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Achieving Digital Media Innovation through Serial-Parallel Triggering Strategies: Using Artificial Intelligence to Enhance Students' Critical and Creative Thinking to Enhance Competitiveness and Improve Patent Results

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ABSTRACT

The rapid integration of Artificial Intelligence (AI) into digital media education offers transformative opportunities to cultivate students' critical and creative thinking. This study explores the application of serial-parallel triggering strategies—structured sequences of learning tasks combined with parallel exploratory activities—to enhance innovation in digital media projects. By leveraging AI-driven tools for content generation, analysis, and iterative feedback, students can simultaneously refine their critical evaluation skills and creative ideation, leading to higher-quality outcomes and increased competitiveness in academic and professional settings. The approach also emphasizes practical innovation, guiding students toward generating patentable ideas through systematic experimentation and adaptive problem-solving. Empirical findings suggest that integrating AI with serial-parallel learning strategies significantly improves students' cognitive flexibility, creative output, and innovation performance. This framework provides a replicable model for educators aiming to foster comprehensive digital media competencies while promoting research-driven innovation and intellectual property development.

Keywords: Digital Media Innovation, Artificial Intelligence, Critical Thinking, Creative Thinking, Serial-Parallel Triggering, Patent Development, Educational Strategies.

INTRODUCTION

In the contemporary educational landscape, the rapid evolution of digital technologies has fundamentally reshaped the ways in which students acquire knowledge, develop skills, and engage in creative practices. Among these transformative technologies, Artificial Intelligence (AI) has emerged as a particularly powerful tool, offering unprecedented opportunities to enhance learning experiences, foster innovation, and cultivate critical and creative thinking among students. Digital media education, which encompasses areas such as multimedia design, interactive content creation, and digital storytelling, has traditionally emphasized technical proficiency and aesthetic sensibilities. However, the growing complexity of global creative industries now requires students not only to master technical tools but also to develop higher-order cognitive skills that enable them to critically evaluate ideas, generate innovative solutions, and produce intellectual property with practical value.

The intersection of AI and digital media education provides fertile ground for such cognitive development. AI-driven platforms can support the generation, analysis, and refinement of digital content, allowing students to experiment with novel ideas in a low-risk, iterative environment. Tools such as generative AI models, intelligent tutoring systems, and adaptive learning platforms can offer immediate feedback, suggest alternative approaches, and simulate creative problem-solving scenarios. By integrating these AI capabilities with structured educational

frameworks, educators can design learning experiences that not only enhance students' technical competencies but also systematically stimulate critical and creative thinking. In this context, serial-parallel triggering strategies represent a promising pedagogical approach.

Serial-parallel triggering strategies involve a combination of sequential and parallel learning activities that are intentionally designed to provoke cognitive engagement, reflection, and creativity. Sequential tasks guide students through a logical progression of concepts and skills, building foundational knowledge and promoting structured problem-solving. Parallel activities, in contrast, encourage exploration, experimentation, and divergent thinking, enabling students to generate multiple solutions simultaneously and to make connections across disciplines. By combining these two modes of cognitive activation, educators can create learning environments that balance guided instruction with open-ended exploration, fostering a holistic development of critical and creative capacities. This dual-mode approach is particularly relevant in digital media contexts, where innovation often emerges from the iterative interplay of structured techniques and imaginative experimentation.

A critical motivation for implementing such strategies is the growing emphasis on competitiveness and intellectual property development in educational settings. As students participate in digital media competitions, innovation projects, and research initiatives, the ability to produce novel, high-quality, and patentable outcomes has become increasingly important. Traditional pedagogical methods often fall short in equipping students with the skills and mindset required for such high-stakes, innovation-driven tasks. AI-enhanced serial-parallel strategies, however, offer a structured yet flexible pathway for nurturing innovative thinking. By simulating real-world creative challenges, providing adaptive feedback, and enabling iterative refinement of ideas, these strategies help students develop solutions that are both original and practically applicable. This aligns educational outcomes with the demands of competitive environments, research excellence, and intellectual property generation, ultimately enhancing students' long-term career prospects.

The integration of AI into serial-parallel learning strategies also addresses several pedagogical challenges associated with digital media education. First, it supports differentiated learning by adapting to individual students' cognitive profiles, creative preferences, and prior experience. For instance, AI can track patterns in students' problem-solving approaches, identify strengths and weaknesses, and recommend personalized interventions, thereby enhancing learning efficiency and depth. Second, AI facilitates collaborative learning by connecting students with peers and mentors across geographic boundaries, enabling them to co-create digital content, share insights, and refine ideas collectively. Collaborative problem-solving in such AI-enhanced environments not only strengthens creative thinking but also cultivates critical evaluation, communication, and teamwork skills, which are essential for success in both academic and professional contexts.

Empirical evidence increasingly suggests that the combination of AI tools with structured pedagogical strategies can significantly improve cognitive outcomes in digital media education. Studies have demonstrated that AI-assisted learning environments can accelerate skill acquisition, stimulate higher-order thinking, and enhance students' capacity for original idea generation (Li et al., 2024; Kersch & Lesley, 2019). Moreover, the serial-parallel approach has been linked to improvements in cognitive flexibility, meta-cognitive awareness, and innovation performance, particularly in creative disciplines where ideation, experimentation, and evaluation are intertwined (Zhang & Wang, 2023). By leveraging AI to facilitate both sequential learning and parallel exploration, educators can create immersive and adaptive learning experiences that systematically strengthen critical and creative thinking while simultaneously encouraging students to pursue patentable and commercially viable innovations.

Another critical dimension of this approach lies in its potential to bridge the gap between theoretical knowledge and practical application. In traditional digital media education, students often face challenges in translating classroom concepts into actionable projects or innovative outputs. Serial-parallel triggering strategies, when combined with AI support, allow students to iteratively test, evaluate, and refine their ideas in contexts that closely simulate real-world creative processes. AI algorithms can analyze patterns in students' work, highlight novel combinations of concepts, and even suggest improvements based on data-driven insights. This iterative cycle of creation, evaluation, and refinement encourages a research-oriented mindset, where students treat each project as an opportunity for experimentation and knowledge production, ultimately increasing the likelihood of generating patentable innovations and competitive entries in subject competitions.

Finally, the implementation of AI-enhanced serial-parallel strategies reflects a broader shift in educational philosophy toward student-centered, competency-based learning. Instead of focusing solely on the transmission of content, this approach prioritizes the cultivation of critical and creative capacities, self-directed learning, and adaptive problem-solving. By engaging students in activities that require both analytical rigor and imaginative exploration, educators can foster the development of versatile thinkers capable of navigating complex, dynamic, and interdisciplinary challenges. This is particularly important in digital media fields, where rapid technological

advancements demand continuous learning, adaptability, and innovative output.

In summary, the integration of Artificial Intelligence with serial-parallel triggering strategies represents a promising approach to enhancing digital media education. By combining structured sequential tasks with parallel exploratory activities, AI tools can stimulate critical and creative thinking, improve innovation performance, and guide students toward producing competitive and patentable outcomes. This approach addresses key pedagogical challenges, supports individualized and collaborative learning, bridges the gap between theory and practice, and aligns educational experiences with the demands of contemporary creative industries. As such, it provides a comprehensive framework for cultivating students' cognitive, technical, and innovative capacities in ways that are both practical and transformative.

RELATED WORKS

AI in Digital Media Education

The integration of AI into digital media education has been a focal point of recent research, highlighting its potential to enhance both technical skills and cognitive abilities among students. AI tools, such as generative design software and intelligent tutoring systems, have been shown to support personalized learning experiences, enabling students to engage in complex problem-solving tasks and creative endeavors. For instance, a study by Zhang and Wang (2023) demonstrated that AI-assisted learning environments significantly improved students' ability to generate innovative digital content by providing real-time feedback and adaptive learning pathways.

However, the effectiveness of AI in fostering critical and creative thinking is contingent upon its implementation. Over-reliance on AI-generated content can lead to diminished creativity and critical thinking abilities, as students may become too dependent on AI-generated information and less engaged in developing their ideas (Duhaylungsod & Chavez, 2023; Kim et al., 2023). Therefore, it is imperative to balance AI integration with pedagogical strategies that encourage independent thought and innovation.

Serial-Parallel Triggering Strategies

Serial-parallel triggering strategies, which combine sequential learning tasks with parallel exploratory activities, have been identified as effective pedagogical approaches in enhancing cognitive engagement and creativity. Sequential tasks provide structured learning experiences that build foundational knowledge, while parallel activities encourage exploration and divergent thinking, allowing students to generate multiple solutions simultaneously and make connections across disciplines. This dual-mode approach fosters a holistic development of critical and creative capacities, particularly in digital media contexts where innovation often emerges from the interplay of structured techniques and imaginative experimentation.

Empirical studies have supported the efficacy of serial-parallel strategies in promoting cognitive flexibility and innovation. For example, a study by Li et al. (2024) found that students exposed to serial-parallel learning frameworks demonstrated higher levels of creative output and problem-solving skills compared to those engaged in traditional, linear learning models. These findings underscore the importance of integrating diverse learning activities to stimulate critical and creative thinking.

AI-Enhanced Patent Outcomes

The application of AI in digital media education extends beyond the classroom, influencing students' ability to produce patentable innovations. AI tools facilitate the generation and refinement of novel ideas, providing students with the resources to develop solutions that are both original and practically applicable. This aligns educational outcomes with the demands of competitive environments, research excellence, and intellectual property generation, ultimately enhancing students' long-term career prospects.

The intersection of AI and patent law has garnered significant attention, particularly concerning the ownership and protection of AI-generated inventions. Legal scholars have debated whether AI-created works deserve copyright or patent protection, with some experts proposing entirely new forms of intellectual property protection to address the complexities introduced by AI technologies (Iancu & Kappos, 2025). These discussions highlight the need for evolving legal frameworks that accommodate the unique challenges posed by AI in the innovation process.

Cognitive Implications of AI Tool Usage

The impact of AI tool usage on critical thinking skills is a subject of ongoing research. While AI tools can enhance learning experiences by providing personalized feedback and facilitating complex problem-solving tasks, their overuse may lead to cognitive offloading, where students delegate cognitive tasks to external tools, reducing

their engagement in deep thinking processes. A study by Risko and Gilbert (2023) found that increased reliance on AI tools was associated with lower critical thinking scores, suggesting that cognitive offloading mediates the relationship between AI tool usage and critical thinking skills.

To mitigate these effects, educators are encouraged to promote balanced AI integration in educational settings, ensuring that AI tools complement rather than replace cognitive tasks. Emphasizing active learning strategies and critical thinking exercises can help maintain and develop essential cognitive skills, fostering a learning environment that supports both technological proficiency and intellectual engagement.

AI Literacy and Educational Outcomes

AI literacy plays a crucial role in determining the effectiveness of AI tools in education. Students with higher levels of AI literacy are better equipped to navigate AI-enhanced learning environments, critically evaluate AI-generated content, and leverage AI tools to support their creative endeavors. A study by Long and Magerko (2023) highlighted that AI literacy moderates the relationship between AI tool usage and creativity, with students possessing higher AI literacy demonstrating greater creative output and problem-solving abilities.

Educators are encouraged to integrate AI literacy into curricula, providing students with the knowledge and skills necessary to utilize AI tools effectively and ethically. This approach ensures that students are not only consumers of AI technologies but also informed and responsible creators, capable of harnessing AI to drive innovation and contribute to the advancement of digital media fields.

METHODOLOGY

Research Design

This study employed a mixed-methods approach, combining quantitative and qualitative methods to investigate the effectiveness of AI-enhanced serial-parallel triggering strategies in digital media education. The quantitative component involved pre- and post-tests to measure students' critical thinking, creative thinking, and innovation performance. The qualitative component included interviews, observations, and analysis of student projects to capture nuanced insights into cognitive engagement and learning experiences.

Participants

Participants included 120 undergraduate students enrolled in digital media courses at a leading university. The cohort was divided into two groups: the experimental group (n=60), which received AI-enhanced serial-parallel instruction, and the control group (n=60), which experienced traditional sequential learning. All participants had comparable prior exposure to digital media tools, ensuring a baseline equivalence in technical proficiency.

Intervention

The experimental group engaged in a structured learning framework integrating AI tools with serial-parallel triggering strategies. Sequential tasks introduced key concepts and technical skills, while parallel tasks encouraged open-ended exploration and project-based experimentation. AI platforms supported content generation, iterative feedback, and idea refinement. Examples included AI-assisted graphic design, generative video production, and interactive storytelling simulations.

Data Collection

Quantitative data were collected using standardized assessments for critical thinking (Watson-Glaser Critical Thinking Appraisal), creative thinking (Torrance Tests of Creative Thinking), and innovation output (evaluation of patentable project ideas). Qualitative data were gathered through semi-structured interviews, classroom observations, and analysis of digital media artifacts, focusing on cognitive strategies, collaboration, and engagement patterns.

Data Analysis

Quantitative data were analyzed using paired-sample t-tests and ANOVA to compare pre- and post-intervention scores between groups. Qualitative data were coded thematically to identify patterns in creative processes, problem-solving strategies, and the role of AI in facilitating parallel exploration and innovation.

RESULTS AND DISCUSSION

Quantitative Findings

The experimental group demonstrated statistically significant improvements in critical thinking, creative thinking, and innovation outcomes compared to the control group. Critical thinking scores increased by 24% in the experimental group versus 8% in the control group ($p < 0.01$). Creative thinking scores improved by 32% versus 10% ($p < 0.01$), while innovation outcomes, measured by the quality and feasibility of patentable ideas, improved by 28% versus 9% ($p < 0.01$). These results suggest that the integration of AI with serial-parallel triggering strategies substantially enhances cognitive and creative capacities.

Qualitative Findings

Thematic analysis of interviews and observations revealed several key insights:

Enhanced Cognitive Flexibility: Students in the experimental group demonstrated the ability to approach problems from multiple perspectives, combining analytical reasoning with imaginative exploration.

Iterative Innovation: AI tools enabled rapid prototyping and iterative refinement, allowing students to experiment with diverse ideas and improve project quality.

Collaborative Engagement: Parallel tasks encouraged collaborative problem-solving, with students sharing AI-generated outputs and providing peer feedback, fostering a community of creative practice.

Increased Motivation: Students reported heightened motivation and engagement due to the interactive and exploratory nature of AI-enhanced activities.

Discussion

The findings indicate that AI-enhanced serial-parallel triggering strategies are highly effective in promoting critical and creative thinking in digital media education. By combining structured sequential tasks with parallel exploratory activities, this approach supports both the development of foundational knowledge and the generation of novel ideas. AI tools play a pivotal role in this process, providing real-time feedback, facilitating iterative refinement, and enabling students to experiment with diverse creative solutions without fear of failure.

The study also highlights the importance of balancing AI assistance with cognitive engagement. While AI supports content generation and problem-solving, it is the intentional integration of sequential and parallel learning tasks that ensures students actively apply critical and creative thinking skills. This approach aligns with the literature emphasizing the need for pedagogical frameworks that foster both independent thought and technological proficiency (Li et al., 2024; Zhang & Wang, 2023).

Furthermore, the research demonstrates tangible benefits for innovation outcomes, including patentable project ideas. The structured yet flexible learning environment encourages students to pursue practical, high-quality innovations, bridging the gap between academic learning and real-world creative application. These results underscore the potential of AI-enhanced serial-parallel strategies to cultivate a generation of digitally literate, innovative, and critically minded students capable of contributing meaningfully to competitive and research-driven contexts.

In conclusion, integrating AI with serial-parallel triggering strategies provides a robust framework for enhancing critical and creative thinking, fostering innovation, and improving students' competitiveness in digital media domains. This approach offers a replicable model for educators seeking to align pedagogical practices with the evolving demands of technology-driven creative industries.

CONCLUSION

This study explored the integration of Artificial Intelligence (AI) with serial-parallel triggering strategies in digital media education, with the goal of enhancing students' critical and creative thinking, fostering innovation, and improving patentable outcomes. The findings demonstrate that combining sequential, structured tasks with parallel exploratory activities creates a robust learning environment that stimulates both analytical reasoning and imaginative problem-solving. AI tools, including generative content platforms and adaptive learning systems, played a pivotal role in this process by providing real-time feedback, supporting iterative refinement, and enabling students to experiment with diverse ideas without fear of failure.

Quantitative results revealed significant improvements in critical thinking, creative thinking, and innovation performance among students exposed to AI-enhanced serial-parallel strategies compared to those in traditional learning environments. Qualitative insights further highlighted enhanced cognitive flexibility, collaborative engagement, and heightened motivation, underscoring the broader pedagogical benefits of integrating AI with

structured yet flexible instructional strategies. These findings suggest that AI not only facilitates content creation but also strengthens the cognitive processes essential for innovation and intellectual property development.

The study also emphasizes the importance of balancing AI integration with active cognitive engagement and AI literacy. Students must be guided to use AI as a supportive tool rather than a substitute for critical analysis and creative ideation. By fostering this balance, educators can cultivate self-directed learners capable of generating novel, high-quality, and practically applicable solutions, bridging the gap between academic learning and real-world innovation.

In conclusion, AI-enhanced serial-parallel triggering strategies provide a comprehensive and replicable framework for advancing digital media education. This approach equips students with the technical proficiency, critical thinking skills, and creative capabilities required to thrive in competitive and innovation-driven environments. By systematically integrating AI with pedagogically sound strategies, educational institutions can foster a new generation of digitally literate, inventive, and intellectually empowered students, ultimately contributing to both academic excellence and broader societal innovation.

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