical thinking ability of high school students in Biology subjects. The independent variable in this research is the application of the Gamification method and a different method, namely the Synchronous-asynchronous method. The moderator variable is the difference in students' academic ability. The dependent variables are metacognitive and critical thinking skills. The instrument used to collect data is a test question developed to measure metacognitive and critical thinking skills. The study comprised two distinct stages. Firstly, the Dick & Carey development steps were used for development research. Secondly, a quasi-experiment was conducted using a 2x2 factorial design with 62 students divided into two groups. The research data was analyzed using the MANOVA statistical analysis technique. Based on the research results, it can be recommended that the Gamification learning method needs to be applied in the classroom with attention to the student's academic abilities..

**AI Thinking: a framework for rethinking artificial intelligence in practice**

Artificial intelligence is transforming the way we work with information across disciplines and practical contexts. A growing range of disciplines are now involved in studying, developing and assessing the use of AI in practice, but these disciplines often employ conflicting understandings of what AI is and what is involved in its use. New, interdisciplinary approaches are needed to bridge competing conceptualizations of AI in practice and help shape the future of AI use. I propose a novel conceptual framework called AI Thinking, which models key decisions and considerations involved in AI use across disciplinary perspectives. AI Thinking addresses five practice-based competencies involved in applying AI in context: motivating AI use, formulating AI methods, assessing available tools and technologies, selecting appropriate data and situating AI in the sociotechnical contexts it is used in. A hypothetical case study is provided to illustrate the application of AI Thinking in practice. This article situates AI Thinking in broader cross-disciplinary discourses of AI, including its connections to ongoing discussions around AI literacy and AI-driven innovation. AI Thinking can help to bridge between the work of diverse disciplines, contexts and actors in the AI space, and shape AI efforts in education, industrial development and policy.

**Enhancing Critical Thinking Skills: Exploring Generative AI-enabled Cognitive Offload Instruction in English Essay Writing**

This study explores the integration of Generative AI technology for cognitive offloading in the context of English essay writing, with the aim of promoting inclusive and equitable quality education. Focusing on how AI-assisted cognitive offload instruction enhances students' critical thinking skills, the research adopts a quantitative approach, collecting data from 240 first-year English majors across four colleges through purposive sampling. Statistical analysis reveals that the implementation of Generative AI-enabled Cognitive Offload instruction significantly improves students' critical thinking skills in essay writing. This instructional strategies and specific practices fosters the development of analytical thinking, problem-solving, and effective communication, creating an educational environment that supports originality, critical thought, and responsible writing practices. The findings contribute to the growing body of literature on the role of AI in educational settings, highlighting the potential of AI-assisted cognitive offloading to advance critical thinking and writing skills through structured instructional design.

**Empowering Higher-Order Thinking Skills in Writing through Gamification and Multimodal Learning within PBL** This study explores the integration of gamification and multimodal learning within a Project-Based Learning (PBL) framework to enhance higher-order thinking skills (HOTs) in writing instruction. HOTs—encompassing critical thinking, creativity, and problem-solving—are vital for equipping students to navigate academic and real-world complexities. Employing a mixed-methods approach, the study collected quantitative data through surveys assessing engagement, motivation, and writing proficiency, while qualitative data from focus groups and reflective journals provided deeper insights into student experiences. By incorporating real-world projects, gamified elements (e.g., challenges, rewards), and multimodal resources (visual, auditory, and kinesthetic tools), the intervention created an engaging and inclusive learning environment. Results revealed significant increases in engagement (90%), motivation (87%), and writing proficiency (22%), as well as marked development in critical thinking, creativity, and collaboration skills. This study highlights the effectiveness of combining PBL with gamification and multimodal strategies to empower students in writing tasks through diverse forms of expression. The findings offer actionable insights for designing inclusive writing curricula and underscore the need for further research on the scalability and adaptability of this approach in diverse educational settings.

The Challenges of Critical Thinking in the Era of ArtificialIntelligence

I argue that critical thinking is based on active learning, engaged independent thinking, and examining all information including recently impactful ChatGPT and other AI sources. Thoughtfully questioning what is being learned as well as critically and creatively analyzing and evaluating information such as AI is necessary to gain a deeper understanding as an effective thinker. Critical thinking pedagogy should also promote “portability” and citizenship, including information-based online multimedia literacy such as AI, as well as employment and professional information. This means becoming a critical thinker inside and outside the classroom and take what is learned into our personal, public, and professional lives. The article begins with an examination of four discrepancies or issues related to critical thinking in higher education. The critical thinking literature and Kenedy’s Model of Cyclical Critical Thinking will then be considered. This will be followed by the discussion and summary regarding suggested guidelines for critically evaluating AI. Finally, conclusions regarding further work including pedagogical models for teaching critical thinking in the era of AI and other future work are considered.

**AI Literacy and Adaptive Learning in Moroccan Education: Advancing Critical Thinking and Personalized Learning**

This research examines how artificial intelligence (AI) can be effectively integrated into education. It focuses on the skills and strategies that students and educators need to be successful. The study takes a qualitative approach. It includes discussions with students and faculty at a Moroccan University of Interdisciplinary Studies and a review of the relevant literature. The findings show that AI has great potential to enhance learning and critical thinking. However, there is a clear need for structured training and strong institutional support to build AI literacy. The study suggests that educational institutions should take a comprehensive approach to integrating AI. This includes creating training programs, integrating AI into the curriculum, and encouraging collaboration on AI-related projects. These steps can help prepare students for a future in which AI plays an important role in their careers. This research adds to the ongoing conversation about AI in education. It also offers practical ideas for improving teaching and learning with technology.

**Unveiling personalized and gamification- based cybersecurity risks within financial institutions**

Gamification has emerged as a transformative e-business strategy, introducing innovative methods to engage customers and drive sales. This article explores the integration of game design principles into business contexts, termed "gamification," a subject of increasing interest among both scholars and industry professionals. The discussion systematically addresses key themes, like the role of gamification in marketing strategies, enhancing website functionality, and its application within the financial sector, including e-banking, drawing insights from academic and industry perspectives. By conducting a systematic literature review of 48 academic articles published between 2015 and 2024, this study examines the use of personalized, gamification-based strategies to mitigate cyber threats in the financial domain. The review highlights the growing digitization of financial services and the corresponding rise in sophisticated cyber threats, including traditional attacks and advanced persistent threats (APTs). This article critically assesses the evolving landscape of cyber threats specific to the financial industry, identifying trends, challenges, and innovative solutions to strengthen cybersecurity practices. Of particular interest is the application of AI-enhanced gamification strategies to reinforce cybersecurity protocols, particularly in the face of novel threats in gaming platforms. Furthermore, the review evaluates techniques grounded in user behavior, motivation, and readiness to enhance cybersecurity. The article also offers a comprehensive taxonomy of financial services, categorizing cyber threats into game-based (e.g., phishing, malware, APTs) and non-game-based (e.g., social engineering, compliance issues) threats. AI-driven measures for prevention and detection emphasize regular security assessments, user training, and system monitoring with incident response plans. This research provides valuable insights into the intersection of gamification and cybersecurity, offering a forward-looking perspective for both academic researchers and industry professionals.

**The Effects of Using AI Tools on Critical Thinking in English Literature Classes Among EFL Learners: An Intervention Study**

Artificial intelligence (AI)-driven learning has become an irreversible trend in foreign language education. Scholars are increasingly focusing on this field, yet few have examined its impact within English literature classes. To fill this gap, we designed an 8-week intervention study with mixed methods and recruited 90 students, with 42 in the experimental group and 48 in the control group, matched for average age, English proficiency and gender ratio. Critical thinking levels were measured before and after the intervention using a standardised assessment tool. In the experimental group, students used AI tools (ChatGPT-3.5, Bodoudou, SummarizBot, etc.) to generate and answer text-related questions, and participate in interactive quizzes and AI-assisted debates during classes, while the control group followed traditional methods without AI tools. The findings revealed a statistically significant improvement in the critical thinking skills of the experimental group compared to the control group, as measured by pre and postintervention assessments (*p* < 0.05). This suggests that AI tools can effectively enhance critical thinking abilities in English literature classes. This study not only contributes to the emerging discourse on AI in education but also offers practical implications for integrating AI technologies to support and enrich the learning experiences of EFL students in literature classes. The findings have the potential to guide educators and policymakers in designing AI-driven educational strategies that are culturally responsive and pedagogically effective.

Gamification and virtual reality for digital twin learning and training: architecture and challenges

### **Background**

Digital Twins are becoming increasingly popular in a variety of industries to manage complex systems. As digital twins become more sophisticated, there is an increased need for effective training and learning systems. Teachers, project leaders, and tool vendors encounter challenges while teaching and training their students, co-workers, and users.

### **Methods**

In this study, we propose a new method for training users in using digital twins by proposing a gamified and virtual environment. We present an overall architecture and discuss its practical realization.

### **Results**

We propose a set of future challenges that we consider critical to enabling a more effective learning/training approach.

Uncharted dimensions, gaps, and future trends of serious games in software engineering

### **Objective**

Serious Games (SG) are a rising trend in Software Engineering (SE) education, for this reason, and since this topic is still immature and further research was encouraged, it is important to investigate how SGs are integrated into SE education. In this line, this study explores the landscape of SGs in SE) education, focusing on their categorization according to their addressed SWEBOK areas and Bloom's levels, extracted their key elements, mechanics and dynamics, exploring in depth their most portrayed player profiles, finding what makes them successful SGs in this field, and last addressing their resulting challenges in the realm of SE education.

### **Methodology**

A systematic search was conducted across prominent databases: Science Direct, IEEE Xplore, ACM, Scopus, and Wiley. Initially, 125 papers met our initial inclusion criteria, from which 46 remained after rigorous full-text review. Utilizing snowball sampling, we added 28 additional studies, resulting in a total of 74 selected papers for comprehensive analysis.

### **Results**

Among the selected papers, which spanned from the early 2000s to May 2021, a notable increase in publications on SGs in SE was observed, particularly since 2010. The majority of these studies focused on validation research (60 %), followed by solution proposals (17.56 %) and evaluation research (13.51 %). Publication channels predominantly included conferences (79.73 %), underscoring the emerging nature of SGs in SE research, with a smaller proportion appearing in journal articles (20.27 %). Specific focus areas within SE, such as Software Engineering Management (33.78 %) and SE Professional Practice (13.51 %), received significant attention, while others, like SE Models and Methods, showed minimal representation. Furthermore, SGs were found to effectively target higher-order cognitive skills based on Bloom's Taxonomy, with notable implementations of game dynamics such as Teams and Realism to enhance learning experiences. Despite these advancements, there remains a predominant focus on player profiles like Achievers (48.64 %) and Players (47.30 %), suggesting potential gaps in addressing a broader spectrum of learner types within SGs designed for SE education.

### **Conclusion**

This study underscores the evolving role of SGs in SE education, emphasizing the need for diverse approaches to enhance engagement and educational outcomes. Future research should focus on optimizing SG potential across educational and industrial settings by expanding publication visibility, integrating artificial intelligence (AI), and conducting comprehensive evaluations of SGs tailored to SE contexts.

Integrating technology in physical classrooms: The impact of game-based response systems on student learning experience

This study examines the impact of game-based student response systems (GSRSs) on students’ learning experiences in face-to-face education. Building on technology-mediated learning and active learning, we demonstrate the positive impact of GSRS use on learning outcomes and learning processes (student motivation, concentration, and enjoyment) in a field experiment in a Dutch secondary school. Our study expands information systems research by showing the educational and social impact of technology integration in physical classrooms and its equalizing role in bridging the performance disparity between underperforming and overperforming students while promoting an inclusive learning environment for all students.

Exploring student engagement in technology-based education in relation to gamification, online/distance learning, and other factors: A systematic literature review

Engaging students in learning activities is the primary duty of the teacher. It is also important to see the methods of engagement in teaching and learning for both students and teachers. Students at all age levels, from elementary schools to graduate students, must have specific engagement methods in a virtual learning environment. In addition, learners encounter differences when engaging in lessons that might be more severe in a virtual environment than in a conventional classroom. The purpose of this study is to identify how students engage with different [educational technologies](https://www.sciencedirect.com/topics/social-sciences/educational-technology). To achieve this purpose, a [systematic literature review](https://www.sciencedirect.com/topics/social-sciences/systematic-review) was conducted using articles published in Scopus and PubMed databases during the 2018–2022 period. A research question developed using the PICO framework and the [PRISMA](https://www.sciencedirect.com/topics/psychology/systematic-review) framework was used for article selection, and 33 articles were used for the analyses. Analysis of the literature is divided into three sections: [gamification](https://www.sciencedirect.com/topics/social-sciences/gamification) and student engagement, online/distance learning and student engagement, and technology and student engagement. The keyword co-occurrence network visualisation map indicates the gap between the conducted studies during this period. The study provided insightful guidance on advancing learning outcomes and student engagement in the digital age. Additionally, future research areas are highlighted at the end.

Gamification in technology and design areas: A teaching innovation project in a fully online environment

Gallifantes and motivation’ is a teaching innovation project intended to foster students to participate in the university online campus of UNIR, a fully online university. Although students at UNIR are used to studying in an online independent way, it is well known that having a learning community and a confident-based relationship with mates enhance learning results. Intended to promote a lively interaction between students, both in the forums and in synchronous lessons, this teaching innovation project proposes gallifantes-rewarded actions during the semester in a competitive run. The 4 students with the highest numbers of gallifantes obtain 0.25, 0.5, 0.75 and 1 additional points in the final grade. In this paper, we present the different approaches followed in 3 subjects in the areas of technology and design, having a total number of 114 active students and 1164 gallifantes rewarded. The students answered a survey at the end of the process. As a conclusion, most of them supports the initiative, obtaining good results in satisfaction, motivation and engagement, while also suggesting improvement opportunities.

Strategies to combat misinformation: Enduring effects of a 15-minute online intervention on critical-thinking adolescents

How is it possible to socialize adolescents to become more vigilant in spotting fake news? In the present [preregistered](https://www.sciencedirect.com/topics/psychology/preregistered), randomized controlled trial (N = 1476), we aimed to implement a scalable, online counter-misinformation intervention by promoting family-based prosocial values and putting them in an expert role to build resistance against misinformation among adolescents. In this intervention, participants were endowed with an expert role and requested to write a letter to their digitally less experienced relatives elucidating six strategies to identify misinformation. We found immediate effects of the intervention (d = 0.17), but these effects disappeared after four weeks. However, those high school students who followed the instructions (N = 791) and had a higher need for cognition demonstrated a substantial benefit in correctly spotting fake news four weeks after the intervention compared to the control group (d+1 SD need for cognition = 0.28, d+2 SD need for cognition = 0.51). The present work demonstrates the power of using classic social psychological components, such as a digital [mindset](https://www.sciencedirect.com/topics/psychology/mindset), expertise role, and prosocial strategies, to achieve long-term behavioral change among certain adolescents. Our approach might complement prior nudge and inoculation interventions in the fight against misinformation in this age group.

Intelligent technologies to optimize performance: Augmenting cognitive capacity and supporting self-regulation of critical thinking skills in decision-making

The purpose of the present paper is to (a) discuss how intelligent systems can augment cognitive capacity, and through self-regulation, assist learners to engage in critical thinking and (b) provide an example that highlights the information-rich context of the [work environment](https://www.sciencedirect.com/topics/psychology/work-environment) and the role of self-regulation in working in partnership with technology to achieve peak performance. Self-regulation from a [social cognitive perspective](https://www.sciencedirect.com/topics/psychology/social-cognitive-perspective) is conceptualized as a fluid, cyclical process whereby learners use externally provided or self-generated feedback to evaluate and adjust their learning strategies. With advances in technology, this paper attempts to illustrate how workers in jobs of the future will be supported in new ways to analyze data, make **interpretations** and draw inferences, evaluate situations, and make decisions within a work context before, during, and post-work. Educational implications will be discussed.

The role of video games in enhancing managers' strategic thinking and cognitive abilities: An experiential survey

Using gamification and video games is one of the modern approaches to cognitive enhancement and improving the abilities and competencies of managers, including strategic thinking skills. Many organizations use video games in the fields of education, marketing, business, and entrepreneurship. This research aimed to investigate the role of video games in enhancing managers' strategic thinking and their potential contribution to developing cognitive capabilities. The sample included 30 students actively involved in the innovation and entrepreneurship ecosystem. To measure the strategic thinking of the participants, Pisapia’s strategic thinking questionnaire was used, and the CANTAB test was employed to measure their cognitive capabilities. To identify the individuals’ game-playing styles, indicators of micro-management, planning, plan recognition, predictions, gathering resources, partial observability, and damage avoidance were designed. The findings indicated that 53.3 percent of the participants had reflective thinking, 30 percent had systems thinking, and the rest had a reframing thinking style as their strategic thinking dominant dimension. On the other hand, given the identified correlation between the damage avoidance criteria with the thinking and reflective style, as well as the inverse and significant correlation of the gathering resources criteria with the results of the PRM test, it seems that strategic games have the potential to change and even develop some cognitive functions such as attention, reaction, and memory, and can be considered as tools to improve cognitive ability. These games can be used to design tasks to enhance managers' cognitive abilities and subsequently promote their strategic thinking and decision-making skills.

Developing an active-learning app to improve critical thinking: item selection and gamification effects

Critical thinking (CT) is widely recognized as an important skill and attitude in this [modern world](https://www.sciencedirect.com/topics/social-sciences/modern-society), but few apps (web-based or installed on devices) have been developed to effectively train it. There is also little research on what kind of content to put into such apps and in what order, if the content is a series of reasoning questions that are intended as CT exercises. Therefore, this research project, consisting of two studies, tries to demonstrate how exercise questions can be presented to learners to sustain their motivation to work on multiple-choice CT questions. In Study 1, question banks were drawn from popular workbooks for CT and verbal reasoning. The questions were ranked in terms of difficulty based on the participation of university students (N = 73).

In Study 2, the questions were loaded onto two types of web-based apps: (1) one that sequentially gives multiple-choice questions with immediate feedback and (2) one with minimum [gamification](https://www.sciencedirect.com/topics/social-sciences/gamification) of group/individual competition. The experiment to examine the effect of the [gamification](https://www.sciencedirect.com/topics/computer-science/gamification) was conducted (N = 124). Both groups with and without [gamification](https://www.sciencedirect.com/topics/psychology/gamification) showed improvements in the scores of the pre-/post-tests using comparable questions, but there was no clear effect of gamification. These findings show that an effective CT app can be developed using existing question banks but that the effect of gamification needs further research.