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The Rise of Digital Tools in Education and Its Implications

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Abstract: The integration of digital tools in educational environments has revealed a growing trend towards their adoption at all levels, from basic education to university training. This phenomenon has generated a wide debate on how to make the most of these technologies to improve teaching, learning and evaluation processes. Various research indicates that curricular designs are undergoing significant transformations to adapt to this new digital reality. The aim is to create more dynamic, flexible, disruptive and innovative content, which allows students to develop 21st century skills, such as critical thinking, creativity and collaboration. This is why the incorporation of digital tools in educational processes has also promoted a series of studies that explore how these technologies can contribute to more meaningful and relevant learning in an increasingly complex world. However, it is essential to address the challenges posed by this transformation, such as the digital divide and the need for adequate teacher training. Therefore, it is necessary to continue researching and developing educational policies that guarantee effective and equitable use of digital tools in all educational contexts.

Keywords: Digital tools, Learning, Collaboration, Training, Teaching

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Introduction

In learning environments, it is essential to effectively use all the tools that stimulate students to be more dynamic in their learning process. Currently, a common situation is the incorrect use of technology by children, adolescents and young people in general, causing a negative impact on the educational process. A variety of studies have shown that the proper use of these tools not only improves the quality of education, but also links learning to society (Ramírez et al. 2021). Given this panorama, educational institutions are committed to training their teachers to adapt, take advantage of and transform technology to benefit the teaching, learning and evaluation process. “Student-centered teaching views students as designers and shifts the teacher's role from a provider of information to a facilitator of learning” (Arellano & Escudero 2024, p. 2).

In this sense, institutions must make the curriculum more flexible or redesign it, coupling the technological tools necessary to improve learning environments, promoting constructive and meaningful spaces in the best way. “Computer or internet use requires a necessary foundation supplies such as computers, digital tools, and

adequate Internet conductivity on campus" (Lu & Song 2020, p. 1119). One of the greatest advantages of these technologies is that they allow learning in different ways and styles, whether through the use of text, audio or video, giving way to continuous educational innovation. "In more recent years, there have been calls from researchers for critical refection on educational technology phenomenon through personal experience" (Mao et al. 2023, p. 2728).

Analyze the impact that the use of technologies may have in educational settings requires understand and know the use of these in the teaching-learning and evaluation process and how they can be used to make this process a exercise that makes it easier for students to acquire knowledge, developing competencies and achieving meaningful learning outcomes for academic and professional success. "In addition to the new pedagogical challenges faced by teachers, the digital competence of students plays an important role in the new learning paradigm" (Zhao et al. 2021, p. 2). To achieve this, the collaboration of all those involved in the educational act, teachers, students, parents, managers, is needed. Where training processes are key to achieving digital transformations in educational settings and also investment in technological infrastructure. "Before a system shifts to digital education or integrates any new technology, its leaders need to consider several educational theories to design an efficacious pedagogical strategy" (Aldhafeeri & Alotaibi 2023, p. 3).

The digital transformation has radically reconfigured educational environments, making digital tools an increasingly present element in classrooms. However, despite their proliferation, there is a pressing need to more deeply understand how these technologies are being integrated into teaching and learning processes, and what their real impacts are on educational outcomes. "Computer is a didactic tool with very broad capabilities, as well as a means of increasing the effectiveness of teachers" (Shoraevna et al. 2021, p. 264).

To advocate for the necessary changes in the curriculum, pedagogy and policies implemented in an institution, it is essential to obtain more information about the situation from which this transformation is taking place (Dirckinck et al. 2023). This research project is justified by the growing relevance of digital technologies in education and by the lack of exhaustive studies that evaluate their impact in a comprehensive manner. By analyzing the degree of integration of these tools, the perceptions of educational actors and the results obtained, this research will contribute to filling a gap in the existing literature and providing empirical evidence for informed decision making in the educational field, both in the institutional context as well as in the classroom.

In the results section, the responses of a sample of teachers who were asked through a survey about how they use digital tools in their daily pedagogical work are analyzed. Each response is analyzed in light of the theory consulted and the review of the literature on similar studies carried out in different countries. Teachers from the corresponding primary, secondary and university levels of study were surveyed.

Method

This study was designed to investigate the integration of digital tools in diverse educational contexts. A total of

250 teachers from primary, secondary, and tertiary education institutions were surveyed, selected based on their active engagement in teaching and use of digital technologies. This purposive sampling ensured the collection of meaningful data from practitioners with firsthand experience in digital pedagogical practices.

Data were collected through an online survey platform to maximize accessibility and convenience for participants. Prior to distribution, the survey instrument was rigorously reviewed to ensure clarity, relevance, and alignment with the study's objectives. The survey focused on several key areas: teachers' use of digital tools, their training experiences, and their perceptions of how digital technologies influence both teaching quality and student learning outcomes. The first two survey questions were designed to contextualize the respondents by addressing the frequency of digital tool use and the extent to which educators promote these tools to support teamwork. Questions three through twelve targeted the study's central themes, providing detailed insights into pedagogical practices, perceived benefits and challenges, and institutional support needs.

Ethical protocols—including informed consent and strict confidentiality of participant data—were fully observed to uphold research integrity and protect respondents' privacy.

The research employed a parallel convergent mixed-methods design, which integrated qualitative and quantitative approaches to achieve a comprehensive understanding of the topic. This methodological strategy allowed for the simultaneous exploration of teachers' and students' lived experiences, as well as the collection of empirical data suitable for generalization (Love et al., 2022). The qualitative dimension, based on documentary analysis, provided insights into how educational actors interpret their experiences with digital tools, highlighting challenges and potential strategies for more effective integration. In parallel, the quantitative component relied on structured questionnaires and record analysis to generate statistical data on usage frequency, attitudes, and perceived educational outcomes.

Integrating these two data sources was essential for a nuanced analysis. Triangulation of the findings enabled the identification of convergences and divergences, helping to validate interpretations and build a coherent narrative of the investigated reality. For instance, qualitative data might suggest that educators value the adaptability of digital tools for personalized learning but express concern over inadequate training. Quantitative results can then either corroborate or contrast with these insights, providing concrete measurements of the scope of such concerns (Love et al., 2022).

This mixed-methods approach proved particularly suitable for addressing complex and layered research questions, including those pertaining to pedagogical practices with digital tools and their impacts on learning outcomes. It allowed the study to illuminate both the benefits and challenges of technology integration, thus offering valuable contributions to educational policy and practice (Udeozor et al., 2023). By fusing the depth of qualitative inquiry with the rigor of quantitative analysis, the study delivers a multifaceted understanding of ICT use in contemporary education. As noted, the 250 participants were drawn from across all three levels of the educational system.

To complement the survey and documentary review, the study incorporated a focused analysis of artificial intelligence (AI) tools aimed at supporting teachers' professional development and classroom effectiveness. A systematic review of current AI applications—such as NotebookLM, Chat PDF, and Algor Education—provided insights into their functionalities, including information management, content summarization, and the development of interactive teaching materials. The aim was to explore how these tools can be employed to enhance lesson planning, personalize instruction, and streamline administrative duties. This additional dimension enriches the study by capturing the evolving role of AI in education, without altering the core methodology.

Finally, the collected survey data underwent detailed statistical analysis to ensure the reliability and accuracy of the findings. Descriptive statistics—specifically percentages and frequency distributions—were used to synthesize responses regarding the use of digital tools. This analysis uncovered prevailing patterns in usage rates, perceived advantages, and common obstacles faced by educators. For instance, the data revealed a high frequency of digital tool use, significant associations between professional training and effective implementation, and persistent barriers such as connectivity issues. Through this methodologically rigorous process, the study produces credible and actionable insights that can inform future educational strategies and policy-making efforts.

Results

The findings reported below are based on the survey responses of the participating teachers. The first two questions contextualize the respondents, while questions three through twelve address the study's core objectives and inform the subsequent analysis. The integration of digital tools has notably influenced educational practices, transforming instructional delivery and student engagement. According to the surveyed educators, these technologies have enabled more interactive and flexible learning environments, enhancing both accessibility and instructional effectiveness. The following section presents an analysis of teacher perceptions regarding the use, benefits, and challenges of digital tools, as well as the institutional and training needs required to optimize their implementation.

Question 1. How often do you use digital tools in your classes?

The responses indicate that digital tools have become a regular feature in many educators' instructional routines. With 45% of teachers using them daily and 30% integrating them three to four times per week, the data reflect a consistent and growing engagement with digital technologies in classrooms. An additional 22.5% of educators reported occasional use, while only 2.5% stated they never use digital tools. This distribution suggests a general trend toward adoption, although the variation in usage frequency points to disparities in access, confidence, or pedagogical integration. As Tick (2021) affirms, the proliferation of educational technologies necessitates ongoing pedagogical adjustments, and the current data underscore how frequency of use alone may not reflect

the depth of meaningful integration.

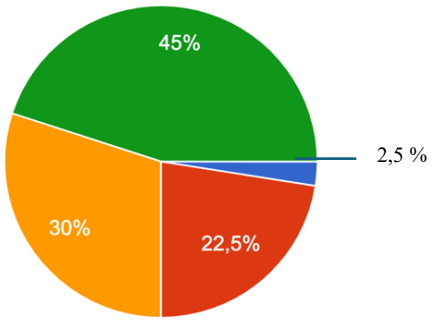

Figure 1. Frequency of Use

Question 2. Do you promote the use of digital tools to support teamwork?

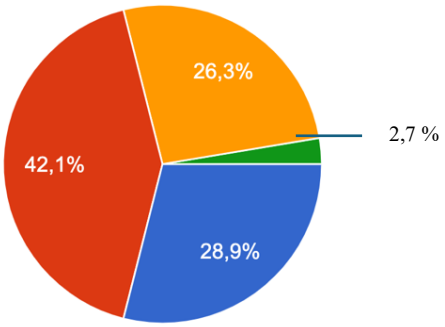

Figure 2. Tool Promotion

Teachers' responses suggest a widespread pedagogical interest in using digital tools to promote collaborative learning. A combined majority—42.1% frequently and 28.9% always—encourage their use for group work, indicating a strong inclination toward incorporating these tools into cooperative tasks. A further 26.3% promote them occasionally, while only 2.7% never advocate their use. This pattern reflects broad but varied implementation of digital collaboration strategies, which may correspond to institutional supports or constraints, as well as individual teaching philosophies (Mukan et al., 2021).

Question 3. What type of digital tools do you use most frequently?

Virtual learning platforms such as Google Classroom and Moodle are the most frequently used by 42.5% of teachers, establishing their foundational role in organizing, delivering, and managing learning activities. Content creation tools follow with 17.5%, reflecting a proactive approach to developing tailored learning materials. Communication and synchronous tools like Zoom are used by 15%, while educational social media and mobile

apps each account for 10% of responses, showing a moderate diversification in tool selection. Gamified and programming platforms such as Class Dojo and Scratch are used by only 2.5% each, indicating limited use of interactive and computational learning environments. These patterns suggest that while core platforms are entrenched, the integration of more innovative or specialized tools may be constrained by training or access (Pérez et al., 2024).

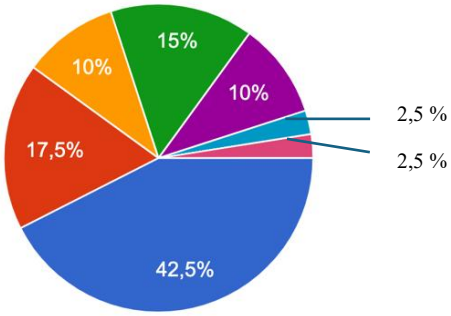

Figure 3. Type of Digital Tools

Question 4. For what activities do you mainly use digital tools?

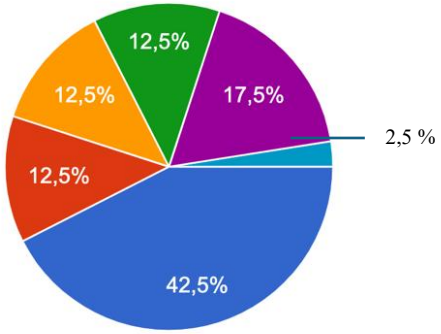

Figure 4. Activities

Digital tools support a wide range of instructional activities. The most frequent use—42.5%—is for interactive presentations, suggesting a strong emphasis on engaging students visually and cognitively. Tools are also commonly used for collaborative work (17.5%), assessments (12.5%), communication with families (12.5%), and content creation (12.5%). A small segment (2.5%) indicated using them for all purposes listed, including physical activity monitoring. This diversity of applications demonstrates the tools' adaptability, though the prominence of presentations might point to an underutilization of more interactive, student-centered capabilities (Shoraevna et al., 2021; Tsujita, 2023).

Question 5. Do you consider that digital tools have improved the quality of your teaching?

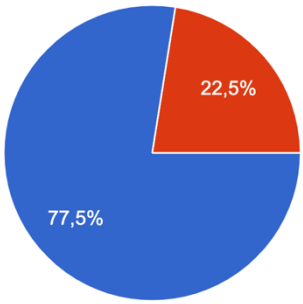

Figure 5. Qualiy in Teaching

Perceptions of improved teaching quality are widespread, with 77.5% of respondents identifying significant enhancement and 22.5% acknowledging some improvement. The high percentage of positive responses suggests a consensus that digital tools contribute meaningfully to instructional effectiveness, including flexibility, student engagement, and enriched content delivery. These perceptions, while subjective, correspond with evidence from recent studies highlighting digital innovation as a means to elevate pedagogical outcomes (Dirckinck et al., 2023; AbuJarour, 2022).

Question 6. What challenges have you faced when using digital tools in your teaching practice?

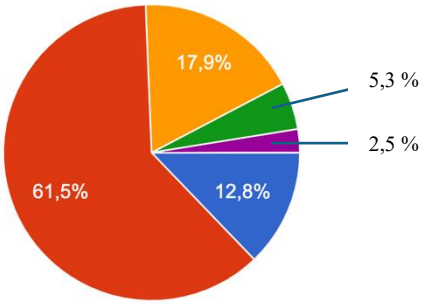

Figure 6. Challenges

Access limitations were the most frequently cited challenge (61.5%), followed by student resistance (17.9%) and insufficient training (12.8%). Technological obsolescence and time management were mentioned less frequently (5.3% and 2.5%, respectively). These findings suggest that barriers are multifaceted, encompassing infrastructure, student preparedness, and teacher readiness. The combination of these challenges indicates that successful digital integration depends on a balanced approach that addresses both technical and human factors (Denić & Petković, 2023; Adtani, 2023).

Question 7. What type of training have you received on the use of digital tools?

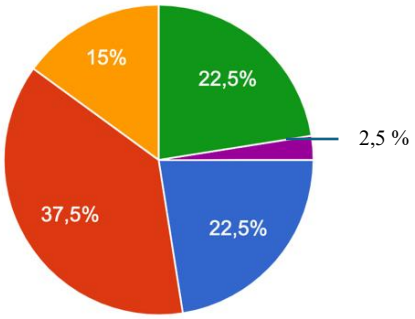

Figure 7. Training

The results reflect varied training backgrounds among teachers. Short courses were the most common (37.5%), followed by continuous training (22.5%) and diploma programs (15%). Notably, 22.5% reported having received no training, while only 2.5% participated in hands-on sessions. The scarcity of practical experience suggests a disconnect between theoretical exposure and classroom application, indicating a need for more experiential learning formats to foster effective technology integration (Tzafilkou et al., 2023; Murugesan & Cherukuri, 2023; Rana et al., 2024).

Question 8. How do you think digital tools have influenced your students' learning?

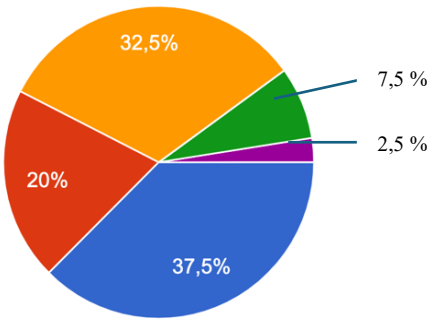

Figure 8. Influence

A range of outcomes were reported, with 37.5% of teachers observing increased student motivation and 32.5% noting enhanced digital skills. Content comprehension was highlighted by 20%, while 7.5% identified improvements in teamwork. Only 2.5% perceived no notable change. These findings reveal a perceived link between digital tools and improved engagement, skill acquisition, and content retention. The predominance of motivational and skill-related benefits reinforces current pedagogical discourse on technology-enhanced personalization (Abendan et al., 2023; Kamalov et al., 2023).

Question 9. Do you think students are more motivated to learn when digital tools are used?

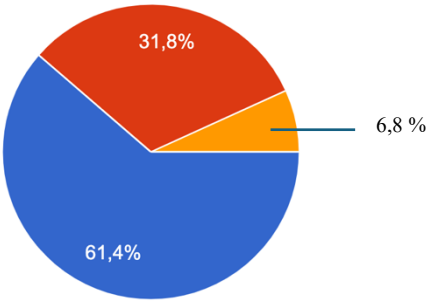

Figure 9. Motivation to Learn

According to 61.4% of respondents, digital tools consistently enhance student motivation. Another 31.8% perceived conditional benefits depending on context or strategy, and 6.8% were unsure. None of the teachers reported a lack of motivational impact. This distribution suggests a general consensus on the motivational value of digital tools, while also indicating the importance of contextually sensitive implementation strategies (Al-Rahmi et al., 2022; Muñoz et al., 2021; Glaister et al., 2024).

Question 10. How do you evaluate your students' learning when using digital tools?

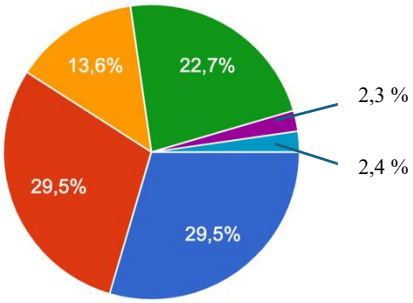

Figure 10. Tools

Assessment practices reflect a blend of traditional and digital methods. Online questionnaires and team-based projects were each used by 29.5% of teachers, suggesting a dual emphasis on individual knowledge acquisition and collaborative skills. Discussion forums (13.6%) and in-person exams (22.7%) remain integral components of the evaluative process. A smaller proportion (2.4%) combine online and face-to-face formats, while 2.3% rely solely on digital testing environments. This distribution illustrates a shift toward hybrid evaluation models that accommodate varied learner profiles and align with curricular objectives (Gómez & Mediavilla, 2022; Zhang et al., 2024; Vilppola et al., 2022).

The aggregated data suggest that while digital tool usage is steadily becoming ingrained in classroom practice, its implementation remains uneven across pedagogical functions. High-frequency use, positive perceptions of instructional quality, and reports of increased student motivation indicate a favorable disposition among educators. However, the presence of notable challenges—particularly limited access and insufficient hands-on training—points to a landscape where enthusiasm may be outpacing infrastructure. This complex interplay between adoption, perceived benefits, and operational barriers highlights the need for institutional coherence and differentiated support to ensure digital integration fulfills its transformative promise.

Discussion

The increasing integration of digital technologies in education has transformed instructional practices, prompting both educators and institutions to adapt to emerging tools and methodologies. Survey findings revealed that 45% of teachers use digital tools daily and 77.5% perceive a significant improvement in the quality of their teaching. Additionally, 61.4% noted enhanced student motivation, and 29.5% emphasized the effectiveness of digital assessments. These results underscore the central role of technology in shaping learning experiences across educational settings.

The analysis highlights that effective ICT integration depends not merely on the availability of tools, but on their purposeful application within pedagogical frameworks. Teachers who report improvements in instructional quality often attribute this to enhanced interactivity, flexibility, and personalization. To achieve these outcomes, strategic planning and ongoing professional development are essential. Technological leadership, when deliberately cultivated, can become a catalyst for sustained digital transformation (Keržič et al., 2021; Çoban et al., 2022). To foster such leadership, institutional initiatives should focus on empowering educators with mentoring programs and collaborative innovation networks.

Institutional infrastructure emerged as a decisive factor in shaping digital integration outcomes. Structured policies, equitable access to devices, and robust connectivity are critical to minimizing discrepancies in digital tool usage. A lack of well-defined frameworks, as noted by Ferede et al. (2022), can lead to fragmented experiences among both teachers and students. To prevent such disparities, institutions must establish inclusive digital strategies that standardize expectations while allowing for contextual flexibility. This approach not only improves consistency but also enhances long-term institutional resilience.

Teacher preparation remains a cornerstone of successful ICT adoption. Although 37.5% of teachers have completed short courses and 22.5% have undergone continuous training, the low rate of hands-on ICT sessions (2.5%) reveals a gap in experiential learning. Transitioning toward blended professional development models that balance theoretical instruction with real-world application is imperative. Arstorp (2021) and Tzafilkou et al. (2023) emphasize the value of such dual-focus training. Equipping teachers with both technical proficiency and pedagogical fluency ensures that digital tools are not only used but are used effectively to foster meaningful learning.

Student outcomes are closely tied to digital competencies and motivation levels. Although teachers reported improved motivation and comprehension, disparities in student self-regulation and digital literacy persist. As Guillén et al. (2020) argue, fostering autonomy in digital environments requires a proactive approach to digital literacy education. Schools should embed these programs across curricula to support student agency and ensure that technological integration translates into authentic academic growth.

Evaluation practices show a hybridization of traditional and digital formats. While tools like online questionnaires and team-based projects are gaining traction, traditional assessments remain relevant. Gómez and Mediavilla (2022) advocate for structured policies that guide digital assessment design, and Zhang et al. (2024) underline the need to align evaluation tools with instructional goals. Moving forward, schools should develop comprehensive assessment frameworks that incorporate diverse formats while preserving academic integrity. This would allow educators to capture a fuller spectrum of student learning, addressing different learning profiles and promoting equity.

Aligning technology with institutional goals and ensuring equitable access are vital for sustainable integration. As Baako and Abroampa (2023) observe, coherent strategies and adaptable policies are fundamental for maintaining innovation and inclusion in digital education. Institutions should regularly review and revise these strategies in consultation with educators to ensure they remain responsive to evolving classroom realities. These insights should guide institutional frameworks toward inclusive, evidence-based policymaking that empowers educators and students alike in the ongoing digital transition.

The study also opens a pathway for examining the role of artificial intelligence in teaching and learning. AI tools offer significant potential to personalize instruction, streamline administrative tasks, and support data-informed decision-making. However, their implementation must be accompanied by professional training and ethical oversight to avoid misuse and inequality. When responsibly integrated, AI can enhance adaptive learning, provide real-time feedback, and reinforce student-centered instruction without diminishing the human dimension of teaching. The results of this study provide actionable guidance for policy design, institutional investment in teacher training, and future research on technology-enhanced education.

The following table presents several useful artificial intelligences that support the teaching and learning process.

Table 1. Artificial Intelligences Useful in Education

AI	**Usability**
Notion	Organize multi-platform tasks
Video to blog	Turn recordings into articles, summaries or blogs
Monica	Take notes, organize and manage information
NotebookLM	Create, summarize and manage documents and notes
Suno AI	Generates songs that combine voices and instruments

Chat PDF	Allows you to ask questions in PDF format
Claude	Processes and analyzes complex information
GitMind	Organize ideas in mind maps
Algor Education	Turn text into mind maps, summaries and outlines
Presentation AI	Transform ideas into impactful presentations
ChapGPT	Stimulates creativity in a variety of formats
Mapify	Turn data into interactive maps
Playground	Generate and edit images
Freepik	Generate visual content
Blinkshot	Capture, summarize and organize information
Gemini	Boost creativity in various formats
Hotpot	Generate images, improve photos and automate designs
Gamma	Create and design dynamic presentations
Speechify	Transform text into audio
Leonardo.AI	Transform ideas into works of art
Ideogram	Turn text into creative images with precision and style
Napkin	Capture, organize and connect ideas
DeepSeek	Answer questions about anything
Speech Gen	Convert texts into various accents
Justdone	Detects plagiarism and identifies content generated by AI
Fliki	Transform ideas into videos

Source: own elaboration, 2025.

Conclusion

This study offers compelling evidence that the success of digital integration in education depends on a constellation of interrelated factors, including purposeful pedagogical implementation, sustained teacher training, and institutional readiness. While the findings affirm the benefits of digital tools in enhancing teaching practices and learner engagement, they also reveal critical gaps in access, practical training, and systemic coherence. These insights reinforce the importance of aligning technological adoption with contextually grounded educational strategies. Only by addressing these multidimensional challenges can educational institutions move beyond superficial adoption toward meaningful transformation in teaching and learning.

The pedagogical use of digital tools can make classes more interactive and attractive, increasing student interest and participation and translating the educational act into improved learning and knowledge retention. Digital platforms and applications allow educators to adapt the pace and content of instruction to the individual needs of each student, facilitating attention to diversity and fostering personalized skill development.

Although the Internet provides a vast range of information and educational resources that enhance traditional materials, it is essential to implement solutions that ensure equitable access to technology. This equity enables students to benefit from updated content across multiple formats and contexts. Moreover, for these tools to be used meaningfully, teachers require ongoing training and institutional support. Developing both digital and pedagogical skills is crucial to integrating technology effectively into classroom practices.

Staying professionally updated is fundamental to transitioning from traditional to innovative educational practices that guarantee learning outcomes. This study emphasizes that thoughtful implementation of digital technologies—combined with targeted teacher preparation, institutional support, and equitable infrastructure—can create inclusive and effective learning environments. Future efforts should focus on designing inclusive educational policies and training frameworks that respond to teachers' needs and support students' holistic development in an increasingly digital world.

Recommendations

Teacher training should go beyond the technical operation of digital tools to encompass their pedagogical application. Educators must be equipped to effectively integrate these tools into the teaching-learning process by selecting appropriate technologies, adapting them to students' needs, and designing innovative and meaningful learning experiences.

It is equally important to foster professional learning communities in which teachers can share experiences, strategies, and digital resources. These collaborative spaces enhance reflective practice and promote continuous professional development through peer support and knowledge exchange.

Furthermore, it must be emphasized that digital tools are intended to complement, not replace, the role of the teacher. The educator remains a central figure in guiding, facilitating, and contextualizing learning. Therefore, institutional policies should support this dual role by investing in both digital infrastructure and pedagogical leadership.

Finally, future studies should consider conducting comparative analyses across educational levels or regional settings. Such investigations could deepen the understanding of how contextual factors influence the integration of digital tools, thereby generating robust evidence for data-driven educational policymaking.

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Social Space and Urban Life Rhythm: Scanning Jakarta City Life via Narrative Architecture of Fiction

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Abstract: This article discusses the relationship between space, time, and urban planning in the short stories that depict workers' lives in Jakarta. Centered on the architecture of urban life, this article explores how space and time in Jakarta's urban layout affect workers' daily lives and social interactions. This research uses a narrative analysis method with Henri Lefebvre's concept of social space and Michel de Certeau's rhythm of urban life. The results show that with all its complexities, Jakarta's urban planning creates spatial imbalances that affect accessibility, travel time, and workers' activity patterns. The limited and dense urban space creates a fast and stressful rhythm of life involving the patterns of segmented social interactions. On the other hand, the short stories also reflect workers' adaptations and strategies to survive in the challenging architecture of urban life. The findings offer the significance of the influence of urban planning on the well-being of urban communities and open up space for further research on the role of inclusive urban planning policies for workers in metropolitan areas. Future research may include comparative narrative analyses with other major cities in Indonesia and a more in-depth study of the impact of environmental transformation on workers' livelihoods.

Keywords: Urban Planning, Worker's Lives, Social Space, City Rhythm, Narrative of Jakarta

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Introduction

As a metropolitan city, Jakarta has grown rapidly for centuries with all the problems it faces, including urban planning. Jakarta has developed into a city with complexities ranging from sociopolitical aspects to environmental issues. This complexity is triggered by the dominance of capitalism in the form of commodification, privatization, and commercialization (Santoso, 2013). Is Jakarta's urban space shaped by the rulers, the capitalists, or those who live and work in the city? The city's transformation and identity are indeed shaped by its history, citizens, and their lived experiences (Martinez & Masron, 2020). Such a transformation, according to Mohammad Fadhil et al. (2020), through the rapid development that occurs in urban areas, can benefit the urban population in general and can stimulate the economy better. From a positive perspective, this statement is highly beneficial to a nation's citizens.

As a metropolitan city with a large population in the world, Jakarta has many problems, including overpopulation, lack of infrastructure, and environmental degradation (Cybriwsky & Ford, 2001). In addition, Mustapha (2024) also highlights that rapid urban expansion, if not effectively managed, may result in adverse economic and social consequences, particularly in the absence of appropriate infrastructure or well-formulated policies to address evolving population dynamics. This is because, according to Ruth and Franklin (2024), urban livability is defined by two key dimensions: the extent to which a city meets the needs and aspirations of its residents and the adequacy of its environmental conditions in sustaining both their daily lives and economic activities. These problems come hand in hand with the expansion and development of the city, including the development of new neighborhoods that create spatial segregation to provide security, comfort, and lifestyle for the wealthy (Firman, 2004). This segregation indicates the political, social, and economic dynamics that emerge in urban spaces that have and will always exist. For example, one of the dynamics of life in Jakarta is the problem of transportation development. Transportation problems include vehicle density, transportation patterns, and other related issues that require a convenient and integrated transportation system (Farda & Lubis, 2018). Hutabarat (2010) reminded us of the importance of implementing transportation infrastructure considering social, economic, and political dynamics. As one of the centers of Indonesia's economic movement, the development of Jakarta cannot be separated from the problem of space and time for workers. Accessibility issues, the rhythm of life, and limited space significantly affect the lives of workers, including those who live and work in Jakarta and those who live around Jakarta but make a living in Jakarta.

Space and time in workers' lives

Workers' lives are meaningful in the development of Jakarta because of their role and efforts to make changes in the city (Park, 2017). Several things need attention in this regard. Dharmowijoyo et al. (2016) observed that allocating travel time to the workplace is an essential concern in Jakarta's urban planning. Power also plays a role in the development of Jakarta, whether by officials, developers, residents, or those who are also influential in the city's economy (Kusno, 2017). It, for example, affects working conditions and comfort in realizing optimal work results (Kurniawan et al., 2024). It aligns with Balducci and Checchi (2009), who emphasized that

quantitative measures, such as pollution, traffic, and public service availability, and qualitative measures, such as interpersonal relationships and lifestyles, can serve as assessment tools.

The inhabitants of Jakarta cannot be separated from the issue of migration. The city's urban space is shaped and transformed by migrants who stay and live in the city or those who simply seek a living there (Park, 2017). The meeting of these two groups raises the issue of activity duration and time spent to reach destinations in this metropolis (Dharmowijoyo et al., 2016). Policies to reduce travel time are needed in this city. Power belongs to the rulers and the rich and commoners such as community members or residents of Jakarta. They also influence the shape and life of the city (Kusno, 2017). It relates to flexible working space and working time to produce maximum results for individual professionals (Kurniawan et al., 2024). The network and expansion of the transportation system affect the expansion of the Jakarta metropolitan area, including the growth of toll roads and railways to satellite areas around the metro that form urban development patterns (Yudhistira et al., 2019). Public transportation modes impact the sustainability of the environment and public space, affecting passengers and accompanying informal activities (Harjoko et al., 2012).

The development of transportation infrastructure affects the expansion of the Jakarta metropolitan area (Yudhistira et al., 2019), especially for those who want a more upscale environment (Winarso & Udisaptono, 2013). The emergence of new areas, especially elite regions, requires a better transportation system to overcome vehicle density and its impacts on sustainable transportation planning (Farda & Lubis, 2018). This creates many modes of transportation that affect the behavior of public transportation workers (Harjoko et al., 2012). Some consider that the city's development needs to consider the views of the community and academics and their participation (Martinez & Masron, 2020). It is closely related to many urban issues, such as overpopulation, inadequate infrastructure, and environmental degradation. All of these require input and support from all groups to periodically get out of these problems one by one (Cybriwsky & Ford, 2001).

Literature and urban life

Fiction can be used to explore the theme of urban life and how representations in literature can reveal social dynamics in big cities. Passell (2013) says that fiction can be used to see the dynamics of the world, whether it is realist fiction or science fiction, including the rhythm of urban life in the form of space and time (Rodríguez-González, 2016). Fiction can describe or criticize the life of a region. The city becomes a symbol of human experience that reveals the identity of its inhabitants or the collective psyche of its people, as well as a source of inspiration for writers (Anton, 2016). Johansson & Lofgren (2020) state that literature and fiction, in both textual and oral forms, are essential to human development and education, shaping our understanding of reality. In addition to depicting an area and its people, fiction can educate urban readers, especially the social fiction method, in providing education about inclusivity and sustainability in urban planning education (Wuyts, 2024). Then, Bina et al. (2017) view fiction as a tool to represent the challenges of contemporary urban society and offer options for the future. Through science fiction, authors can provide input to policymakers in developing

sustainable and futurist urban areas. Thibault et al. (2024) introduced the term semiotics of urban futures with types of cities and urban design.

Writers have dealt with urban and rural issues for a long time. Ferdinal (2022) and Ferdinal et al. (2025) confirmed that postcolonial issues such as exploitation and trauma have attracted their attention. Simpson (2010), in the context of American literature, asserts that twentieth-century writers have shifted focus from depicting nature to the urban environment, noting that industrial modernity has changed city life and affected American identity, particularly issues of belonging and alienation in the city. Similarly, in Malaysia, *Putera Gunung Tahan*, written in 1937, is a notable colonial-era novel studied for its portrayal of the struggle for independence, justice, and resistance against colonial rule (Mohd. Tahir, 2011).

Wilson & Wyly (2023) depict Jakarta in comparison to Flint as a smart city with grand real estate, with power and authority in a parasitic relationship. More specifically, Shackford-Bradley (2006) outlines how Indonesian short stories depict urban space and public discourse. Indonesian fiction also deals with public issues both in rural lives (e.q. Ferdinal et al. 2025a; Oktavianus et al. 2025; Nopriyasman et al. 2024, Nopriyasman et al. 2025) and urban scopes such as censorship (Ferdinal, 2013), Terror (Ferdinal, 2021), religion and culture (Ferdinal et al., 2023; Oktavianus et al., 2024; Revita et al., 2024; Ferdinal et al. 2025b). Then, Aribowo (2024), by examining Ahmad Tohari's novel Jegingger, looks into the tension between subsistence and productive economies that can damage social relations. Previously, Soehadi (2018) had found the issue of migrants and exploitation in Teguh Karya's 'Secangkir Kopi Pahit' where Teguh highlighted the people of Jakarta at the end of the 20th century with all the realities they faced.

Among the many urban short stories in Indonesia, 'Bakul Daun Cincau' presents a number of problems to its readers. In this paper, the two main issues raised are: first, how this work criticizes the influence of space and time on the daily lives of workers, especially accessibility, travel time, activity patterns, and social interactions in the community. Then, how Lefebvre's concept of social space and de Certeau's rhythm of urban life can explain the urban dynamics described in this short story. This article aims to study the relationship between space, time, and urban life and understand the impact of urban planning on the daily lives of permanent workers or migrants in Jakarta. It also looks at the strategies used by the workers in dealing with the dynamics of life in Jakarta's crowded urban environment.

This literary study can provide an alternative perspective on workers' lives in Jakarta through the lens of literature. The results of this study can serve as input for policymakers in designing, building, and evaluating existing urban spaces and considering the welfare of workers in the city. In simple terms, the central part of this article begins with how space, time, and life in Jakarta are portrayed in Jakarta urban fiction, especially the story 'Bakul Daun Cincau' by Parakitri T. Simbolon and how the people of Jakarta live their lives in this time of change and what strategies they use to survive. The findings are then discussed with reference to previous related research studies.

Theoretical Framework

This study applies the concepts of Social Space and the Rhythm of Urban Life to look at the representation of the urban architecture of Jakarta in the selected stories. Urban sociology theory asserts that social space is essential to urban issues. How is this space formed, and how does it impact individuals? People need appropriate spaces to foster social relationships among them (Lefebvre, 2012). Space is required by people in their daily lives in a socio-political context. For Lefebvre, people have the right to their (urban) life. He criticizes the concept of space constructed by capitalists through mental domination (created space) over natural and social space. Lefebvre divides his concept into three layers, namely Representations of Space (conceived space), Representational Space (lived space), and Spatial Practice (perceived space). According to Henri Lefebvre, social space is suitable for social relations.

The theory of urban rhythm by Michel de Certeau (1984) emphasizes that the city as a space is not only a physical entity but also complemented by social space where people, life activities, and urban environments are formed and produce urban rhythms. In his book *The Practice of Everyday Life*, Certeau writes that city life consists of the daily activities of its residents, including how they fill their individual lives and build relationships with others. These interactions form the city's rhythm with specific patterns involving time, space, and human activity. Certeau invites us to look at the city not only from spatial planning or urban planning but also from a micro perspective, namely how individuals use urban space creatively and often against or deviate from official rules.

Urban rhythms are also understood through the duality between regular or institutional rhythms, such as working hours or public transportation, and spontaneous daily activities. Certeau uses the terms "strategy" and "tactics" to describe this interaction. Strategies refer to the planning and organization of space by institutions or powers, while tactics refer to the way individuals adapt, circumvent, or creatively utilize urban space for their needs. In other words, the city is rhythm results from the tension between established structures and people's spontaneous activities. This concept invites us to understand the city as a living space constantly moving and changing, influenced by patterns that continue to evolve.

Methodology

This qualitative research uses a narrative analysis method focusing on the story's structure, plot, setting, and theme, which describes the lives of workers in Jakarta. This analysis shows how space and time are depicted in urban fiction, highlighting workers' daily lives. To see this, the first step is theme identification. Through in-depth reading, the researchers looked for urban themes such as the accessibility of workspaces, the rhythm of travel, and social interaction in public spaces. Then, the researchers outline the elements of the story that illustrate space and time by examining how the characters interact with others through these elements. Furthermore, to analyze the dynamics of space and time, especially the theme of social space and the rhythm of

urban life, this study uses an urban sociology theory approach with an emphasis on the concept of social space by Henri Lefebvre and the rhythm of urban life by Michel de Certeau.

The formal object of this research is social space and urban rhythms, and the material object is the stories that depict the themes, especially the story 'Bakul Daun Cincau' by Parakitri T. Simbolon. Social space and urban rhythms are essential issues in urban development today, especially in Jakarta, and they are always in the spotlight because they have never been solved. This work was chosen for several reasons. First, this short story raises the theme of space and time in the lives of Jakarta workers. Secondly, it raises issues relevant to urban architecture, such as accessibility and social interaction in Jakarta.

Data on the representation of social space and the rhythm of urban life were collected from the short story 'Bakul Daun Cincau.' The story was read in-depth to find patterns, themes, and elements of space and time related to urban planning. Meanwhile, secondary data were taken from other sources, including other works on urban Jakarta. The data collected was thematically coded by identifying themes such as accessibility, the social spaces present, and the existing urban rhythms. Next, we interpreted how the social context of space and time depicted in the story influenced workers' lives in Jakarta with Lefebvre's social space theory and Certeau's Urban Rhythm theory. Then, we identified how space and time create challenges and adaptation strategies for people living their lives. To ensure the validity and reliability of the research, the analysis process was conducted in depth with a triangulation approach of theories (Lefebvre and Certeau), selected works, and other relevant references. This helps ensure that the findings produced have a strong theoretical foundation and apply to the phenomena studied at the level of fiction and reality. The expected results of the proposed study is limited in many aspects, such as the number of stories used being purposive on certain stories, so the results cannot cover all aspects of city life in Jakarta. The qualitative approach cannot generalize the conclusions but provides a deeper understanding of the researched topic.

Results and Analysis

A number of writers have expressed their concern about the representation of urban life in Jakarta. Indonesian authors such as Pramoedya Ananta Toer, Muchtar Lubis, Ahmad Tohari, and Seno Gumira Ajidharma. Toer, for example, in his book *Cerita Dari Jakarta* has written a collection of short stories representing stories about the residents of Jakarta, such as 'Jongos + Babu,' 'Ikan yang Terdampar,' 'Berita dari Kemayoran', and 'Nyonya Dokter Hewan Suharko'. Muchtar Lubis, in his *Senja di Jakarta* looks at the social-political situation in Jakarta. Ahmad Tohari has written some works. 'Anak Ini Mau Mengencingi Jakarta' is among his works that expose life in Jakarta. Seno Gumira Ajidarma is possibly one of the writers who pays much attention to Jakarta due to his close contact with the city. Among his works, we can mention 'Jakarta Suatu Ketika', *Atas Nama Malam*, and *Jakarta 2039*. The stories center on the lives of different characters.

Published by Kompas, the story 'Bakul Daun Cincau' also deserves readers' attention. The story talks about the impact of Jakarta's urban planning on the people, especially the workers who live in Jakarta. It tells the story of

a Jakarta resident who travels by *angkot* from Parung to Lebak Bulus. He meets a migrant worker who makes a living by selling *cincau* leaves from a suburb on Jakarta's border to the city's center. The story depicts how these characters spend their time from where they live to where they work. This work illustrates the imbalance of space that affects workers' accessibility, travel time, and activity patterns. Looking at dense spaces and the fast pace of life, Simbolon sees the consequences of limited and dense urban spaces on stress and patterns of social interaction. How do workers adapt to this situation, and how do they survive in this challenging urban environment? This work depicts three spaces that serve as his social critique: the perceived space, the imagined space, and the inhabited space, and how the rhythm of life is lived. This section is organized around the social space and followed by the rhythm of people's urban life.

Angkot as a perceived space

Referring to space as a physical location filled with the daily activities of workers, this short story looks at the daily lives of workers in a corner of Jakarta. In this story, the narrator's journey on public minibus transportation (*angkot*) is described as a public space designed by the government to provide travel facilities for city residents. Physically, this journey is accompanied by the atmosphere of the road, the vehicle's condition, the dynamics of *angkot* drivers and other vehicles, and those who are present and use this vehicle. *Angkot* serves as a meeting place for people with various work and activity backgrounds, such as formal workers, migrant workers, and other passengers who choose this mode of transportation with different life goals. This space shows how the physical elements of the city become the main setting for various practical and daily activities. Unlike Seno's 'Jakarta Suatu Ketika,' which alienates the marginalized Jakartans, this story softly illustrates the symbolic alienation caused by the inappropriate government planning on social space felt by the characters.

Of the many urban space issues facing Jakarta, the impact of urban planning on workers' lives is one of the highlights depicted in this story. This urban planning creates spatial imbalances and workers' accessibility to workplaces, public services, and social spaces. In the dimension of perceived space, Simbolon uses descriptive language to build a physical picture of a social space that is accessible to the reader. She describes the *angkot* route area and its locational elements.

> Saya baru mengetahuinya pada suatu sore, sekitar pukul empat, ketika saya naik angkot biru jalur Parung-Lebak Bulus di suatu tempat yang disebut “Pojok” di tepi Jalan Cirendeu Raya, di sisi Lapangan Terbang Pondok Cabe. Rencananya saya akan turun hampir di ujung jalur angkot itu, di tempat taksi“ngetem” persis menjelang pintu masuk tol Pondok Pinang. Dari sana saya akan meneruskan perjalanan dengan taksi. (p. 75)

> I found out about it one afternoon, around four o'clock, when I took a blue angkot on the Parung-Lebakbulus line at a place called "Pojok" on the edge of Cirendeu Raya Road, on the side of Pondok Cabe Airport. I planned to get off almost at the end of the *angkot* line, where taxis "ngetem" just before

> the Pondok Pinang toll entrance. From there I would continue my journey by taxi (Translation by the researchers).

The quote shows that the journey from Parung, West Java, to Lebak Bulus, South Jakarta, is made by taking an *angkot* because this route is very congested with vehicles and can routinely be passed by *angkot* and motorcycles. After the congested route ends, the journey can be continued by taking a taxi or other transportation to the destination. This work highlights the problem of long travel times and the diverse patterns of people's activities. It illustrates that the complex urban layout and transportation infrastructure affect workers' travel time and impact their daily lives and time. This description gives an accurate impression of the physical condition of the road between Parung-Lebak Bulus, placing the reader as if they are in the area. The quote above describes the angkot route as a space and conveys an atmosphere of discomfort mixed with the limited facilities. The use of language builds a space that the reader perceives as a public space close to daily life. However, this descriptive language also reveals how different characters feel transportation space. For example, for migrant traders, the road is a place of economic opportunity, as seen from their dialogues that use pragmatic language such as "*Halal* goods, sir. Very good stuff" (81). "This good stuff is grass jelly leaves, sir. Green grass jelly leaves that are vines, not shrubs, not jangelan. I hope you once liked drinking *cendol cincau*" (82). For office workers, this route is a place where they can get to their destination and observe other members of urban society, as illustrated in the narrative: "I've lived in the village near the airstrip for seventeen years, but it wasn't until my fifteenth year that I started taking *angkot*. The reason was that the traffic jam on Cirendeu Raya was unbearable" (77). The language used here reflects how space is perceived differently by different users. One is happy to be transported, while the other feels forced because there are no other transportation options. This depiction of transportation life and the people involved can also be found in some urban narratives about Jakarta, including the story 'Anak Ini Mau Mengencingi Jakarta' by Ahmad Tohari.

Idealism vs suffering on the conceived space

Referring to how space is designed by a powerful authority, the story 'Bakul Daun Cincau,' reveals that the *Parung-Lebak Bulus angkot* route was designed by the government as an ideal route (space) that symbolizes the smooth movement of people, transportation, and order and progress of the city. The government envisioned this route as a symbol of urban modernity, an orderly highway amid the hustle and bustle of the city. However, the government's vision clashed with the reality of its citizens. For example, the *angkot* on this route is considered to bring suffering.

> Sungguh makan hati rasanya saat mula-mula saya naik angkot. Sudah panas di dalam dan “sewa”-nya padat, sopirnya juga ugal-ugalan, sedangkan mobil sendiri nongkrong dan karatan di garasi. Terhadap sopir yang ugal-ugalan itu, anehnya sewa bukannya protes, malah ramai-ramai mengipasi agar dia lebih berani mencuri jalur. (77).

> It was heart-wrenching when I first boarded an *angkot*. It was already hot inside and the "fare" was crowded, the driver was also irresponsible, while the car itself was hanging out and rusting in the garage. Strangely enough, instead of protesting against the reckless driver, the rentals fanned him so that he would be more courageous in his pursuit of the lane (Translation by the authors).

This quote shows how this imagined space demonstrates the dominance of authority in defining how urban space should be used. A space that is supposed to produce more inclusive and fluid transportation turns into a mode of choice and fear. Simbolon, in this story, does not present a representative of the government but presents this authority symbolically. Authority is illustrated through the coercion of an actor who has to use *angkot* to get to his destination and a grass jelly leaf vendor who is supposed to ride a truck but then has to take an *angkot* to his destination. On the other hand, the *angkot* driver also picks up passengers who should not be allowed to take *angkot* but agree because of the rent. All of this illustrates an authority that has not been able to solve the problem of vehicle density and correct allocation. This narrative reflects that Jakarta's government's vision of progress and order has become disconnected from everyday reality. Meanwhile, their desire to bring comfort and order does not give birth to hope but discomfort, creating a space for conflict between marginalized groups and authority.

Subjectivity of the lived space

This dimension describes space as experienced by city residents through social interactions and cultural symbols. In the short story 'Bakul Daun Cincau,' *angkot* becomes a tool and a space where various human experiences converge. A worker uses this space as a place to transport merchandise. Meanwhile, a worker uses this space to think about and observe the environment among other citizens. This space comes alive because of social interactions involving various groups of people with different needs and meanings for its existence. Corresponding to the story 'Berita dari Kemayoran' by Pramoedya Ananta Toer, which stresses unfulfilled feeling, this experienced space is subjective and often contradicts the authority's design and frequently creates social space conflicts.

By using Lefebvre's concept of social space, readers can identify conflicts that occur in this city's *angkot* route, such as conflicts between the government and marginalized residents. This short story conveys how the narrator is upset by the scene where the *angkot* driver drives the vehicle recklessly because of the need and desire to get more passengers and rent. This shows how the *angkot* and its lanes are often controlled by a capitalist logic that prioritizes more income and money to the exclusion of the needs of other groups. Conflicts between space users also occur. For example, a private car driver is annoyed by the presence of an irresponsible *angkot* on the highway. This illustrates the different views on how road space should be used.

The story' Bakul Daun Cincau' uses *angkot* as a symbol of urban social inequality. While *angkot,* with its lanes, is designed to be an ideal movement space for marginalized people, this territory and tool have become a battlefield between various groups with different interests. Simbolon criticizes how public spaces are often not

inclusive but tend to reinforce social inequalities. Using Lefebvre's concept of social space, this short story illustrates how the highway is not only a physical space but also a social space full of meanings, symbols, and conflicts. The perceived, imagined, and experienced dimensions of the space conflict with each other, creating complexity in the use of the space. This short story invites readers to reflect on how urban spaces can be more inclusive and equitable for all users.

From this short story, in addition to understanding Henri Lefebvre's concept of social space in cities, we can also observe the use of language in building social space. In this short story, language is used by the characters to express their experience of going with *angkot* and its regional routes. This language often contains symbols and metaphors, reflecting how individuals make personal and emotional sense of space. First, the language of politeness. Simbolon writes of using polite language amidst the hustle and bustle of Jakarta's violence and indifference.

> “Saya yang terpaksa naik angkot,” katanya sama lembutnya. “Supir pick-up yang sudah janji akan membawa saya, ingkar. Minta maaf pak. Kepada sopir dan penumpang lain saya sudah dulu minta maaf.” (81).
>
> "I had to take an angkot," she said just as gently. "The pick-up driver who had promised to take me, broke his promise. I apologize, sir. I apologize to the driver and other passengers first." (Translation by the researchers).

Simbolon then presents pessimistic language in the lives of people who have longed and thirsted for togetherness and brotherhood. He writes, “Hati saya pun terasa lega selega angkasa, sekaligus merasa beruntung dapat ketemu seseorang yang santun di tengah lingkungan yang sudah cemas dengan akuisme dan nafsu-nafsu pribadi” (81) (My heart was relieved, and at the same time, I felt lucky to meet someone polite in a neighborhood that was already worried about acquisitiveness and personal lust).

In the story, the narrator refers to the social space in Jakarta as full of acquisitiveness and lacking togetherness and brotherhood. This phrase reflects the narrator's emotional experience of finding a sense of caring and togetherness in *angkot*. The choice of the words "selfishness and individual lust" suggests that the *angkot*, although only a tiny and temporary space, becomes a social space that provides a sense of coolness, at least to specific individuals, including those who are marginalized. The language used reflects the different views and values between social groups.

Negotiation language and the conflicting meaning of social space

The language used in the short story 'Bakul Daun Cincau' shows how social space is never neutral. It is always an arena for negotiation and conflict of meaning. In this social space, language can play various functions: as a

tool of control and resistance. Besides, language also functions as emotional expression, social interaction, the control of reality, recording facts, instrument of thought and the expression of identity (Crystal, 1998). Language also functions as the social mirror (Chaika, 1989). The authorities use the former or those with power, and the marginalized utilize the latter. Those in power tend to use straightforward and harsh language. In contrast, the latter use symbolic language, including small traders, to challenge the dominant narrative. This reflects the dominance of imagined space over experienced space.

Crowded spaces and fast rhythms of life

Through language, the characters express alternative meanings of the space they inhabit. The use of language in the short story builds a dynamic and conflicted social space. Descriptive language creates a perceived physical space, formal language reflects the dominance of authority in an imagined space, and the symbolic language of marginalized groups creates a personally experienced space. Simbolon shows how language becomes a tool to represent and contest the meaning of social space in the city, depicting a complex and non-uniform urban reality.

Yang lebih membuka mata saya lagi adalah keterangannya menjawab sederetpertanyaan saya tentang tata-niaganya. … Dua karung itu masing-masing berisi 20 kilo daun cincau yang dibayarnya Rp5.000 per kilo. Dia akanmembawanya ke Pasar Mede di kawasan Cipete, Jakarta Selatan, makanya dia harus turun sampai titik terakhir jalur angkot di Terminal Lebak Bulus. Dari sana dia akan mencari alat angkutan lain. (p. 82).

What was even more eye-opening was that his description answered a series of questions I had about his trade system. ... The two sacks each contained 20 kilos of grass jelly leaves for which he paid Rp5,000 per kilo. He would take them to Pasar Mede in the Cipete area of South Jakarta, so he had to get off at the last point of the *angkot* line at Lebak Bulus Terminal. From there he would look for other means of transportation (Translation by the researchers).

In this story, Simbolon hints that the hectic rhythm of city life does not allow its inhabitants to enjoy the social space of interacting with other communities, so their sensitivity and knowledge of the environment are lacking. They are not even analytical of their lives.

> Di Pasar Mede, orang tua itu akan menjual daun cincaunya seharga Rp20.000 sekilo. Kaget juga saya endengar angkat itu. Itu berarti dia akan mendapat keuntungan kotor sedikitnya 300%. Dia, katanya, setiap minggu ke Ciseeng, memetik sendiri daun cincau dari kebun penduduk. Dengan demikian dia akan memperoleh hampir Rp2,5 juta keuntungan setiap bulan dari kegiatan sampingan seringan itu. (p. 83).

> At Mede Market, the old man would sell his *cincau* leaves for Rp20,000 a kilo. I was shocked to hear that raise. That means he will make a gross profit of at least 300%. He went to Ciseeng every week, he said, to pick the grass jelly leaves himself from the villagers' gardens. He would thus earn almost Rp2.5 million in profit every month from such a small side activity (Translation by the researchers).

The social space between migrant groups and those who live in certain areas has not built mutually beneficial relationships. The fast rhythm of life, the density of transportation, and the relatively long travel time tend not to produce a profitable social space. Only economic language can break the rigidity of social space between them. Economic needs force them to interact with each other, albeit in unusual ways. Languages such as trade, merchandise, profits, villages, and cities have become the language of social space conversations between them behind the fast and monotonous rhythm of life.

The story' Bakul Daun Cincau' describes a character's journey walking along a big city highway filled with the hustle and bustle of human activity, vehicles, and various other urban elements. In the context of Certeau's concept of urban rhythm, this short story indicates two main dimensions: spatial rhythm and temporal rhythm.

Conclusion

The short story 'Bakul Daun Cincau' by Parakitri T. Simbolon represents the imbalance of social space and the rhythm of Jakarta's dynamic city life, which affects accessibility, travel, activity patterns, and workers' lives. Workers must find strategies to overcome the limited space and time in urban areas and come up with solutions to their problems without relying on spatial planning that the authorities have determined.

The solutions they present independently result from the limited space they can enjoy and impact the mental, physical health, and social interactions of workers in Jakarta. This picture implies that city policymakers should provide and support the presence of accessibility, welfare, and quality of life in the community, especially workers who are constantly faced with the challenges of urban life full of complexity. For this reason, the visualization in the words conveyed by this short story emphasizes the importance of urban planning in favor of the working community by paying attention to their social needs, including access to public space and conducive and efficient transportation.

Recommendation

With the limitations of this study, future research can look at how the author describes the impact of urban planning on people in other cities, especially urban planning changes, and their effects on the welfare and lives of workers. Studies of urban planning and its impact on urban workers emphasize the importance of inclusive urban planning that considers the well-being and psychology of workers and urban communities.

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Analysis of Postgraduate Theses on Creative Thinking in Education Science in Türkiye

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Abstract: This study aims to analyze postgraduate theses in the field of educational sciences in Türkiye that focus on creative thinking between the years 2020 and 2025. Designed as a qualitative study, it utilizes the document analysis method, which involves systematically collecting, analyzing, and interpreting written materials. A total of 70 theses, accessible through the National Thesis Center of the Council of Higher Education (YÖK), were examined based on criteria such as thesis type (master's/doctoral), publication year, research method, sample group, and associated conceptual keywords. The data were structured using a coding form developed by the researcher, validated by expert opinion, and tested through a pilot application. The findings were analyzed using descriptive statistics, including frequency and percentage distributions. The analysis revealed trends in methodological preferences, frequently studied concepts in relation to creative thinking, and sample characteristics. The results aim to contribute to the conceptual mapping of the creative thinking field in educational research and to guide future researchers and practitioners.

Keywords: Creative Thinking, Postgraduate Theses, Türkiye

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Introduction

In the knowledge-based societies of the 21st century, individuals are expected not only to access information but also to use this knowledge creatively, generate new insights, and develop original ideas in problem-solving processes. Consequently, the acquisition of creative thinking skills holds critical importance, not merely for individual development but also for societal and economic progress. Particularly, technological transformations such as digitalization, artificial intelligence, and automation have heightened the necessity for individuals to produce original ideas and develop creative problem-solving abilities (Beghetto & Kaufman, 2016; Ozturk, 2023; Robinson, 2011; Tekin, 2025).

Creative thinking is a cognitive process that involves the production of original, functional, and valuable ideas (Mayanti & Widiyatmoko, 2025 ; Runco & Jaeger, 2012). Torrance (1974) explained creative thinking through the dimensions of fluency, flexibility, originality, and elaboration, establishing that this skill is both measurable and developable. In the educational domain, supporting creative thinking enhances students' active participation

in the learning process and contributes to their holistic development alongside critical thinking, problem-solving, and lifelong learning skills (Treffinger et al., 2002).

Recent research indicates that creative thinking can be developed in educational settings from early ages and that this skill also supports interdisciplinary learning (Duval et al., 2023; Habeeb et al. 2024; Hammershøj, 2014). Particularly, the integration of creative thinking into different fields such as STEM (Science, Technology, Engineering, Mathematics), arts, and social sciences enhances the quality of educational programs and enables more effective implementation of learner-centered approaches (Henriksen et al., 2016).

In Türkiye, creative thinking is included among the fundamental life skills in the curricula prepared by the Ministry of National Education (MEB, 2018), which presents various learning outcomes aimed at developing this skill. However, despite the inclusion of objectives related to creative thinking in curricula, the extent to which this skill is reflected in classroom practices, which methods and techniques are used to support it, and how it is integrated into teacher education processes still requires further research (Berkant & Varki, 2022; Karabey, 2010).

In this context, systematically examining postgraduate theses on creative thinking in the field of educational sciences is valuable for determining academic trends in the field. An analysis based on variables such as the concepts associated with these theses, methodological approaches preferred, age groups studied, and distribution by year will both contribute to the academic literature and provide insights for new areas of study.

Indeed, while there has been an observed increase in postgraduate theses related to creative thinking in Türkiye, comprehensive analyses of methodological, thematic, and conceptual trends in these theses remain limited. This study aims to contribute to the literature by examining postgraduate theses focusing on creative thinking in the field of educational sciences in Türkiye within the framework of specific variables. Such a study will particularly benefit:

Postgraduate students conducting research at the master's and doctoral levels, who can identify current trends and research gaps when determining their study topics. Academic advisors, who can provide more informed guidance to students conducting theses on creative thinking. Educational policy developers, who can shape their decisions in areas such as curriculum development and teacher education by observing how creative thinking skills are addressed in the education system. Practicing teachers and educational administrators, who can enrich their own practices by analyzing which concepts are associated with creative thinking and which methods are more frequently preferred.

In this context, the research aims to contribute both to academic knowledge production and practical applications by revealing the reflections of creative thinking in the field of educational sciences.

Theoretical Framework

Creative thinking is defined as the process by which an individual uses their existing knowledge base in new and original ways to produce unconventional solutions, develop new products, and generate different perspectives (Runco & Jaeger, 2012). Torrance (1974) conceptualized creative thinking across four fundamental dimensions: fluency (generating numerous ideas), flexibility (producing ideas across different categories), originality (generating unusual and rare ideas), and elaboration (enriching the ideas produced). This model represents one of the foundational theories guiding efforts to measure and develop creative thinking in educational settings.

Creative thinking is represented by the "creating" category at the highest level of the cognitive domain in Bloom's revised taxonomy (Anderson & Krathwohl, 2001). Within this framework, developing students' creative thinking skills is critical for supporting higher-order cognitive processes. Creative thinking has strong connections with 21st-century skills such as problem-solving, critical thinking, and innovative learning (Beghetto & Kaufman, 2016).

Vygotsky's (1978) social development theory also highlights the importance of social context in the development of creative thinking. According to this theory, individuals develop higher-order mental skills through social interaction. Interactions with teachers and peers in educational environments offer rich learning opportunities for the development of creative thinking. Bruner's constructivist learning approach emphasizes that creative thinking can be supported through the individual's active participation and learning through discovery (Bruner, 1961).

Creative thinking is also evaluated as an interdisciplinary skill and is reported to contribute to students' multifaceted development when integrated with fields such as STEM, art, and language education (Henriksen et al., 2016). Current research reveals that creative thinking has positive effects on students' academic achievement, motivation, and self-efficacy perceptions (Orakçi, 2023).

The importance given to creative thinking is also increasing at the level of educational policies. In Türkiye, creative thinking is defined among the basic life skills in the curricula updated by the Ministry of National Education (MEB, 2018), and it is emphasized that this skill should be acquired from an early age. However, questions remain regarding the extent to which these curricular emphases are reflected in practice, and how teachers and teacher candidates approach creative thinking.

In this context, examining the concepts associated with postgraduate theses on creative thinking, the methods preferred, and the target sample groups can identify both theoretical and practical areas for development. This will contribute to more effective integration of creative thinking into the education system.

Purpose of the Research

Aksoy (2023) examined postgraduate theses in the field of creative thinking, focusing on works produced between 2012 and 2021. In contrast, the present study analyzed postgraduate theses in the field of educational sciences between 2020 and 2025. These results align with previous literature in the field. For instance, Tümer and Aslışen (2022) found a significant increase in thesis production in the creative drama domain after 2019, yet highlighted an over-reliance on master's theses and the predominance of child samples.

Similarly, Eğmir et al. (2020) and Demirkol and Anılan (2024) reported that studies on creative thinking skills often employed quantitative or mixed methods, used medium-sized samples, and focused on subject areas such as Social Studies and Science. Öz and Türkel (2023) noted a growing trend in postgraduate research on creative thinking, especially after 2005, and emphasized that most theses centered on educational themes within the social sciences. They also observed frequent use of practical techniques like brainstorming and Torrance-based approaches.

Furthermore, Genç (2020) and Saracaloğlu et al. (2014) emphasized key methodological limitations in creativity-related theses and articles, such as the overuse of descriptive designs, limited diversity in data collection tools (mostly questionnaires and scales), and a dominance of quantitative methods. These patterns also surfaced in the current study, indicating persistent methodological tendencies in the field.

However, the present research differs from previous studies in its exclusive focus on the most recent five-year period (2020–2025), thereby offering a more up-to-date and detailed portrayal of the current state of postgraduate research on creative thinking within Turkish educational sciences. By employing a systematic document analysis approach, this study aims to map the contemporary landscape of creative thinking research, identify dominant methodological trends, explore conceptual associations, and analyze target populations. The ultimate goal is to provide a comprehensive overview that can inform and guide future academic efforts and policymaking in the field.

Method

Research Design

This research is a qualitative study designed using the document analysis method. Document analysis involves the systematic collection, analysis, and interpretation of written materials as a data collection technique (Yıldırım & Şimşek, 2022). In this study, the aim was to evaluate postgraduate theses on creative thinking in the field of educational sciences in Türkiye through content analysis. The research has a descriptive design; the current situation was presented through the classification of theses according to specific categories and the derivation of percentage and frequency distributions from these classifications.

Study Group / Data Set

The data set of the research consists of postgraduate theses on creative thinking prepared in the graduate programs of universities in Türkiye and available in the Council of Higher Education National Thesis Center (https://tez.yok.gov.tr) database. The data were obtained by scanning theses published between 2020-2025 that include the term "creative thinking" in their title or keywords. The identified theses were classified according to various categories such as thesis type (master's/doctoral), publication year, method type, sample group, and associated concepts. While 85 theses were initially accessed, 15 were determined to be outside the field of educational sciences and were excluded. The study continued with the remaining 70 theses.

The data set was structured in an Excel file created by the researcher. Information was coded with one row for each thesis in the file, and conceptual associations were indicated through multiple coding. The scope of the study was clarified by numerically specifying the total number of theses analyzed.

Data Collection Tool and Process

The research data were obtained from the publicly accessible YÖK National Thesis Center database through a qualitative data collection form. The form consists of the following basic components:

- Thesis type (Master's / Doctoral)
- Publication year
- Research method (Quantitative / Qualitative / Mixed)
- Sample type (Student levels, teachers, academics, etc.)
- Associated concepts (problem solving, critical thinking, motivation, creativity, self-efficacy, etc.)
-

Only publicly accessible theses were included in the data collection process. In preparing the data for analysis, the coding form was prepared in accordance with expert opinions and tested with a pilot application.

Data Analysis

The collected data were analyzed using descriptive analysis. Frequency (f) and percentage (%) values were calculated in line with the coded categories; findings were presented in tables. In this context, analyses were conducted for both single variables (such as thesis type, year) and multiple-choice variables (such as associated concepts).

Microsoft Excel 365 and SPSS 25 software were used in the analysis of the data. In multiple conceptual coding, the frequency of selection for each concept was evaluated separately; thus, the distribution of concepts most frequently associated with creative thinking was presented in detail.

Findings

The analysis of postgraduate theses on creative thinking in Turkish educational sciences revealed several significant patterns regarding publication trends, thesis types, target populations, methodological approaches, and conceptual associations. These findings provide valuable insights into the current state of research in this field and highlight areas for future investigation.

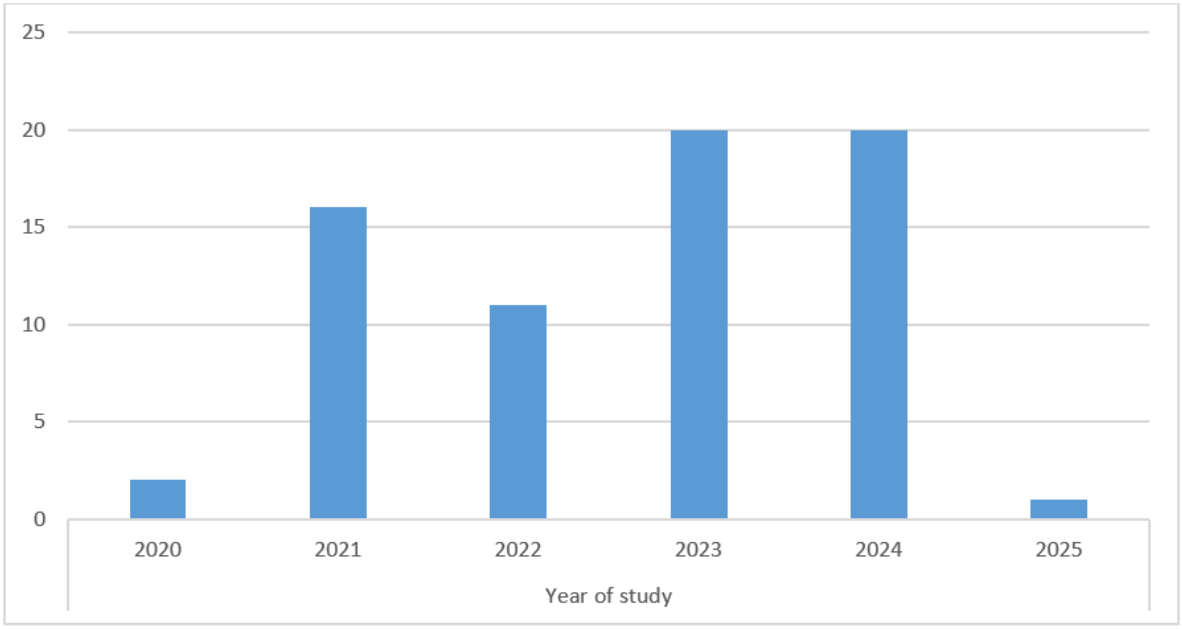

Figure 1. Distribution of Thesis Studies by Year

Theses on creative thinking in Turkish educational sciences increased markedly after 2020, with 71.5% of studies published between 2021-2024. The 2023-2024 surge (28.6% each year) suggests growing academic interest in this domain (Figure 1).

Table 1. Thesis Type Distribution

Type	Frequency	Percent
Doctoral	17	24.3
Master's	53	75.7

The distribution of thesis types reveals that the majority of research on creative thinking in Educational Sciences in Türkiye has been conducted at the master's level (75.7%), with a smaller proportion comprising doctoral dissertations (24.3%). This indicates that creative thinking has garnered significant attention at the graduate

level, although there is comparatively limited engagement at the doctoral level (Table 1). The disparity may reflect institutional emphasis, research feasibility, or topic selection trends within postgraduate education.

Table 2. Target Populations in Creative Thinking Research

Population	Frequency	Percent
Middle school	20	28.6
Undergraduate	16	22.9
Primary school	10	14.3
Teachers	6	8.6
Preschool	5	7.1
High school	3	4.3
Adults	3	4.3
Graduate students	1	1.4

The analysis of target populations shows that middle school students (28.6%) and undergraduate students (22.9%) are the most frequently studied groups in creative thinking research (Table 2). This suggests a strong focus on adolescent and early adult learners in Türkiye. Primary school students (14.3%), teachers (8.6%), and preschool children (7.1%) are also represented, albeit to a lesser extent. The relatively low frequency of studies involving high school students, adults, and graduate students indicates potential gaps in the literature, which future research could address to broaden the scope and generalizability of findings.

Table 3. Methodological Approaches

Method	Frequency	Percent
Quantitative	40	57.1
Mixed	23	32.9
Qualitative	7	10.0

In terms of research methodology, quantitative approaches dominate (57.1%), followed by mixed methods (32.9%) and qualitative studies (10.0%). The prevalence of quantitative designs suggests a preference for measurable outcomes and experimental or quasi-experimental frameworks in assessing creative thinking (Table 3). However, the notable use of mixed methods points to a growing interest in capturing both numerical data and in-depth insights. The limited number of qualitative studies indicates an area for potential development, particularly for exploring the nuanced, contextual, and process-oriented aspects of creative thinking.

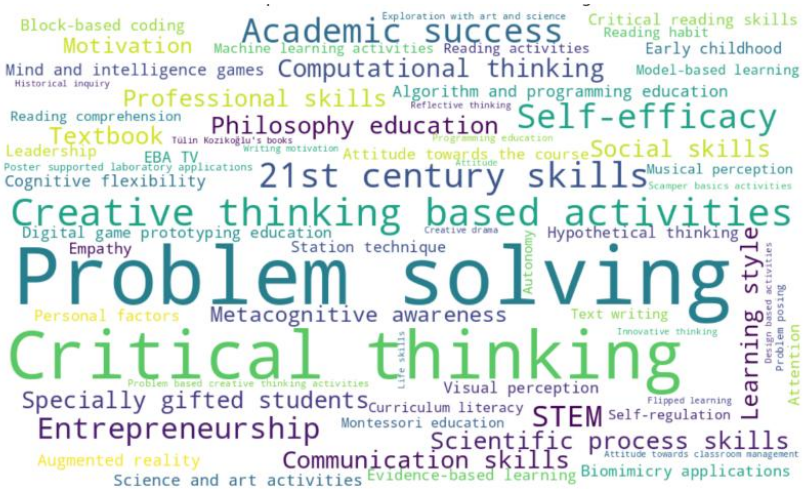

Figure 2. Concepts Associated with Creative Thinking

The word cloud visualizes the concepts most frequently associated with creative thinking in postgraduate theses conducted in the field of Educational Sciences in Türkiye (Figure 2). The size of each term corresponds to its frequency of occurrence in the analyzed corpus, offering insights into the thematic emphasis within the academic literature.

The most prominent concept is "problem solving", which reflects a strong linkage between creative thinking and the application of knowledge to real-world challenges. Closely following are terms such as "critical thinking" and "creative thinking-based activities", both of which underscore the cognitive dimensions of creativity, including analysis, evaluation, and idea generation.

The presence of terms like "21st-century skills", "STEM", "entrepreneurship", "self-efficacy", and "metacognitive awareness" indicates that creative thinking is frequently conceptualized within a broader educational framework that values interdisciplinary competence, learner autonomy, and the ability to adapt to complex and evolving contexts.

Furthermore, the inclusion of affective and socio-emotional variables such as "motivation", "self-regulation", "empathy", and "autonomy" suggests a holistic approach, positioning creative thinking as not only a cognitive process but also an affective and social construct.

Less frequently mentioned but noteworthy concepts include "augmented reality", "machine learning", "block-based coding", "creative drama", and references to children's literature, illustrating the diverse instructional and cultural contexts in which creative thinking is explored.

In summary, the word cloud reveals that postgraduate research in Türkiye adopts a multidimensional perspective on creative thinking, addressing it through cognitive, technological, affective, and pedagogical lenses. This reflects a growing recognition of the complexity of fostering creativity in educational settings and the need for integrative and innovative approaches.

Discussion

The aim of this study was to examine postgraduate theses on creative thinking conducted in Türkiye, in order to identify trends, methodological characteristics, and areas of focus. The findings revealed that the majority of the theses were conducted at the master's level, with fewer doctoral dissertations. Quantitative and mixed methods were preferred more frequently than qualitative approaches. Most studies targeted middle school students, and there was an uneven distribution across educational levels. Additionally, technological tools were underutilized, and studies often focused on limited constructs such as problem-solving or critical thinking.

These results align with previous literature in the field. For instance, Tümer and Aslışen (2022) found a significant increase in thesis production in the creative drama domain after 2019, yet highlighted an over-reliance on master's theses and the predominance of child samples. Similarly, Eğmir et al. (2020), Demirkol and Anılan (2024) reported that studies on creative thinking skills often applied quantitative or mixed methods, using medium-sized samples, and focused on subjects such as Social Studies and Science. Öz and Türkel (2023) noted a growing trend in postgraduate research on creative thinking, especially after 2005, and emphasized that most theses centered on educational themes within the social sciences. They also observed a frequent use of practical techniques like brainstorming and Torrance-based approaches.

Genç (2020) and Saracaloğlu et al. (2014) emphasized methodological limitations in creativity-related theses and articles, including an overuse of descriptive designs, limited diversity in data collection tools (mostly questionnaires and scales), and a dominance of quantitative methods. These patterns also surfaced in the current study. The scarcity of longitudinal, experimental, and interdisciplinary designs suggests a need for broader and deeper investigation into the nature and development of creative thinking skills.

Another important gap in the reviewed theses is the limited attention to the emotional and dispositional dimensions of creative thinking, such as curiosity, willingness to take risks, and coping with failure. These are crucial aspects of creativity, yet they remain underexplored in the academic literature. In addition, the integration of creative thinking with educational technologies and digital literacy remains an open area for development, especially in light of the increasing importance of 21st-century skills.

Conclusion

This study revealed that postgraduate theses in Türkiye on creative thinking are concentrated at the master's level, rely heavily on quantitative or mixed methods, and focus mainly on middle school samples and cognitive variables. Despite a noticeable increase in research output, particularly after 2010, methodological diversity and conceptual breadth appear limited. Emotional, dispositional, and technological aspects of creative thinking remain underrepresented. These findings underline the need for more comprehensive, innovative, and inclusive research designs in this field.

Recommendations

Based on the findings of this study, several recommendations can be made to advance the quality and scope of postgraduate research on creative thinking in Türkiye. First, it is essential to promote more doctoral-level research in the field, as the dominance of master's theses limits the theoretical depth and academic rigor necessary for advancing knowledge. Encouraging doctoral candidates to pursue innovative and comprehensive topics could significantly enrich the literature. Second, greater methodological diversity is needed. Researchers should be supported in designing studies that employ qualitative, longitudinal, and experimental methods to better capture the complex and dynamic nature of creative thinking processes. Third, future research should include a more diverse range of participants. While many existing theses focus on middle school students, there is a need to expand research to early childhood, secondary, and higher education levels in order to understand developmental trajectories and contextual influences more fully.

Another key recommendation is the integration of educational technologies into research on creative thinking. Given the increasing importance of digital literacy and 21st-century skills, exploring the relationship between creativity and tools such as artificial intelligence, programming, digital storytelling, and augmented reality can offer valuable insights. Additionally, there is a need to broaden the conceptual focus of studies to include dispositional and emotional dimensions of creativity—such as curiosity, risk-taking, tolerance for ambiguity, and resilience—which are often overlooked yet play a critical role in fostering creative potential. Lastly, interdisciplinary approaches should be encouraged. Collaborations that draw on psychology, education, neuroscience, and digital pedagogy can offer a richer, more holistic perspective and produce findings that are both theoretically meaningful and practically relevant for contemporary educational settings.

Acknowledgements

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An Analysis of the Relationship between Problem-Solving and Creative Thinking Skills in a Theoretical Context

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Abstract: This study examines the theoretical relationship between problem-solving and creative thinking skills, which are considered essential cognitive competencies for higher education students. The research emphasizes the significance of these skills for academic success, professional development, and lifelong learning while analyzing their interconnectedness from various theoretical perspectives. Through an extensive review of relevant literature, the study reveals that problem-solving and creative thinking are inherently interconnected processes that complement and enhance each other. Problem-solving, particularly for ill-structured problems, requires creative thinking to generate innovative solutions. In contrast, creative thinking employs problem-solving processes in its operational framework. The relationship between these skills is explored through cognitive, neurobiological, and educational lenses, demonstrating their shared underlying mechanisms, such as cognitive flexibility, knowledge restructuring, and establishing novel connections. The study concludes by highlighting the importance of developing these skills in an integrated manner within higher education contexts and recommends the development of assessment tools specifically designed to measure creative problem-solving abilities, which are currently lacking in the field. Additionally, the paper suggests directions for future research, including interdisciplinary investigations of how these skills interact across different domains and an examination of how digital technologies are transforming the nature and application of these critical cognitive abilities.

Key Words: Creative thinking, Problem-Solving, Theoretical Context

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Introduction

The rapidly changing dynamics of contemporary society require higher education students to possess not only domain-specific knowledge but also advanced thinking skills. Among these skills, problem-solving and creative thinking are particularly prominent as essential qualifications for the 21st century (Trilling & Fadel, 2009).

Problem-solving and creative thinking skills are of critical importance for university students for several reasons. First, they provide a competitive advantage in professional life beyond academic success. Research

indicates that employers prefer candidates who have developed problem-solving and creative thinking abilities alongside technical skills (World Economic Forum, 2020).

These skills enhance students' capacity for interdisciplinary work, strengthen their ability to cope with uncertainty, and contribute to the development of lifelong learning habits. Higher education offers an ideal environment for students to acquire these skills.

This study examines the theoretical foundations of problem-solving and creative thinking skills, analyzes the relationship between these two skills from different perspectives, and offers recommendations for future research.

Theoretical Framework

To understand problem-solving and creative thinking skills, it is necessary to first examine the theoretical foundations on which these concepts are based. Both concepts fall within the scope of various disciplines such as cognitive psychology, educational psychology, and organizational psychology.

Problem-Solving: Theoretical Perspectives

Problem-solving is the process of overcoming obstacles to reach a goal. This process includes the stages of identifying the problem, generating alternative solutions, selecting the most appropriate solution, and implementation (Newell & Simon, 1972; Yurt, 2025). One of the most influential theoretical approaches to the problem-solving process was put forward by Gestalt psychologists. Wertheimer (1959) defined problem-solving as a process of gaining insight. According to this approach, the problem solver perceives the problem as a whole and reaches a solution by restructuring the relationships between parts. From an information processing theory perspective, Newell and Simon (1972) conceptualized problem-solving as the process of searching in the problem space to reach from the initial state to the goal state. This approach treats problem-solving as a systematic and step-by-step process.

Within the framework of social cognitive theory, Bandura (1997) drew attention to the importance of self-efficacy beliefs in the problem-solving process. Individuals' beliefs in their problem-solving abilities affect their determination and performance in overcoming challenges they face. According to Sternberg's (1985) Triarchic Theory of Intelligence, problem-solving occurs through the interaction of analytical, creative, and practical intelligence components. This perspective emphasizes that creativity is an important component in the problem-solving process. The development of problem-solving skills can also be examined from the perspective of Vygotsky's (1978) socio-cultural theory. According to this theory, problem-solving skills develop through social interaction, and the individual gradually becomes an autonomous problem solver, requiring less external guidance over time.

Creative Thinking: Theoretical Approaches

Creative thinking is a cognitive process that involves the production of new and valuable ideas, products, or solutions. Torrance (1974) defined creativity as the ability to be sensitive to problems, identify knowledge gaps, search for solutions, make predictions, and communicate results. Guilford (1967), who conducted pioneering work on creativity, established the distinction between convergent and divergent thinking. Convergent thinking aims to reach a single correct answer, while divergent thinking involves generating multiple possibilities. Creativity is particularly associated with the ability to think divergently.

Amabile's (1996) Componential Model of Creativity explains creativity as the interaction of three basic components: domain-relevant skills, creativity-relevant processes, and intrinsic motivation. This model emphasizes that creativity is not only an innate talent but is also influenced by skills that can be developed and motivational factors. Csikszentmihalyi's (1996) Systems Model views creativity as a product of the interaction between the individual, the domain, and the environment. According to this approach, creativity encompasses individual abilities, the knowledge base in a specific domain, and the evaluation process by experts in that domain.

From a metacognitive perspective, Kaufman and Beghetto (2009) examined creativity within the framework of the "Four-C Model": Mini-c (personally meaningful creative insights), Little-c (everyday creativity), Pro-c (professional-level creativity), and Big-C (transformative creativity). This model emphasizes that creativity can emerge at different levels and is a developmental process.

Problem-Solving Skills

Problem-solving is the process by which an individual overcomes obstacles between the current situation and the desired situation to reach a goal. This skill encompasses various cognitive processes such as analytical thinking, logical reasoning, and decision-making.

Stages of the Problem-Solving Process

Dewey (1933), one of the first researchers to systematically examine the problem-solving process, defined this process in five stages:

1. Recognizing and defining the problem
2. Analyzing the problem
3. Proposing possible solutions (developing hypotheses)
4. Evaluating and selecting solutions
5. Implementing the selected solution and evaluating results

Polya (1945) presented a four-stage model for solving mathematical problems: understanding the problem, devising a plan, carrying out the plan, and looking back and evaluating. This model has had an impact beyond mathematics education and has been adapted to general problem-solving processes.

The IDEAL problem-solving model developed by Bransford and Stein (1984) includes five stages: identifying the problem (Identify), defining the problem (Define), exploring solution strategies (Explore), implementing strategies (Act), and reviewing results (Look back). This model emphasizes the importance of metacognitive skills at each stage of the problem-solving process.

Problem-Solving Styles and Strategies

Individuals use different styles and strategies in the problem-solving process. Some individuals adopt an analytical and systematic approach, while others may prefer a more intuitive and holistic approach (Sternberg & Grigorenko, 1997). Problem-solving strategies include narrowing the problem space, setting sub-goals, working backward, leveraging similar problems, and means-end analysis (Mayer, 1992). The effectiveness of these strategies varies depending on the structure of the problem and the individual's cognitive resources.

Development of Problem-Solving Skills

Problem-solving skill is not an innate ability but a competency that can be developed through experience and education. Vygotsky's (1978) concept of the zone of proximal development suggests that individuals can go beyond their current problem-solving capacities with guidance and support. Schön's (1983) concept of "reflection-in-action" emphasizes that effective problem solvers continuously evaluate their own thinking and actions during the process and adapt their strategies when necessary. This reflective practice plays a critical role in the development of problem-solving skills.

In the context of higher education, pedagogical approaches such as problem-based learning, project-based learning, and case studies contribute to the development of students' problem-solving skills (Hmelo-Silver, 2004). These approaches enable students to encounter real-world problems and integrate interdisciplinary knowledge.

Creative Thinking Skills

Creative thinking is a cognitive process that involves the production of new, original, and valuable ideas, products, or solutions. This skill encompasses the ability to think outside the box, develop different perspectives, and establish innovative connections.

Stages of the Creative Thinking Process

Wallas (1926) described the creative thinking process in four stages:

1. Preparation: Researching the problem and gathering relevant information
2. Incubation: Conscious attention is diverted from the problem while processing continues in the subconscious
3. Illumination: The sudden emergence of a new idea (eureka moment)
4. Verification: Testing and developing the idea

This classic model emphasizes that the creative process includes both conscious and unconscious components. Amabile (1996) addressed the creative thinking process in five stages: problem or task presentation, preparation, idea generation, idea validation, and outcome assessment. This model emphasizes the importance of motivational factors in the creative process.

Creative Thinking Techniques

Various techniques have been developed to support creative thinking. Techniques such as brainstorming (Osborn, 1953), SCAMPER (Eberle, 1996), six thinking hats (de Bono, 1985), and TRIZ (Altshuller, 1984) attempt to systematize creative idea generation. The common characteristic of these techniques is that they encourage breaking thought patterns, establishing unusual connections, and developing multiple perspectives. Additionally, they aim to prevent critical thinking from hindering the creative process by separating the evaluation and idea generation stages.

Components of Creative Thinking

Torrance (1974) evaluated creative thinking in terms of fluency (ability to produce many ideas), flexibility (ability to think in different categories), originality (ability to produce unusual ideas), and elaboration (ability to develop ideas). Creative thinking also requires a balanced use of convergent and divergent thinking processes. While divergent thinking is at the forefront during the idea generation phase, convergent thinking becomes important during the evaluation and implementation of ideas (Guilford, 1967).

The Relationship Between Problem-Solving and Creative Thinking Skills

The relationship between problem-solving and creative thinking skills is complex and multidimensional. These two skills can be seen as complementary and mutually nourishing processes.

Problem-Solving and Creative Thinking as Complementary Processes

The most fundamental connection between problem-solving and creative thinking processes is that both involve restructuring knowledge and establishing new connections. Mumford and colleagues (1991) suggested that creativity is essentially a type of problem-solving process. In particular, solving ill-defined problems requires creative thinking. Runco (1994) examined the relationship between problem finding and problem solving and noted that creative individuals excel not only in solving given problems but also in discovering and defining

new problems. From this perspective, the problem-finding process is an important component of creative thinking.

Relationship in Terms of Cognitive Processes

From a cognitive perspective, both problem-solving and creative thinking involve similar mental operations. Both processes require reorganizing existing knowledge, abstract thinking, and creating mental models (Mednick, 1962). Weisberg (2006) proposed that creativity is actually an extension of normal cognitive processes and involves the same basic mechanisms used in the problem-solving process. According to this perspective, the difference between creativity and problem-solving is not qualitative but quantitative.

Different Problem Types and Thinking Styles

Jonassen (2000) classified problem types as well-structured and ill-structured. Well-structured problems (e.g., routine mathematics problems) can generally be solved by following a specific solution path, while ill-structured problems (e.g., social issues) may involve multiple solution paths and answers. Creative thinking plays a more central role in solving ill-structured problems. Such problems require thinking outside the box, developing different perspectives, and trying innovative approaches (Schraw, Dunkle, & Bendixen, 1995).

Creative Problem-Solving Model

The Creative Problem Solving (CPS) model is an approach that integrates problem-solving and creative thinking processes. Developed by Osborn-Parnes and revised by Isaksen, Dorval, and Treffinger (2000), this model includes three main components:

1. **Understanding**: Finding opportunities, exploring data, and clarifying the problem
2. **Idea Generation**: Producing numerous, diverse, and unusual ideas
3. **Preparation**: Developing solutions and planning implementation

This model envisions a balanced use of convergent and divergent thinking processes. At each stage, a broad field of possibilities is first created with divergent thinking, then the most promising options are determined with convergent thinking.

Neurobiological Foundations

In recent years, neuroimaging studies have begun to illuminate the foundations of problem-solving and creative thinking processes in the brain. The prefrontal cortex and default mode network of the brain play an active role in both processes (Beaty, Benedek, Silvia, & Schacter, 2016). Strong connections between different regions of the brain are important in creative thinking and problem-solving processes. This facilitates the combination of information in new and unusual ways (Jung et al., 2013).

Conclusions and Recommendations

This study has examined the theoretical relationships between problem-solving and creative thinking skills. The literature reviewed indicates that these two skills are inseparably linked and complement each other. The problem-solving process, especially in ill-defined and complex problems, requires creative thinking. Similarly, creative thinking encompasses the stages of the problem-solving process. Both skills rely on common cognitive mechanisms such as cognitive flexibility, restructuring of knowledge, and establishing new connections.

In an educational context, it is important to develop problem-solving and creative thinking skills in an integrated manner. The creative problem-solving approach provides an effective pedagogical framework that combines these two skills. Higher education institutions should create learning environments that allow students to develop these skills. For future research, it is recommended to develop valid and reliable tools for measuring creative problem-solving skills. Existing measurement tools generally evaluate either problem-solving or creative thinking skills separately. However, an integrated assessment of these two skills would better reflect students' performance in real-life situations.

Additionally, it is suggested to conduct interdisciplinary research examining how problem-solving and creative thinking skills interact in different disciplines. Each discipline has its own unique problem types and solution methods. Understanding these differences will contribute to the development of discipline-specific creative problem-solving approaches. Finally, research should investigate how digital technologies affect problem-solving and creative thinking processes. Developments in artificial intelligence and information technologies are changing the nature and importance of these skills. In the future, creative problem-solving processes based on human-machine collaboration are expected to become even more important.

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MCQs as a Strategy for Authentic Assessment in the Era of AI Advancements

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Abstract: The rapid advancement of artificial intelligence (AI), particularly large language models (LLMs), has disrupted traditional educational assessment. These models can generate human-like texts, allowing students to produce convincing work without genuine understanding, revealing the weaknesses of assessments that emphasize knowledge recall over application. As a result, educators face growing challenges in evaluating authentic learning and intellectual capacity. This study argues that education must integrate AI collaboration rather than resist it. Continuing to assess skills from a pre-AI era is equivalent to prioritizing handwriting in a digital world. The unprecedented capabilities of AI demand a shift in teaching, learning, and assessment to ensure relevance in the AI age. In this transformed context, human strengths such as creativity, knowledge application, and decision-making become critical. Success will depend on the ability to think creatively, apply knowledge effectively, and make sound judgments alongside AI systems. The paper explores multiple-choice questions (MCQs) as an adaptable and reliable assessment strategy for this new environment. Despite their limitations, well-designed MCQs can measure higher-order thinking, resist AI manipulation, and complement other assessment methods. Integrating MCQs within a broader evaluation framework ensures fairness, efficiency, and authenticity in assessing student learning in the era of artificial intelligence.

Keywords: Assessments, Conventional Assessment Methods, Multiple Choice Questions, Educational Objectives, Artificial Intelligence Collaboration.

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Introduction

The rapid advancement of AI, particularly LLMs like ChatGPT-4, has disrupted various sectors, including education. These models can generate essays, answer complex questions, and even write code with remarkable proficiency. This capability presents a significant challenge to traditional assessment methods, especially those relying on free-form written responses, as students can easily use these tools to produce work that appears to be their own. This raises concerns about academic integrity and the validity of assessments in evaluating real student learning (Ashraf, 2021; Khan, 2018).

Despite AI's multiple capabilities in the present context, it is important to understand what cognitive skills of students are required to be assessed in any context (Hussain, 2023; Khan, 2024). Bloom's Taxonomy explains several such skills, which have been accepted by many education systems in all parts of the world (Krathwohl, 2002).

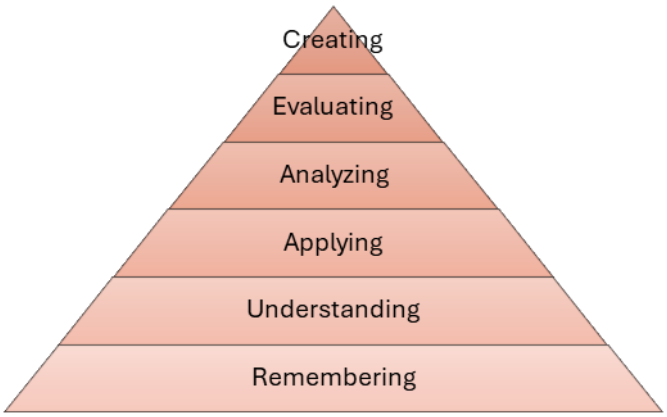

Figure 1: Revised Bloom's Taxonomy

While the concept is broadly applicable across disciplines, its scope varies with the student's level of study. In school education, for instance, the foundational cognitive skills of remembering and understanding are typically addressed at all levels. Application, analysis, and evaluation are introduced at a basic level, commensurate with the subject's depth (Khan, 2018). Notably, assessments of creativity at this stage generally do not require novel tasks. In the contemporary context, AI can facilitate the acquisition of these skills. However, student performance will still differ based on the specific AI tools employed and the effectiveness of their interaction with those tools.

The concept's application varies by student level. In school, basic cognitive skills are universal, while higher-order skills are introduced gradually. AI aids skill acquisition, but individual performance differs based on AI tool usage and interaction.

A debatable question arises as to whether it is necessary to test the students on certain knowledge attributes for which an AI will easily perform in an AI-dominated environment. One can argue that this could be a similar situation where teaching strategies try to improve the clear handwriting skills of students in an era of Digital typing that has completely dominated. Besides, when the AI-assisted processing, analyzing, and evaluations are incomparably faster than humans, the time allocated for teaching, learning, and assessments has to be restructured to make them faster as well. Failure to adhere to this phenomenon will affect the students' outputs due to unnecessary non-engagement periods (Mishra, 2024).

The ability of AI to process, analyze, and generate text challenges the validity of traditional assessment criteria. This raises the question of which learner attributes should be evaluated in the AI-driven era and how assessments can be effectively redesigned to address these changes.

Objectives

1. To understand the challenges posed by traditional assessment methods in the AI era.
2. To identify strategies, including potential amendments such as time allocation adjustments, and to determine the knowledge attributes that should be prioritized for assessment in an AI-dominated era.
    - Focus areas: time factors across teaching, learning, and assessment strategies; knowledge, knowledge communication, decision making, and knowledge application.
3. To explore the potential of MCQs as an effective assessment strategy within the AI-driven educational landscape.

Research Questions

1. How has AI influenced and challenged traditional assessment methods?
2. What key learner attributes (under knowledge, communication, and application) should be prioritized for assessment in the AI-driven era?
3. What are the advantages and limitations of MCQs in assessing these key knowledge components?
4. How can MCQs serve as a reliable alternative or complement to traditional assessment methods, particularly considering:
    - Time factor
    - Accessibility of all target learner attributes
5. How can MCQs be designed to effectively assess *higher-order thinking skills?*

Literature Review

A comprehensive review of recent literature was conducted to address the research questions and to develop the conceptual framework for this study. Artificial Intelligence is significantly transforming education, particularly in areas such as data analysis and personalized instruction. However, its role in enhancing human critical

thinking is still evolving (Bengio, 2024; Seldon, 2024). While AI can process vast information and simulate creative outputs, it lacks core aspects of human cognition, such as emotional depth, creativity, self-awareness, and the ability to form independent opinions (Butlin, 2023; Lou, 2023).

Unlike humans, whose thoughts evolve dynamically through personal experiences, emotional inputs, and shifting perspectives, AI operates through programmed logic and pattern recognition (Ismayilzada, 2024). Even when AI simulates emotion, it is only an illusion, pre-programmed to imitate emotional intelligence without genuinely experiencing it (Butlin, 2023; Elyoseph, 2023). Therefore, although AI may complement human creativity, it is unlikely to replace it (Magni, 2024).

Current discourse emphasizes the need for humans to collaborate with AI rather than resist it. Educational transformation must therefore focus on integrating AI to augment, not override, human potential. This involves fostering competencies such as AI literacy, emotional intelligence, critical thinking, and the ability to communicate knowledge effectively (Lou, 2023; Oritsegbemi, 2023). These interdisciplinary skills are increasingly seen as crucial for thriving in an AI-integrated academic and professional world (Ismayilzada, 2024; Magni, 2024).

Impact of AI on Education and Assessment

AI significantly affects education, especially student learning and assessments. Tools like automated grading and AI-generated content enable personalized learning but raise concerns about academic integrity (Sullivan, 2023; McGrath, 2023). The ease of producing AI-generated assignments challenges traditional methods in ensuring originality.

Challenges with Traditional Assessment Methods

Essays and written assignments have long been a cornerstone of education, but they now face significant challenges in the age of AI. With students able to generate entire essays using AI tools, it is becoming harder to ensure the originality of their work (Rodway, 2023; Yusuf, 2024). At the same time, traditional assessments often focus more on memorization than on applying knowledge to real-world situations (Yeganeh, 2025). As education increasingly emphasizes skills like problem-solving and critical thinking, it's fair to question whether these conventional methods still meet the needs of today's learners.

Time Factor and Non-Engagement Period

Another significant challenge in the AI-driven educational landscape is the management of time. AI tools have expedited research and writing processes, making traditional extended deadlines less relevant (Wang, 2023). Students often complete assignments rapidly and then disengage during the remaining time, which negatively affects learning outcomes. Research suggests that shorter, structured deadlines improve cognitive engagement

and creativity (Yu, 2023), helping students adapt to the fast-paced environments influenced by AI and automation. Moreover, in an era where adaptability and speed are critical, prolonged timelines may underutilize the most valuable resource, i.e., time, by reducing the productive pressure that stimulates cognitive readiness (Gunkel, 2019; Miailhe, 2017).

Need for Rethinking Assessment Models

Simply discouraging AI use in assignments is no longer sufficient. Conversely, over-reliance on AI risks undermining educational objectives unless assessments are designed to evaluate knowledge application and communication skills (Nuovo, 2006). Integrating traditional assessments with oral exams, practical applications, and presentations can help distinguish authentic student work from AI-generated content. However, it's crucial to ensure these methods effectively foster contemporary competencies such as creativity, decision-making, knowledge application, communication, and the ability to perform under appropriate time constraints. In this context, developing timely, efficient, and effective assessment strategies is increasingly necessary (Gaytan, 2007; Wang, 2007).

Multiple-Choice Questions (MCQs) in Education

While oral tests and presentations provide depth, they are resource-intensive and susceptible to biases. MCQs offer efficient, objective, and scalable assessment tools ideal for AI-influenced environments. Though often criticized for focusing on recall (Anderson, 1981) Modern MCQs can assess higher-order skills like analysis, synthesis, and application.

This paper explores how well-designed multiple-choice questions (MCQs) can resist AI manipulation, potentially more effectively than open-ended tasks, particularly when incorporating complex reasoning, scenario-based challenges, and visual elements like diagrams or real images (Bengio, 2024; Farhi, 2023). Because current AI models lack true contextual understanding and decision-making capabilities, MCQs can promote more authentic engagement (Yeganeh, 2025). Some of the suggestions for adjusting conventional MCQs that meet the requirements are given in the latter part of this section.

Additionally, MCQs mirror real-world decision-making processes, preparing students for environments where rapid analysis and judgment are critical (Madri, 2023; Newton, 2023).

Restructuring Assessments for AI-Enhanced Education

Having accepted the fact that education must restructure assessments to protect academic integrity while nurturing essential cognitive skills, this paper will explore how MCQs, combined with other suitable methods, can effectively assess the needed knowledge components. The goal is not to replace traditional methods entirely but to strategically integrate MCQs, ensuring fair, efficient, and adaptable assessments for the AI era.

Proposed Conceptual Framework to Bring MCQ as a Remedy for AI-Influenced Educational Misconduct in Higher Education

Based on the identified challenges and insights from the literature, the following conceptual framework is structured as a pathway to address the need for new assessment methods in an AI-influenced educational environment. The framework combines traditional assessments with AI-assisted MCQs to better evaluate key cognitive components, namely: creativity, knowledge application, decision-making, and knowledge communication, that are critical for students in an era where AI tools are becoming increasingly prevalent.

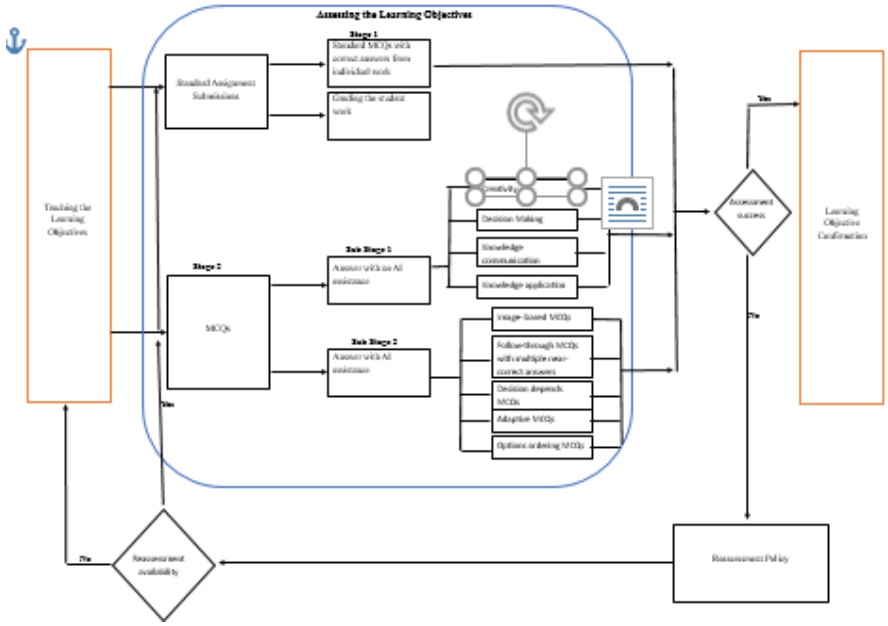

Figure 2: Conceptual framework: bifocal assessment strategy

Key Cognitive Components to Assess in the AI-Influenced Era

While additional knowledge elements may be relevant in an AI-influenced educational environment, this effort identifies four core cognitive components as increasingly essential for individuals to use AI productively and responsibly.

1. Creativity – The ability to generate original ideas and adapt solutions beyond AI-generated outputs (Ismayilzada, 2024).
2. Knowledge Application – The skill to apply theoretical knowledge in dynamic, real-world settings where AI tools serve as support systems rather than replacements (Jarrahi, 2023).
3. Knowledge Communication – The capacity to clearly articulate understanding, explain reasoning, and evaluate AI outputs in collaborative contexts (Tsui, 2000).
4. Decision-Making – The human judgment needed to select appropriate AI tools, validate their outputs, and make ethical, context-sensitive choices (Duan, 2019; Phillips-Wren, 2012).

These components are critical to ensure that learners are not merely passive consumers of AI but active, thoughtful users who can amplify their intellectual capabilities in a digital age.

The Bifocal Assessment Framework

To evaluate these cognitive components, the framework introduces a *bifocal assessment model*, combining traditional assessments with AI-assisted MCQs. This hybrid approach allows for a more comprehensive and dynamic assessment of students, moving beyond Memory-based learning to provide a deeper understanding of their cognitive abilities.

Stage 1: Restructured Traditional Assessments

The first stage of the model involves rethinking traditional assessments, such as essays and reports. The key strategies for this channel are:

Shortened Deadlines: By reducing the time allowed for assignments, students are encouraged to engage with the material more actively and think critically. This prevents passive learning while relying on AI tools for completing tasks.

MCQ Pairing with Individual Submissions: After submitting an individual assignment, students will answer a set of pre-generated MCQs with correct answers based on the student's work. While the questions are common and aligned with the learning objectives of the assignment (to ensure fairness within the entire cohort), the correct answers for the questions could be extracted from the respective student's work, simply with AI assistance. The student then answers these questions to demonstrate their understanding of the submission. This pairing ensures that students engage deeply with their work and comprehend the material while mitigating biases and inconsistencies inherent in viva assessments. Other expected advantages are faster evaluation and confirmation of meeting the learning objectives. However, it is important to note that a weightage can always be decided for the students' output based on the scope and depth of the subject matter, although it is encouraged to provide limited scopes.

Stage 2: Cognitive MCQ Assessments

The second stage of the framework focuses on structured MCQs designed to assess creativity, knowledge application, and knowledge communication. This stage is split into two distinct sub-stages:

Sub-stage 1: Direct MCQ Assessment

This route evaluates students directly through MCQs designed to test their creativity, decision-making, knowledge application, and communication skills. These questions require students to apply their knowledge in

new, complex contexts, testing critical thinking and problem-solving abilities. For example, scenario-based MCQs require students to apply learned concepts to real-world problems, moving beyond simple factual recall (Azer, 2003).

Sub-stage 2: MCQs to answer with AI assistance

In this sub-stage, students have the opportunity to use AI tools to assist in answering MCQs. However, due to AI's limitations, such as challenges with interpreting images or making nuanced decisions, students must possess the required essential understanding of the subject and be able to effectively communicate with AI to reach accurate results. Key features of this stage include:

Image-Based MCQs: AI may struggle to interpret real-time images, sketches, or local visuals the same way humans do. As a result, students will need to clearly describe and interpret these images in order to communicate with the AI effectively. Without this clear communication, the AI won't be able to provide accurate answers, requiring students to rely on their insights to complete the assessment.

Follow-Through MCQs with Multiple Near-Correct Answers: MCQs that include two or more near-correct options or extend beyond the typical three to four choices require students to make nuanced decisions under time pressure. These formats reduce overreliance on AI by demanding deeper reasoning and greater engagement with the material. While AI can provide strong analyses of answer choices, the student must ultimately apply their knowledge to select a final answer, especially when subsequent questions depend on that choice (the *Decision-Dependent MCQ Models*). For example, the subsequent question would be asking the reason why you picked this option. Overdependence on AI may also lead to time-management issues during assessments. Notably, restricting copy-paste functionality on exam platforms can further promote students' ability to communicate knowledge independently.

Adaptive MCQs and Decision-Dependent MCQ Model: Besides the Decision-Dependent MCQ Models discussed above, a key feature of this pathway is the use of Adaptive MCQs, which adjust in complexity and content based on the student's previous responses. If a student demonstrates proficiency, subsequent questions may delve deeper into more complex aspects of the material (Sullivan, 2023). This ensures personalized, adaptive learning.

Options Ordering Questions: Another evolving approach is asking students to rank or order options based on their relevance or severity within a scenario. These strategies ensure that, even in AI-assisted environments, student performance reflects real comprehension, communication skills, and the ability to work effectively under pressure.

This framework introduces an innovative approach to student assessment by integrating traditional methods with AI-assisted and AI-resistant MCQs. Notably, many of these MCQs will themselves be generated with the

support of AI. By targeting creativity, knowledge application, decision-making, and communication skills, the framework promotes deeper student engagement while reducing the risk of AI-driven academic misconduct. Its dynamic and adaptive structure ensures personalized assessment, fostering critical thinking and problem-solving abilities essential in an AI-driven world. The following methodology chapter will examine the conceptual feasibility and acceptance of this framework. If successful, the research will proceed to prototype development, modeling the assessment strategy through AI integration

Methodology

Given the innovative nature of this research, the Delphi method has been chosen as the primary approach to assess the feasibility and conceptual effectiveness of the proposed framework. The Delphi method is a structured process that gathers expert opinions through iterative rounds, refining responses until a consensus is reached (Okoli, 2004). This approach is particularly valuable for evaluating emerging educational models, as it allows for rigorous examination without the immediate need for large-scale implementation. While a full empirical application of AI-assisted MCQ concept would require extensive time, effort, and financial investment, it is essential to first establish the theoretical soundness of the approach. To ensure the framework is thoroughly evaluated before a potential real-world application, this study engages subject-matter experts (SMEs) in AI, education, and assessment design to critically examine and refine the concept.

Participants

The expert panel consisted of professionals with expertise in higher education assessment, AI-assisted learning, and psychometrics. Experts were selected based on their research contributions, professional experience, and familiarity with AI's role in education. The initial pool consisted of 15–20 participants, ensuring diversity in expertise while maintaining manageability in iterative rounds.

The collection of data involved two key components, which are as follows:

Questionnaire-Based Feedback

Experts were provided with structured questionnaires incorporating Likert-scale items, Yes/No questions, and open-ended prompts to gauge their perspectives on AI-generated MCQs as an assessment tool.

Iterative Refinement

The Delphi method involves two rounds of expert feedback to refine insights and ensure consensus. The Delphi method is particularly suitable for evaluating emerging educational models in their conceptual phase before empirical testing, as it accommodates expert consensus without requiring immediate large-scale trials.

Round 1: Initial Survey and Expert Input

In Round 1, experts provided their initial feedback on the proposed framework using the questionnaire. This round focused on gathering quantitative and qualitative data to assess the conceptual feasibility and effectiveness of the suggested framework of the MCQs strategy in assessments.

Quantitative Data: Likert-scale responses and Yes/No questions provided numerical feedback on various aspects of the framework, such as its fairness, practicality, and alignment with educational goals.
Qualitative Data: Open-ended questions allowed experts to share more in-depth views, concerns, and suggestions for improvement.

Responses from Round 1 were analyzed to identify key themes, areas of agreement, and areas requiring refinement. This analysis formed the basis for the second round of feedback.

Round 2: Feedback Integration and Refinement

In Round 2, experts were provided with a summary of the Round 1 responses, including aggregated quantitative data and categorized qualitative feedback. Experts were asked to reassess their initial opinions, considering the input from other participants, and to refine their perspectives.

The goal of Round 2 was to address concerns raised in Round 1 and to further refine the proposed framework based on collective expert insights.

Data Analysis

The analysis approach combined both quantitative and qualitative techniques:

1. Quantitative Analysis: Likert-scale and Yes/No responses were analyzed using descriptive statistics, including mean scores, standard deviations, and frequency distributions. If applicable, comparative analyses were conducted to examine variations in responses across different expert backgrounds.

2. Qualitative Analysis: Open-ended responses were thematically categorized to identify recurring patterns, concerns, and recommendations. Thematic analysis was conducted to ensure that subjective insights were systematically captured and integrated into the study's findings.

3. Consensus Measurement: The stability of expert responses across rounds was assessed using statistical measures such as interquartile range (IQR) or standard deviation to determine the level of agreement.

Ethical Considerations

To ensure ethical integrity, participants were informed about the study's purpose, data confidentiality, and their right to withdraw at any stage. Responses were anonymized to promote candid feedback and reduce biases, which is a characteristic of the selected Delphi method.

Synthesis and Final Report

After Round 2, a final synthesis of the expert feedback was conducted. This will include identifying areas of strong agreement and addressing any remaining points of divergence. The final report summarized the consensus on key aspects of the AI-assisted MCQ framework, suggested improvements based on expert input, and outlined any further steps for refining the framework or conducting additional rounds. The practical implication, which is the larger project and the subsequent research, will be based on this outcome.

Findings

Introduction to Round 1

In Round 1 of the Delphi study, experts were asked to provide their views on the use of AI-generated MCQs based on students' assignments, cognitive elements relevant to AI-enhanced assessments, and adaptive MCQs that adjust to students' responses. This round aimed to gather initial feedback on how these methods might impact engagement, learning, and the efficacy of assessment. Based on the Questionnaire developed for round 1, the responses are summarized below.

Table 1. Round 1 Delphi Responses (N = 20 Professionals)
(Responses are based on a Likert scale: 1 = Strongly Disagree, 5 = Strongly Agree)

Question (refer)	Mean Score	Std Dev	Comments Summary
Cognitive Elements Evaluation	N/A	N/A	Creativity, Knowledge Application, and Critical Thinking were most commonly selected. Some debate on assessing creativity through MCQs.
Stage1: AI-Generated MCQs Based on Individual Assignments			
3. Engagement with own work	4.1	0.9	General agreement, though some concerns about AI-generated MCQs being superficial.
4. Preventing AI misuse in assignments	4.3	0.8	Strong agreement: most believe it could help but worry about students finding loopholes.
5. Reducing assignment time due	0.85	0.4	Mixed responses—some believe it would improve

Question (refer)	Mean Score	Std Dev	Comments Summary
to AI			efficiency, while others worry about superficial learning.
6. Reducing idle time and increasing engagement	3.9	1.0	Agreement, but some think AI use could lead to disengagement in other ways.
7. Challenges (Open-ended)	N/A	N/A	Concerns over AI's ability to generate meaningful MCQs, academic integrity, and AI biases.
Stage 2: Cognitive MCQs (Without AI Assistance)			
8. Higher-order thinking MCQs as alternatives	4.0	1.0	Strong agreement, but some prefer a mix of MCQs and short-answer questions.
9. Improvements (Open-ended)	N/A	N/A	Suggestions include incorporating explanations in MCQs and combining with short-answer formats.
Sub-stage 2: AI-Assisted MCQ Pathway			
10. Encouraging critical AI evaluation	4.2	0.8	Most agree but caution that students may still rely on AI excessively.
11. Visual elements enhancing AI-assisted MCQs	0.72	0.5	Mixed responses; some see it as helpful, others think it adds complexity.
12. Challenges (Open-ended)	N/A	N/A	Accessibility issues, AI reliability, and need for teacher training identified as concerns.
Adaptive MCQs with Increasing Complexity			
13. Measuring progressive learning	4.3	0.7	Strong agreement that adaptive MCQs effectively track learning progress.
14. Comparing adaptive vs. fixed-difficulty MCQs	4.4	0.6	Strong agreement that adaptive MCQs are superior for assessing deeper understanding.
15. Accuracy in assessing individual capabilities	0.88	0.3	Agreement, but concerns about increased student stress with rising difficulty.
16. Recommendations (Open-ended)	N/A	N/A	Fairness, balancing difficulty, and providing feedback loops highlighted as key factors.

Table 2. Responses to Yes/No Questions in Questionnaire 1

Question No	Question	Mean Score (Round 1) (Yes)	SD (Round 1) (Yes)
2	Should traditional assignment time allocations be shortened as they are produced within much shorter periods with AI assistance?	0.82	0.45

Question No	Question	Mean Score (Round 1) (Yes)	SD (Round 1) (Yes)
5	Should traditional assignment time allocations be shortened as they are produced within much shorter periods with AI assistance?	0.85	0.36
11	Since AI cannot perceive information in the same way humans do, would integrating visual elements (e.g., locally produced diagrams) enhance the effectiveness of AI-assisted MCQs?	0.65	0.48
15	Would implementing adaptive MCQs improve the accuracy of assessing individual student capabilities?	0.92	0.28

Further Analysis and Transition to Round 2

In Round 1 of the Delphi study, expert responses highlighted strong support for using AI and MCQ-based methods to assess cognitive skills, though opinions varied depending on context. While 70% of participants believed that all selected cognitive elements such as knowledge application and critical thinking could be assessed through advanced MCQs, concerns remained about evaluating creativity and complex problem-solving.

There was notable agreement on the effectiveness of AI-generated MCQs in promoting engagement and reducing academic dishonesty, with mean scores above 4.0 on relevant Likert-scale items. However, experts were divided on issues such as shortening assignment time (M = 0.85) and integrating visual elements into assessments (M = 0.72), suggesting the need for flexible implementation strategies. Adaptive MCQs received strong endorsement (M = 0.88), particularly for their capacity to measure progressive learning and individual capabilities.

Based on these results, Round 2 was designed to deepen the inquiry into the cognitive elements, two stages, and sub-stages identified in Round 1. Experts were invited to re-evaluate the appropriateness of these elements and assessment formats, focusing specifically on the feasibility of reducing assignment time, the effectiveness of adaptive MCQs, and the use of visual enhancements in AI-assisted assessments. Round 2 was initiated through ‘Questionnaire 2’ using the exact insights gained from Round 1. It is noted that, not all individual question responses are presented here in order to maintain focus and avoid unnecessary length in the paper.

Round 2 Responses

Having distributed the updated Questionnaire with the outcome of ‘Round 1, below are the results obtained from expert feedback in Round 2. Changes in Mean Scores and Standard Deviations reflect shifts in opinion after refinement discussions.

Table 3. Responses to rated Questions in Questionnaire 2

Question No.	Question	Mean Score (Round 1)	Standard Deviation (Round 1)	Mean Score (Round 2)	Standard Deviation (Round 2)	Comments Summary (Round 2)
1	Would AI-generated MCQs help ensure students engage with their own assignments?	4.35	0.72	4.50	0.65	Further strengthened the agreement, reinforcing AI-generated MCQs as a viable engagement tool.
2	Would the use of visual elements enhance the effectiveness of AI-assisted MCQs?	3.85	0.89	4.10	0.78	Slight improvement after discussions on the strategic integration of visuals. More clarity is needed on specific implementations.
3	Should AI-generated MCQs be part of regular assessments?	4.70	0.58	4.75	0.55	Consensus improved. Experts support integrating AI-generated MCQs into standard assessments.
4	Would this approach reduce the risk of students submitting AI-generated assignments without understanding their content?	4.20	0.75	4.30	0.70	Slight increase in agreement, with additional emphasis on question design to counter shallow AI-generated responses.
5	Would shortening time allocation for assignments improve students' continuous engagement by minimizing unnecessary idle time?	4.10	0.80	4.15	0.78	Experts support controlled reductions in assignment time but suggest subject-specific adjustments.
6	Do you think MCQs	4.55	0.66	4.60	0.60	Strengthened consensus

Question No.	Question	Mean Score (Round 1)	Standard Deviation (Round 1)	Mean Score (Round 2)	Standard Deviation (Round 2)	Comments Summary (Round 2)
	designed for higher-order thinking (e.g., decision-dependent MCQs) are a valid alternative to traditional assessment methods?					on the effectiveness of higher-order MCQs as an alternative.
7	Do you believe adaptive MCQs are an effective method for measuring progressive learning?	4.45	0.69	4.50	0.63	Experts reinforced the validity of adaptive MCQs in tracking student progress.
8	Do you believe adaptive MCQs would improve the accuracy of assessing individual student capabilities?	4.20	0.72	4.35	0.67	Consensus strengthened, but suggestions for refining algorithms to better align with learning objectives.
9	Do you think AI-assisted MCQs encourage students to critically evaluate AI-generated responses?	4.50	0.62	4.55	0.58	Slight increase in agreement, with emphasis on improving question structuring for deeper critical thinking.

Table 4. Responses to Yes/No Questions in Questionnaire **2**

Question No.	Question	Mean Score (Round 1) (yes)	Standard Deviation (Round 1) (Yes)	Mean Score (Round 2)	Standard Deviation (Round 2)	Comments Summary (Round 2)
5	Should traditional assignment time	0.85	0.36	0.87	0.34	Stronger agreement but

Question No.	Question	Mean Score (Round 1) (yes)	Standard Deviation (Round 1) (Yes)	Mean Score (Round 2)	Standard Deviation (Round 2)	Comments Summary (Round 2)
	allocations be shortened as they are produced within much shorter periods with AI assistance?					with suggestions to allow flexibility based on assignment type.
11	Since AI cannot perceive information in the same way humans do, would integrating visual elements (e.g., locally produced diagrams) enhance the effectiveness of AI-assisted MCQs?	0.65	0.48	0.72	0.42	Increased agreement, but concerns remain about consistency in applying visual elements effectively.
15	Would implementing adaptive MCQs improve the accuracy of assessing individual student capabilities?	0.92	0.28	0.93	0.27	Almost unanimous agreement on the benefits of adaptive MCQs in improving assessment accuracy.

Summarized Open-Ended Feedback

Visual Elements in AI-assisted MCQs

- Experts acknowledge the potential of visuals but stress the need for well-structured visual-based MCQs.
- Some recommend subject-specific guidelines for effective use of diagrams and images.
- Concerns exist about accessibility and the technical feasibility of integrating visuals into automated assessment platforms.

Time Allocations for Assignments

- Experts generally support reducing assignment time but propose differentiated time reductions based on subject complexity.

- Some suggest providing guidance to students on how to allocate time effectively when using AI tools.
- Adaptive deadlines based on student performance could be explored in future studies.

Refinements for Adaptive MCQs

- Strong agreement on their effectiveness, with suggestions to further refine real-time adaptability to students' responses.
- Recommendations to further analyze how AI-driven MCQs align with course objectives and learning outcomes.
- Need for case studies comparing adaptive MCQs with traditional assessments to validate their efficiency further.

Additional Considerations

- Some experts highlight the importance of balancing AI-assisted assessment with human evaluation to ensure holistic learning.
- Include features that explain how AI-generated MCQs are created, so students understand the reasoning behind each question.
- Continued refinement of question difficulty levels to match student capabilities without excessive reliance on AI.

Discussion

The findings from Round 1 of the Delphi study offer valuable insights into the potential of AI-generated and adaptive MCQs for enhancing assessment practices in higher education. In alignment with the research objectives, the study highlights key areas where AI tools can address challenges in traditional assessment methods and improve learning outcomes. The results also underscore the importance of balancing AI integration with human oversight to preserve academic integrity, fairness, and the effectiveness of assessments.

AI-Generated MCQs Based on Student Work

This step showed strong potential in enhancing engagement. The positive response to their ability to engage students with their own assignments suggests that AI tools could personalize learning, fostering a deeper understanding of content. However, concerns regarding the limitations of AI in assessing In-depth knowledge and critical thinking were highlighted. While AI can provide tailored questions, it might struggle to capture the depth of higher-order cognitive processes such as creativity, decision-making, and problem-solving. However, this could be tested during a real-world pilot study.

Discussion on AI Misuse

The response also indicated that while AI-generated MCQs could reduce the risk of students submitting AI-generated assignments without understanding their content, academic integrity remains a concern. Promoting authentic student engagement necessitates refining AI-generated content to preserve assessment depth. Standardizing making learning objective oriented MCQs are very crucial in this regard.

Cognitive MCQs (Without AI Assistance)

Response to this element of assessment indicated a mixed but generally positive viewpoint. Experts recognized the utility of MCQs for assessing knowledge application and critical thinking, particularly when designed to assess higher-order thinking (e.g., decision-dependent MCQs). However, feedbacks indicated that MCQs may not fully capture more complex cognitive elements such as creativity or constructive problem-solving knowledge. A blend of MCQs with short-answer questions was suggested to provide a more holistic assessment approach.

AI-Assisted MCQs Answered in AI Assisted Environments

This element received strong support for their potential to promote critical thinking and independent judgment. However, concerns about excessive reliance on AI and the need for adequate teacher-training for these set ups, were raised as a concerned. Implementing AI tools effectively would require ensuring that students do not passively accept AI-generated responses, but instead critically evaluate them, thereby encouraging active learning.

Adaptive MCQs

This is significant part of the Stage 2, sub-stage 2. Experts agreed that adaptive MCQs could measure progressive learning effectively, with the flexibility to adjust difficulty based on student performance. This adaptability allows for a more personalized assessment of student capabilities and ensures a better match between the level of difficulty and the student's understanding. However, experts also warned that increasing the difficulty too much could cause student stress, so adaptive MCQs need to be designed to challenge students while still offering enough support.

Conclusion

The rapid advancement of AI presents both challenges and opportunities for higher education assessment. Traditional methods struggle to keep pace with AI’s capabilities, raising concerns about academic integrity, engagement of students, and the effectiveness of student evaluation. In response, this study has explored the potential of MCQs as a viable assessment strategy, leveraging AI’s capabilities while maintaining fairness and

objectivity. The structured yet adaptable nature of MCQs allows them to test cognitive abilities such as creativity, knowledge application, decision-making, and communication, which are essential skills in the AI-driven era.

One can propose traditional assignment-based assessments to be evaluated as-is by AI to improve efficiency. This could still be debatable, as it will not effectively engage students, assess their true understanding, or differentiate their contributions from AI-generated content. Relying on AI detectors and discouraging AI use are neither practical nor sustainable, as AI technologies continuously evolve by making detection methods obsolete. Rather than engaging in an endless cycle of countermeasures between artificially humanized AI contents and AI content detectors, a more effective approach is to assess the students' ability to understand, interpret, and apply AI-generated contents successfully. In that context, AI-generated MCQs are a good strategy to serve this purpose efficiently, aligning with modern time constraints while ensuring meaningful evaluation as well.

Given the growing need for scalable and efficient assessment methods, integrating AI-assisted MCQs offers a forward-thinking solution. This approach not only preserves academic integrity but also enhances learning outcomes by shifting the focus from mere content generation to critical engagement with AI-generated knowledge. Future research should explore pilot studies incorporating AI-assisted assessment models under this proposed framework, provide empirical evidence for their effectiveness and refine their implementation in higher education.

More broadly, this highlights a key cognitive element that humans should develop in the AI era: understanding, interpreting, and applying AI-generated knowledge. Rather than resisting AI, the focus should be on integrating it meaningfully while ensuring that human cognitive skills remain central. As AI continues to reshape education, frameworks like the one proposed here offer a strategic roadmap for aligning assessment with the demands of a digitally integrated world.

Recommendations

Based on the findings and the discussion, the following recommendations are proposed for integrating AI-generated and adaptive MCQs into higher education assessments:

Implementation of AI-Generated MCQs

Institutions should consider incorporating AI-generated MCQs as a supplementary assessment tool, particularly for enhancing student engagement with their own work. However, it is crucial to continuously monitor AI outputs to ensure that they do not oversimplify or misrepresent student understanding. Instructors should have the flexibility to adjust AI-generated questions for more depth, particularly when assessing higher-order thinking.

Blended Assessment Approaches

Given the limitations of MCQs in assessing more complex cognitive elements such as creativity and problem-solving, a blended assessment approach that combines MCQs with short-answer questions or projects should be adopted. This would allow for a more comprehensive evaluation of student abilities, particularly in areas that AI-generated MCQs may not fully capture.

Teacher Training and Support

To maximize the effectiveness of AI-assisted MCQs, substantial training for educators is required. Teachers must be equipped with the skills to integrate AI tools effectively and to guide students in critically engaging with AI-generated content. Furthermore, institutions should ensure equitable access to AI tools, addressing potential disparities in student access to technology.

Adaptive MCQs with Caution

While adaptive MCQs offer significant advantages in measuring student progress, care must be taken to ensure that difficulty levels are calibrated to avoid causing undue stress for students. Adaptive MCQs should also be accompanied by timely feedback loops to guide students through their learning process and to offer opportunities for improvement.

Reconsidering Assignment Time Allocations

The suggestion to shorten assignment time allocations in response to AI assistance received mixed feedback. While some experts see time reduction as a way to improve efficiency, others caution that such changes may compromise the depth of assessments. Therefore, assignment time should be carefully managed, considering both the benefits of AI assistance and the need for students to fully engage with the material.

Further Research and Pilot-Studies

This study was done to substantiate the concept through experts views which could lead to the second stage of the study i.e. feasibility study for modeling the framework as a pilot-study. Given the evolving nature of AI tools and assessment practices, future studies should focus on piloting AI-assisted and adaptive MCQs in real-world classroom settings. These studies should evaluate the practical feasibility, student engagement, and learning outcomes of AI-enhanced assessments. Furthermore, pilot studies should explore the integration of visual elements and AI-generated MCQs to assess their impact on student comprehension and engagement.

Future Development of MCQs For Creativity

Finally, while creativity was identified as a cognitive element that may not be fully assessed through MCQs, further research is needed to explore how MCQs can be adapted to assess more creative and complex cognitive tasks. This might include the development of multi-answer MCQs, decision-dependent scenarios, or MCQs that require justification of answers, all of which could help bridge the gap between AI tools and creative thinking assessments.

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