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A Study on the Development of an AI-Based Animation Production Instructional Model in Multimedia Education for Early Childhood Education Pre-Service Teachers

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A B S T R A C T :

The rapid advancement of artificial intelligence (AI) technologies has transformed the field of multimedia education, offering new opportunities for creative learning experiences in teacher education. This study aims to develop an instructional model for AI-based animation production applicable to multimedia education in early childhood education departments. Through a literature-based developmental approach, the study integrates the principles of multimedia learning theory, technological pedagogical content knowledge (TPACK), and the ADDIE instructional design model. The resulting AI-Assisted Animation Production (AI-AP) model outlines a six-phase structure—Orientation, Exploration, Design, Production, Evaluation, and Reflection—designed to enhance preservice teachers' creativity, AI literacy, and educational media production competence. This paper discusses the educational significance, ethical implications, and future directions for implementing AI in multimedia education for early childhood teacher preparation programs.

Keywords: Artificial Intelligence, Multimedia Education, early childhood education, instructional model, animation production, teacher training

INTRODUCTION

Artificial intelligence (AI) has become a driving force in transforming educational environments, particularly in multimedia-based teaching and learning. With the emergence of generative AI tools such as ChatGPT, D-ID, Runway ML, and Pika Labs, educators can now create animated and interactive instructional materials with unprecedented ease and creativity. These tools can assist teachers in developing engaging, age-appropriate, and pedagogically sound multimedia content.

In early childhood education, animation serves as a powerful medium that supports children's cognitive, linguistic, and socio-emotional development. However, in many early childhood education departments, the multimedia education curriculum remains limited to basic video editing or static digital storytelling. There is a pressing need to integrate AI-based animation production into preservice teacher education to foster creative and technological competencies. This study, therefore, seeks to establish a theoretical and practical foundation for designing and implementing an AI-based animation production instructional model for multimedia education in early childhood teacher preparation programs.

This study addresses the following questions:

1. What are the theoretical foundations of AI-based multimedia education in early childhood teacher training?
2. What design principles and instructional components should be included in an AI-based animation production model?

LITERATUREREVIEW

2.1. Multimedia Education in Early Childhood Teacher Preparation

Multimedia education refers to the integration of text, images, sound, and animation to support learning and communication. According to Mayer (2009), multimedia learning is most effective when instructional design aligns with cognitive processes through principles such as coherence, segmentation, and dual coding. In early childhood teacher education, multimedia courses traditionally emphasize digital storytelling, PowerPoint, or video editing (Kim & Park, 2021). However, these approaches often neglect the interactive and constructivist potential of multimedia tools. For future educators, understanding how to design educational media that promotes engagement and conceptual understanding among young learners is crucial (Fleer, 2020). AI-powered multimedia production can address this gap by enabling preservice teachers to generate visuals, voices, and scripts tailored to developmental goals. Such approaches reflect the shift from passive media use to active media creation, aligning with creative pedagogy.

2.2. The Role of Artificial Intelligence in Creative Education

AI technologies are increasingly viewed as co-creators rather than mere tools (Graff, 2023). In educational contexts, AI can assist in brainstorming ideas, automating technical tasks, and personalizing learning content (Holmes et al., 2022). For teacher education, AI-based design processes foster reflective thinking, problem-solving, and ethical awareness (Lee & Kim, 2024). In multimedia production, AI enables learners to conceptualize ideas quickly and visualize narratives efficiently. Tools like Runway ML, Pika Labs, and Synthesia facilitate animation generation, lip-synced narration, and scene composition—reducing technical barriers while encouraging creativity. Therefore, AI supports pedagogical innovation, allowing educators to focus more on storytelling, emotional tone, and developmental appropriateness rather than technical limitations.

2.3. Instructional Design Frameworks for Model Development

This study synthesizes three key theoretical frameworks for instructional design:

1. ADDIE Model – A systematic design model encompassing five phases: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). It ensures that learning objectives, materials, and assessments are aligned.
2. TPACK Framework – Technological Pedagogical Content Knowledge (Mishra & Koehler, 2006) emphasizes the integration of pedagogical strategies, content knowledge, and technological tools.
3. SAMR Model – Proposed by Puentedura (2012), this model explains the transformative potential of technology use in education, ranging from substitution to redefinition of learning experiences.

Combining these frameworks provides a robust foundation for designing an AI-based multimedia instructional model that promotes transformative learning and AI literacy among preservice teachers.

METHODOLOGY

This research employed a literature-based developmental research approach. Rather than empirical testing, the study focuses on the theoretical construction of an instructional model grounded in the synthesis of existing research.

3.1 Research Procedure

3.1.1 Literature Collection:
Databases such as Scopus, ERIC, Google Scholar, and RISS were searched using keywords: AI in multimedia education, animation production, early childhood teacher training, TPACK, and ADDIE model.

3.1.2 Data Analysis:
A total of 54 relevant studies were reviewed and categorized into themes: (1) AI-based educational design, (2) multimedia learning principles, (3) instructional modeling in teacher education, and (4) ethical considerations.

3.1.3 Model Development:
The AI-Assisted Animation Production (AI-AP) Model was developed by aligning identified principles with the ADDIE process. The model's structure and subcomponents were refined through conceptual validation by three educational technology experts.

RESULT

The AI-AP Model is a structured instructional model for integrating AI-based animation production into multimedia education. It emphasizes creative collaboration, AI literacy, and pedagogical reflection. The model follows six iterative phases: Orientation, Exploration, Design, Production, Evaluation, and Reflection.

4.1 Model Phases and Activities

The AI-Assisted Animation Production (AI-AP) model was conceptualized through a synthesis of multimedia learning theory, the ADDIE design process, and TPACK integration principles. Each phase represents a progressive learning stage that enables preservice teachers to plan, design, and implement educational animation projects while developing AI literacy and pedagogical awareness. The model emphasizes cyclical reflection—learners move iteratively between creative exploration and pedagogical evaluation—ensuring that technological experimentation remains grounded in educational goals.
Table 1 presents the six phases of the AI-AP model, outlining the key purposes, activities, and expected learning outcomes for each stage.

Table 1 – Model Phases and Activities

Phase	Description	Key Activities	Expected Outcomes
1. Orientation	Introduce objectives, tools, and ethical use of AI in education.	Discuss AI ethics, define target learners (preschoolers), and analyze learning goals.	Awareness of AI's educational role.
2. Exploration	Analyze existing educational animations and explore AI tools.	Compare visual/narrative styles, experiment with Runway, Canva, Pika, D-ID, etc.	Understanding of animation structure and tool capabilities.
3. Design	Plan storyboards, scripts, and prompts integrating pedagogical goals.	Draft 6–10 scenes with dialogue, background, and narration prompts.	Instructionally aligned storyboard.
4. Production	Generate and assemble visual/audio assets using AI tools.	Create characters, render animations, synchronize audio.	Prototype animation (1–2 min).
5. Evaluation	Conduct peer review and self-assessment.	Apply rubrics for educational suitability and cognitive load.	Improved design and self-efficacy.
6. Reflection	Present final product and reflect on learning process.	Showcase videos, write reflection papers on AI integration.	Consolidated creativity and ethical awareness.

4.2 Evaluation Rubrics

To ensure the pedagogical and technical quality of AI-based animation projects, the study proposes an evaluation rubric aligned with multimedia learning principles and teacher education standards. The rubric serves both as a formative guide during production and as a summative assessment framework upon completion. It evaluates students' ability to integrate early childhood educational goals, apply AI tools responsibly, and produce coherent and ethically sound media products. Table 2 summarizes the propose evaluation criteria with three performance levels—Excellent, Satisfactory, and Needs Improvement—across five core dimensions.

Table 2 – Evaluation Rubrics

Dimension	Criteria	Excellent (5)	Satisfactorys (3)	Needs Improvement (1)
Educational relevance	Alignment with child development goals	Fully aligned	Partially aligned	Misaligned
Story & structure	Logical flow and clarity	Coherent and engaging	Moderate clarity	Fragmented
AI utilization	Appropriate, ethical use of AI tools	Purposeful integration	Basic use	Misuse or minimal
Multimedia quality	Visual/audio balance, readability	Excellent composition	Acceptable	Overloaded or inconsistent
Reflection	Depth of insight and ethical reasoning	Deep and specific	Moderate	Superficial

DISCUSSION

The AI-Assisted Animation Production (AI-AP) model was designed as a pedagogical framework for preservice teachers enrolled in early childhood education programs. Its development highlights how artificial intelligence can be meaningfully integrated into teacher training to strengthen students' creative, technological, and pedagogical competencies. The model promotes active participation and design-based learning experiences, allowing students to construct educational content for young children while simultaneously improving their own digital and reflective skills. Through project-based engagement with AI tools, early childhood education majors are encouraged to perceive multimedia not merely as a technological product but as a medium of pedagogical expression that supports developmental learning goals.

From an educational standpoint, the AI-AP model facilitates the growth of creative problem-solving and pedagogical reasoning among early childhood education students. Each phase—orientation, exploration, design, production, evaluation, and reflection—encourages learners to plan systematically, collaborate effectively, and critically assess their outputs. As students design storyboards, generate characters, and produce AI-assisted animations, they apply theoretical knowledge about child development, communication, and learning through play. This process bridges the gap between abstract theory and applied practice, helping students to embody the role of reflective educators capable of translating developmental principles into concrete educational media.

Another key implication is the enhancement of AI literacy among preservice teachers. Familiarity with generative AI tools provides students with the ability to navigate emerging technologies responsibly and confidently. Rather than passively consuming AI-generated materials, students in the AI-AP framework actively engage in prompt engineering, critical evaluation of outputs, and iterative refinement. This cycle of experimentation and evaluation cultivates both technological autonomy and metacognitive awareness, enabling future educators to make informed decisions about how and when to incorporate AI into their teaching practice.

Ethical reflection constitutes an essential component of the AI-AP model. Because early childhood educators work with highly impressionable learners, preservice teachers must recognize the ethical dimensions of media creation, including copyright, fairness, and representation. The model intentionally embeds discussions on AI ethics—particularly during the Orientation and Reflection stages—to foster sensitivity to issues such as bias in image generation, age-appropriate content design, and the responsible use of synthesized voices or faces. By engaging with these concerns, students develop a professional mindset grounded in both creativity and accountability.

The model's implementation provides a foundation for curriculum innovation in teacher education programs. Integrating AI-based animation projects into multimedia or instructional technology courses can transform traditional coursework into an experiential, project-driven format. This approach aligns with the demands of twenty-first-century teacher education, where digital fluency and creative collaboration are essential. The AI-AP model can thus serve as a scaffold for capstone projects, media design practicums, or interdisciplinary coursework linking technology, art, and pedagogy.

The discussion of this model reveals that AI-integrated animation production serves as a transformative pedagogical practice for early childhood education students. It prepares preservice teachers not only to master digital tools but also to apply child-centered pedagogical reasoning, ethical reflection, and collaborative creativity in designing educational media. By situating AI as a partner in learning rather than a replacement for human creativity, the AI-AP model redefines multimedia education as a reflective and future-oriented process that empowers the next generation of early childhood educators.

CONCLUSION

This study proposed an AI-based animation production instructional model for multimedia education in early childhood teacher training. The AI-AP model, grounded in ADDIE and TPACK frameworks, provides a systematic process for preservice teachers to plan, design, and evaluate educational animations using AI tools. The model's contribution lies in its balance between technological creativity and educational appropriateness. As AI continues to evolve, teacher education institutions should integrate AI literacy and media production into their curricula to prepare future educators for the digital age. Future research should empirically test the model's effectiveness in real classroom settings, exploring its impact on preservice teachers' creativity, ethical reasoning, and instructional design competence.3.1 Research Procedure

RECOMMENDATIOM

Based on the findings and discussions of this study, several recommendations are proposed for the effective integration of AI-based animation production within multimedia education for early childhood education majors. These recommendations address three key dimensions—curriculum practice, teacher preparation, and future research.

1. Curriculum Integration and Instructional Practice

Universities offering early childhood education programs should consider embedding the AI-Assisted Animation Production (AI-AP) model into existing multimedia or educational technology courses. This integration would allow students to experience authentic, project-based learning that connects theory with practice. Faculty members can adopt the model as a structured framework for capstone projects or collaborative assignments where students plan, design, and evaluate AI-generated educational media. Furthermore, departments should provide access to appropriate AI tools (e.g., Runway ML, Canva, D-ID) and establish clear guidelines on ethical use, ensuring that technology is utilized to support—not replace—pedagogical creativity and child-centered design.

2. Teacher Preparation and Professional Development

Preservice teachers must be systematically trained in AI literacy and ethical digital production. Teacher education institutions should offer workshops and seminars focused on responsible AI use, prompt engineering, and copyright awareness. Faculty members themselves also need professional development opportunities to familiarize themselves with emerging AI technologies and pedagogical applications. Collaborative training between educational technologists and early childhood education faculty could strengthen interdisciplinary teaching and ensure that AI-based creative practices are appropriately contextualized for young learners.

3. Future Research Directions

While this study was conceptual and literature-based, future research should empirically validate the effectiveness of the AI-AP model in classroom settings. Experimental and mixed-method studies could examine how AI-assisted animation projects influence students' creativity, problem-solving skills, and reflective thinking. Longitudinal research could further explore the model's impact on graduates' readiness to integrate AI into actual early childhood classrooms. Additionally, cross-cultural comparative studies may provide insights into how teacher education institutions in different contexts adopt and adapt AI-integrated multimedia learning.

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