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Empowering junior high school dance education: a multimedia literacy-based competency approach for prospective teachers

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ABSTRACT

This study develops interactive thematic dance teaching materials integrating multimedia literacy through a competency-based approach, addressing theoretical gaps in technology integration within arts education. The research adapts Majumdar's multimedia literacy model into a six-stage pedagogical framework for kinesthetic learning, empirically validating pre-service teachers' capacity as content creators. Using Research and Development with the Thiagarajan 4D model, 27 pre-service teachers designed interactive materials validated by three experts and field-tested with 30 junior high school students. Expert validation rated materials as "Suitable" (M=4.00/5.00). Regression analysis confirmed multimedia literacy awareness significantly predicted product creation ability (β=0.505, p=0.007). Field implementation showed high effectiveness: attractiveness 98.3%, learning skills 96.1%, and all indicators >88%. This framework advances arts education by demonstrating that disciplinary authenticity and technological innovation coexist synergistically, preserving aesthetic values while enhancing digital competencies for 21st-century learning.

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1. Introduction

Dance education, as a crucial part of arts education, plays an essential role in fostering character growth, creativity, and cultural appreciation [1], [2], [3]. However, its pedagogical practices still encounter significant challenges. Recent studies document that 78% of arts educators report limited access to interactive instructional media, while 65% lack adequate technological infrastructure [4],[5]. Specifically in Indonesian junior high schools, only 23% utilize technology-enhanced dance materials systematically, with most relying on demonstration-imitation methods [6]. A 2023 survey of 150 dance teachers revealed that 82% had never created digital teaching materials, citing low digital literacy (68%) and insufficient training (74%) as primary barriers [7]. Traditional methods are characterized by: (1) teacher-centered demonstration without multimodal representation, (2) physical imitation without conceptual scaffolding, (3) absence of self-paced resources, and (4) limited creative exploration [4],[5]. Comparative studies show these approaches correlate with 34% lower student engagement and 42% reduced movement retention rates compared to interactive multimedia environments [8]. As a result, learning methods often remain traditional and fail to address the needs of 21st-century students, who are inherently connected to digital technology and active learning techniques. Similar issues occur in developing teaching materials, where teachers encounter restrictions related to technology access, low digital proficiency, and inadequate resource infrastructure [6], [7], [8]. Modern educational demands require a shift in learning to develop 21st-century skills, including creativity, critical thinking, communication, collaboration, and digital as well as multimedia literacy [4]. As Hobbs [5] and Potter [6] describe, multimedia literacy involves the ability to access, analyze, evaluate, create, and communicate messages through digital media. In line with this view, using multimedia-based instructional materials has

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been shown to effectively increase student engagement and improve learning outcomes in both arts education and vocational skill development [7].

Research on developing dance teaching materials based on multimedia literacy and applying a competency-based approach remains limited [9]. Most existing studies mainly focus on technology use, without creating thematically integrated, interactive, and achievement-oriented instructional frameworks [10]. In contrast, training in developing digital teaching materials that adopt active and project-based learning approaches has been shown to improve teacher competence and learning quality [11]. A promising alternative involves developing interactive thematic teaching materials that not only link multiple subjects through local arts and cultural contexts but also encourage project-based learning, exploration, and reflection [12]. Interactive multimedia enhances motivation and collaboration through: (1) multimodal representation accommodating diverse learning preferences, (2) immediate feedback enabling self-regulation, (3) interactive navigation empowering learner autonomy, (4) embedded social features facilitating collaborative knowledge construction, and (5) gamification elements activating intrinsic motivation [13], [14], [15]. This model has demonstrated positive outcomes, for example, in pencak silat instruction, where the integration of interactive multimedia increased student motivation and participation, while also reinforcing learning interest, conceptual understanding, and collaborative interaction between teachers and students [13]. Research consistently demonstrates that the use of interactive multimedia in education has a positive impact on learning outcomes. Research indicates that the integration of such media markedly improves students' critical and creative thinking abilities [14]. Specifically within the context of higher education, multimedia technology plays a strategic role in strengthening academic achievement and language proficiency among students [15]. Furthermore, educational multimedia fosters reflective and creative thinking, particularly in literature learning for prospective educators [16]. The integration of various elements like text, images, graphics, and photographs within multimedia aligns with core multimedia literacy principles and is shown to increase motivation and learning outcomes [17]. An analysis of relevant studies reveals that no comprehensive research has yet developed a multimedia literacy model that explains how multimedia literacy functions and how its outcomes can be utilized in product development within the context of arts education, particularly dance. Such research remains scarce, especially that involving prospective art teachers in designing interactive thematic teaching materials grounded in student competencies. Furthermore, the application of the 4D development model (Define, Design, Develop, Disseminate) in creating multimedia literacy–based arts teaching materials is still notably limited.

This study introduces a scientific innovation in its approach, subject focus, and context of application, addressing the gap in previous research related to the development of a multimedia literacy model grounded in Majumdar's theory within arts education. Its distinct contributions lie in the involvement of prospective art teacher students as instructional designers, the integration of multimedia literacy in dance learning, and the implementation of a competency-based thematic approach aligned with the Junior High School (SMP) curriculum. The purpose of this study is to design and evaluate an interactive thematic teaching material model grounded in multimedia literacy through a competency-based approach. The proposed model is expected to serve as a strategic innovation for integrating multimedia technology into dance education, ensuring its relevance to 21st-century learning needs while supporting the achievement of student competencies [18], [19], [20], [21], [22]. Theoretically, this study contributes (1) contextualized adaptation of Majumdar's framework for kinesthetic learning domains, (2) a six-stage pedagogical model bridging TPACK with arts-specific competencies, (3) empirical validation of pre-service teachers' dual role as literacy developers and content creators, and (4) a competency-based thematic structure demonstrating how disciplinary authenticity and digital innovation coexist synergistically. Practically, it aims to improve the professional skills of arts teachers in creating contextual, interactive, and learning-oriented instructional materials. This study explores three key questions: (1) What are the specific needs for developing interactive thematic teaching materials based on multimedia literacy for dance education? (2) How can an effective model be designed to incorporate multimedia literacy into a competency-based framework? and (3) How practical and effective is the proposed model in

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enhancing student skills? These questions provide the conceptual basis for designing, developing, and evaluating the model, ensuring that the results are both theoretically solid and practically useful within arts education.

2. Methods

This study adopts a Research and Development (R&D) approach based on the 4D development model, which includes the phases of Define, Design, Develop, and Disseminate [23], [24], [25], [26]. In dance education context, implementation proceeded as follows: (1) Define, needs analysis through observation identified gaps in students' multimedia competence and traditional teaching approaches in dance pedagogy; (2) Design, prototype development integrating TPACK principles with movement-based learning, emphasizing multimodal representation (visual, auditory, kinesthetic); (3) Develop, iterative refinement through expert validation and limited trials, ensuring alignment between technological features and embodied learning characteristics; (4) Disseminate, field implementation in authentic classroom settings with junior high school students, assessing pedagogical effectiveness and user engagement. This model is commonly used in creating learning media [27]. It is applied to (1) examine how preservice teachers engage with multimedia literacy, (2) incorporate these skills in designing interactive, thematic digital teaching materials, and (3) assess the feasibility of the final product among junior high school students. The use of this approach is supported by previous studies that show the effectiveness of the 4D model in developing multimedia-based arts learning, especially in improving learner engagement, motivation, and learning outcomes [28].

This research was carried out in the Dance Education Study Program at the Indonesia University of Education during the even semester of the 2024/2025 academic year, coinciding with the implementation of the ICT Literacy and Learning Media course. The site was selected for its alignment with the study's focus, developing interactive, thematic teaching materials grounded in multimedia literacy and a competency-based approach. The primary participants were students enrolled in the course above. A total of 27 participants were selected through purposive sampling, ensuring the inclusion of individuals with relevant academic and technical backgrounds. For testing the application of the developed model, probability sampling was employed, involving junior high school students as respondents. In the limited field test, 30 students from the target school represented the intended user population. This selection strategy ensured that participants possessed adequate conceptual and technical readiness to engage in designing multimedia-based teaching materials aligned with competency-based dance instruction. The adoption of purposive sampling follows established practices in the development of arts learning media. Recent studies have confirmed that purposive sampling effectively facilitates the selection of participants whose characteristics are most suitable for the design, validation, and evaluation of arts and multimedia educational instruments [23]. This research was carried out in the Dance Education Study Program at the Indonesia University of Education during the even semester of the 2024/2025 academic year, coinciding with the implementation of the ICT Literacy and Learning Media course. The site was selected for its alignment with the study's focus, developing interactive, thematic teaching materials grounded in multimedia literacy and a competency-based approach.

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Operationally, the research consisted of the following stages: Needs Analysis, conducted through observation and discussions with lecturers and students to identify instructional problems, learning needs, and learner characteristics. Indicators measured: (1) technology use frequency and quality in teaching practice, (2) perceived multimedia design competence, (3) digital resource availability, (4) alignment between materials and 21st-century frameworks, and (5) student engagement with existing media.

- Product Design: development of teaching materials grounded in the findings of the needs analysis and the principles of art pedagogy.
- Expert Validation: engagement of subject-matter experts, media specialists, and instructional designers to evaluate the content validity, visual presentation, and instructional flow, followed by revisions based on their feedback. Limited Testing—implementation with a small group of students to examine initial feasibility, user engagement, and areas for refinement.
- Effectiveness Analysis: assessment of changes in understanding, engagement levels, and user responses to the developed teaching materials. Parameters measured: (1) cognitive: pre-post test scores on dance concepts and TPACK knowledge, (2) skill: product quality via rubrics evaluating technical proficiency and pedagogical alignment, (3) affective: motivation and creative confidence via validated scales, and (4) behavioral: engagement metrics including completion rates and interaction time.

Data collection employed a mixed-methods approach, integrating both quantitative and qualitative techniques to capture the complexity of the learning process and provide a deeper understanding of students' perceptions. Five primary methods were applied in this process.

- First, semi-structured interviews were conducted during the initial phase as an exploratory tool to identify students' needs for interactive teaching materials and to assess their level of multimedia literacy within the context of dance education. This interview format enabled flexible yet focused exploration of participants' perspectives.
- Second, participatory observation was conducted to examine student activities during the exploration, design, and implementation stages of interactive teaching materials in the classroom. The observation aimed to capture the dynamics of interaction, media utilization, and learning strategies employed by students in the context of direct instruction.
- Third, formative assessments were administered to measure students' conceptual understanding of multimedia literacy and their ability to apply these concepts in the development of teaching materials. The tests were designed to evaluate both cognitive comprehension and practical application.
- Fourth, a questionnaire was distributed to assess two independent variables central to this study. The first variable (X_1) represented students' level of multimedia literacy, reflecting their understanding and mastery of the fundamental principles of digital media use. The second variable (X_2) denoted the degree to which multimedia literacy was applied in developing instructional products, indicating their capacity to integrate literacy into pedagogical design. In addition, the questionnaire was also used to measure the product's applicability among users, namely junior high school students in the field.
- Finally, documentation techniques were employed to collect various forms of written and visual data, including product design outcomes, field notes, individual student reflections, and photographic and video records of teaching and learning activities. All collected data were analyzed triangulatively to ensure validity and obtain a comprehensive understanding of the research findings.

Quantitative data obtained from questionnaires and tests were analyzed using multiple linear regression to determine the extent to which multimedia literacy skills (X_1) and the utilization of multimedia literacy outcomes (X_2) influenced the quality of interactive thematic teaching materials in dance education for junior high school students (Y). In addition, questionnaires were employed to measure product applicability for users through descriptive statistical analysis. The analysis was performed using SPSS version 20, with a significance level

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of 95% (α = 0.05). This method was considered appropriate for assessing the statistical contribution of each independent variable to the dependent variable [25]. Qualitative data derived from interviews and observations were analyzed using Miles and Huberman's interactive model, which comprises three main stages: data reduction, data display, and conclusion drawing/verification [26]. This approach enabled the researchers to gain a deeper understanding of the learning context and dynamics, as well as to capture authentic participant responses during the development process of the instructional materials. To ensure the feasibility and quality of the developed materials, a validation process was conducted by three experts with complementary areas of specialization. The validation covered aspects of content quality, instructional design, and product applicability in the context of junior high school dance education. The validation involved: (1) A multimedia expert, holding at least a master's degree in educational technology or multimedia, responsible for evaluating the technical features, visual design, navigation, and aesthetics of the developed digital media; (2) An education expert, with a minimum qualification of a master's degree in arts education or curriculum studies, tasked with assessing content alignment with core competencies, pedagogical structure, and the competency-based learning approach; (3) Field practitioners, namely junior high school dance teachers with a minimum of five years of teaching experience, who evaluated the product's practicality, usefulness, and potential for implementation in real classroom settings.

Validation was carried out by three groups of experts. First, multimedia specialists, holding at least a master's degree in learning technology or multimedia, were responsible for assessing the technical aspects, visual design, navigation, and aesthetics of the developed digital media. Second, education specialists, with a minimum qualification of a master's degree in arts education or curriculum studies, evaluated how well the teaching materials aligned with basic competencies, pedagogical structures, and competency-based learning approaches. Third, field practitioners, consisting of junior high school dance teachers with at least five years of teaching experience, assessed the practicality, usefulness, and potential for classroom implementation of the product. The validation instrument was designed as a Likert scale-based questionnaire, comprising four rating categories: highly valid, valid, moderately valid, and invalid. The instrument's indicators encompassed content validity, learning constructs, and media practicality. The Likert scale was selected because: (1) it quantifies qualitative expert judgments enabling systematic comparison, (2) demonstrated high reliability (α >0.85) in media validation contexts [27], [28], (3) accommodates evaluative judgments on a continuum, (4) allows aggregation into composite scores while preserving diagnostic information, and (5) provides benchmarks for interpreting validation outcomes. [37], [38]. Validation data were analyzed descriptively and quantitatively to determine the overall suitability of the product. The findings of this analysis served as the basis for revising and refining the product before proceeding to the limited trial phase. This multidisciplinary validation approach has proven effective in enhancing the quality of multimedia-based learning products. Pratiwi (2019) demonstrated that interactive multimedia validated by subject matter and media experts achieved a feasibility level exceeding 80%, categorized as highly feasible for implementation [27]. Furthermore, the use of the Likert scale in learning design validation has shown high reliability in various educational media development studies [28]. Through this validation strategy, the development of teaching materials is expected to meet both technical and pedagogical standards while ensuring high applicability in classroom practice.

3. Results and Discussion

3.1. The Need for Interactive Thematic Teaching Materials in Multimedia Literacy-Based Dance

Based on interviews, questionnaires, and observations of students enrolled in the *ICT Literacy and Instructional Media* course, it was found that 77% of the participants had never used teaching materials that interactively integrate multimedia, Fig. 1. To illustrate the initial condition of ICT literacy and students' ability to integrate digital media into dance education, an analysis was conducted involving 27 students. The findings were classified and converted into quantitative data to identify prevailing tendencies and areas requiring intervention in the development of interactive teaching materials.

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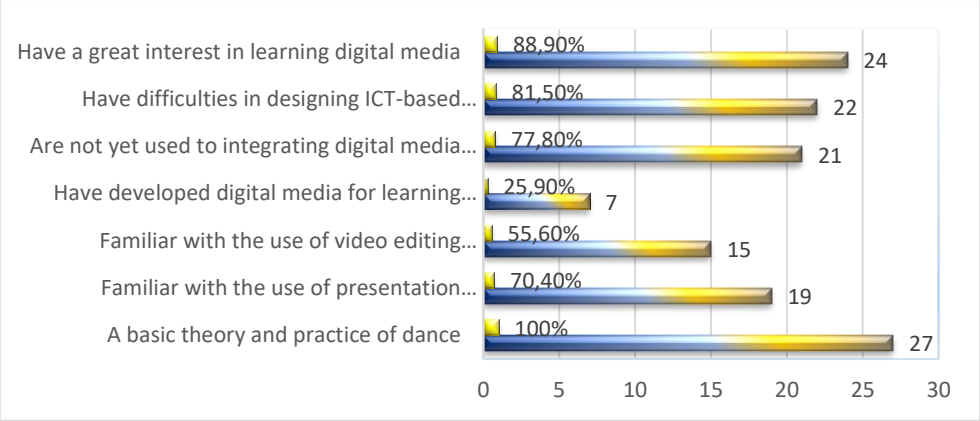

Fig. 1. Experience in dealing with technology

The preliminary results indicated that the majority of students (77.8%) were not yet accustomed to creatively integrating digital media into dance learning. Furthermore, 81.5% reported difficulties in designing ICT-based interactive learning media. The analysis also revealed that 88.9% of students expressed a strong interest in improving their skills in educational technology. Interview data further suggested that these students possess considerable potential for creativity as prospective art educators. They showed enthusiasm for exploring innovative teaching methods, particularly those that combine artistic elements with digital technologies. However, such interest has not been fully optimized due to the current course approach, which remains predominantly theoretical.

Based on the analysis, the majority of students (92.6%) demonstrate strong creative potential as prospective art educators, Fig. 2. These percentages represent agreement rates from Likert-scale responses, where "agree" and "strongly agree" were combined. Raw scores were converted using: (Total Score / Maximum Possible Score) × 100%. However, only 37% have had exploratory experience in developing technology-based instructional media for art education. This indicates a clear gap between their potential and its actual implementation in practice. Furthermore, most students (77.8%) reported that the predominance of theoretical approaches in lectures has limited their ability to fully express their creative potential. The 85.2% figure represents mean score conversion: average Likert response (4.26/5.0) translated to percentage format. These findings highlight the need for learning experiences that promote comprehensive ICT literacy, encompassing not only the use of digital applications but also the mastery of strategies for designing creative multimedia teaching materials aligned with the distinctive characteristics of dance education.

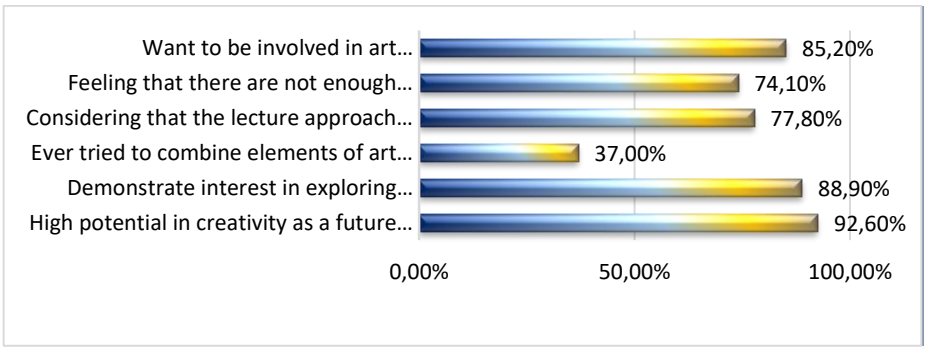

Fig. 2. Pupils' interests and potential

The analysis reveals that 81.5% of students have not yet achieved comprehensive mastery of ICT literacy, with their abilities remaining limited to the use of basic digital applications, Fig. 3. Furthermore, 77.8% of students have not fully understood the principles of multimedia

 ISSN 2655-9153

learning design appropriate to the distinctive characteristics of dance education. This condition underscores the need for more in-depth and practical learning interventions. A total of 85.2% of students reported a need for training in designing creative and contextually relevant multimedia teaching materials. Moreover, the majority (88.9%) expressed a preference for applied, project-based learning that integrates artistic and digital technology elements as part of developing their professional competencies as future art educators. Interview and observation data further indicate that students, as prospective art teachers, face genuine challenges in integrating technology into classroom instruction. They require training to design learning media that are relevant to real teaching contexts and responsive to the demands of contemporary education, which emphasizes interactivity and innovation.

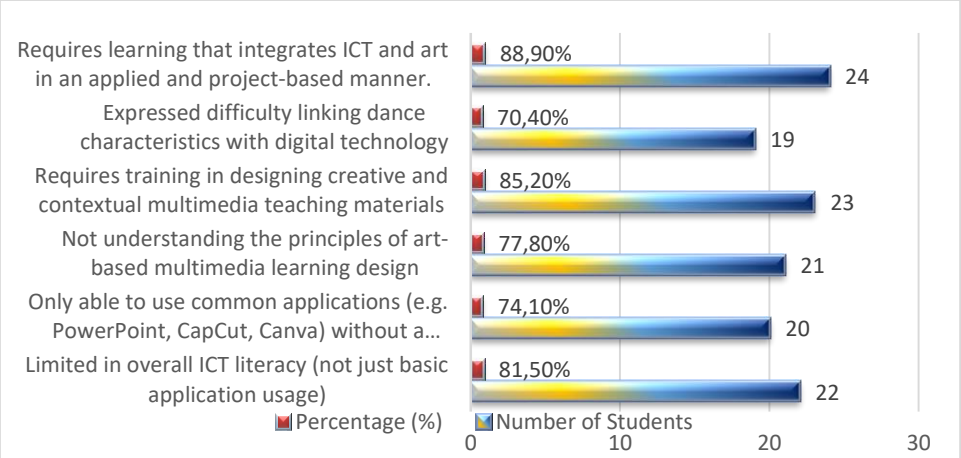

Fig. 3. The need for digital literacy development

The interviews also highlight that students need multimedia literacy skills that facilitate visual and kinesthetic exploration [29], [30], [31]. These findings affirm the crucial role of strengthening multimedia literacy in enhancing students' creative capacity. Multimedia literacy extends beyond the ability to comprehend and process visual and auditory information; it also entails the competence to integrate both dimensions synergistically within creative thinking processes. For students, particularly in the current era of digital transformation, mastering multimedia literacy provides extensive opportunities to articulate ideas and innovations through diverse creative outputs. This aligns with the characteristics of the digital generation, which tends to respond more effectively to learning experiences that optimally employ visual and auditory technologies. Consequently, the development of interactive and visually engaging multimedia-based learning designs has become increasingly essential to support the attainment of optimal learning outcomes.

3.2. Designing Interactive Thematic Teaching Materials Based on Multimedia Literacy and a Competency-Based

The diagram delineates a six-stage framework for cultivating multimedia literacy within the TPACK model. The sequence comprises theme exploration, TPACK mapping for dance-specific intersections, the development and application of multimodal materials, the infusion and transformation of literacy through iterative product refinement, authentic classroom implementation with adaptive interaction, and systematic reflection to evaluate pedagogical efficacy and technological alignment. Collectively, these stages advance learners' literacy from foundational awareness toward progressively more integrated and transformative instructional practice. These stages were formulated by adapting and further developing the multimedia literacy model proposed by Majumdar [17]. Each stage is systematically structured to ensure the integration of content, pedagogical strategies, and technology, while simultaneously promoting the progressive development of students' multimedia literacy competencies. The six stages are described in Fig. 4.

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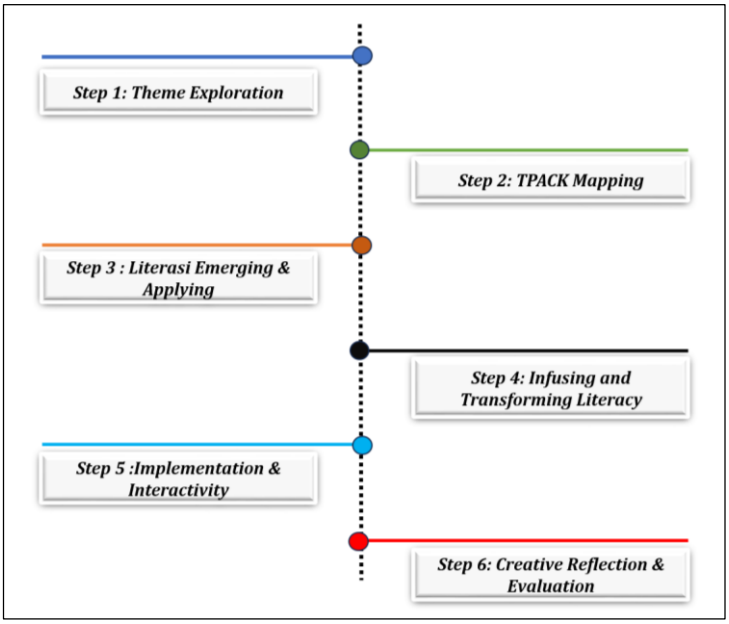

Fig. 4. Stages of Multimedia Literacy Development in Dance Education

Findings from the literacy stage and the design of TPACK-based interactive teaching materials through ICT literacy were adapted from the model proposed by Majumdar et al. (2005)[32], which consists of the following stages:

- Stage 1. Theme Exploration in Action 1: Introduction and Basic ICT Literacy: The initial stage focuses on developing students' foundational understanding of the role of technology in thematic learning. Lecturers facilitate the introduction of ICT concepts, educational software, and the potential of interactive technologies, while students explore various platforms such as Canva, Genially, and PowerPoint. This stage represents the emerging ICT literacy phase within the TPACK framework, with the primary outcome being students' ability to comprehend the basic functions of technology in interactive learning design. These findings align with Yeh *et al.* [33], who highlight that the integration of TPACK through project-based and reflective practices enhances pre-service teachers' competence in designing technology-supported learning materials.
- Stage 2. TPACK Mapping in Action 2: Understanding TPACK and Integrating Learning Themes: The second stage serves as a bridge between technological understanding and pedagogical structure. Lecturers introduce the TPACK framework with an emphasis on the integration of technology, content, and pedagogy. Students analyze curriculum themes, identify core competencies, and construct the foundational structure of materials for further development. At this ICT literacy level, the applying phase is evident, as technology begins to be utilized in the planning and design of instruction. Existing research confirms that TPACK-based teaching materials play a crucial role in integrating technology, pedagogy, and content to foster 21st-century learning competencies. [34].
- Stage 3. Emerging and Applying Literacy in Action 3: Designing Interactive Teaching Materials: The third stage represents the peak of students' creative engagement in designing TPACK-based interactive thematic teaching materials. At this point, students integrate visual media, audio elements, animation, and digital interactive features under the guidance of lecturers, who provide formative and constructive feedback. Their ICT literacy reaches the infusing phase, characterized by the integrated and purposeful use of technology in learning design [35]. The primary focus at this stage lies in achieving alignment among technological, pedagogical, and content dimensions [36], culminating in the creation of interactive teaching material prototypes that reflect students' comprehensive understanding of the TPACK model [37]. These findings reinforce the view that prospective art educators with strong creative capacities possess the potential

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to cultivate multimedia literacy through artistic exploration and technological experimentation [38].

- Stage 4. Infusing and Transforming Literacy in Action 4: Product Implementation and Presentation: At this stage, implementation is conducted through presentations and learning simulations in which students demonstrate their interactive teaching materials, while lecturers act as facilitators. Here, ICT literacy reaches the transforming phase, characterized by the comprehensive application of the TPACK framework [39]. The developed products are tested through simulation activities and receive feedback from lecturers and peers regarding content quality, pedagogical methods, and technological integration. The activities include discussions, educational games, media-based dance demonstrations, and intergroup collaborations that foster communication, problem-solving, and adaptive content development. Observations indicate notable improvements in pedagogical competence, collaboration, and technological proficiency, confirming the effectiveness of project-based learning (PjBL) in guiding prospective teachers' transition from technology users to technology integrators within instructional practice [40]. Examples of interactive thematic teaching materials developed by students and compiled using Book Creator include various forms of media, such as Canva-based interactive modules, digital comics, animated dance learning videos, and interactive quizzes, Fig. 5.

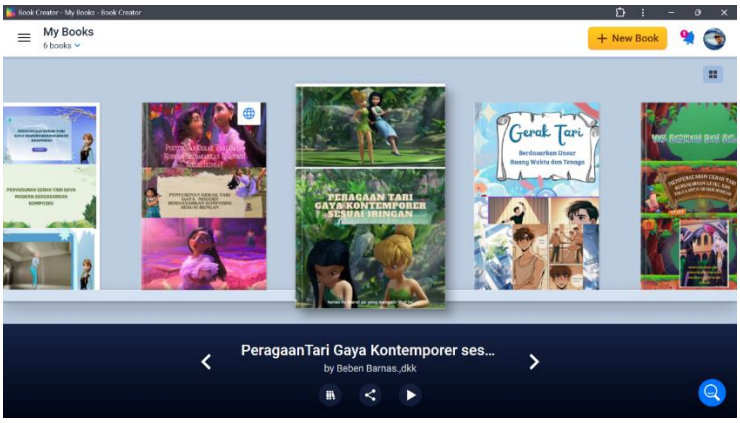

Fig. 5. Interactive Teaching Materials for Dance Education Based on Book Creator

- Stage 5. Interaction and Interactivity in Action: At the implementation and interactivity stage, lecturers act as facilitators who guide learning objectives, direct the use of teaching materials, and provide feedback [41], while students present multimedia products containing text, images, audio, video, and other interactive components. The central focus at this stage is the practical application of multimedia literacy, specifically, the harmonious integration of diverse media elements to support effective learning [42]. The process of developing multimedia literacy across the six stages emphasizes not only aesthetic considerations but also the alignment of content with competencies, pedagogical principles, and learners' needs [43]. Reflection at each stage contributes to the refinement, contextual relevance, and readiness of the teaching materials for implementation [44]. At the implementation and interactivity stage, lecturers act as facilitators who guide learning objectives, direct the use of teaching materials, and provide feedback, while students present multimedia products containing text, images, audio, video, and other interactive components. The central focus at this stage is the practical application of multimedia literacy, specifically, the harmonious integration of diverse media elements to support effective learning.
- Stage 6. Reflection and Critical Evaluation: At the end of each stage, evaluation and reflection are conducted to assess the overall progress of the process. This final stage serves as a reflective phase in which students and lecturers collaboratively evaluate TPACK-based products encompassing aspects of technology, pedagogy, content, creativity, and interactivity [45]. Through critical discussions and feedback, students

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learn to analyze the effectiveness of both the substance and the presentation of their materials [46]. At this point, ICT literacy evolves into a conceptual framework for evaluating instructional practices, with an emphasis on pedagogy and assessment [47]. The outcomes, comprising reflective reports and revised products, demonstrate the maturity of students' thinking as prospective innovative educators in the digital era. These findings are consistent with which highlights that structured TPACK-based reflection can enhance both the quality of instructional materials and the understanding of technology's role in learning [48].

3.3. Feasibility and Effectiveness of the Product in Enhancing Competence

This section presents three main research outcomes: the validation of product feasibility, the assessment of students' competence in product design, and the evaluation of product effectiveness in real classroom contexts. First, based on the experts' evaluations, this section reports the results of the feasibility testing. The assessment was conducted by three specialists, namely, a technology expert, an instructional design expert, and a field instructor, each of whom examined the product from distinct perspectives: technical suitability, pedagogical accuracy, and contextual applicability. This process aimed to ensure that the product met academic, functional, and practical standards before its implementation in the effectiveness testing stage. Furthermore, the effectiveness test focused on determining the extent to which the product's use could significantly enhance students' knowledge, skills, and attitudes in alignment with the intended learning outcomes. The feasibility test yielded high ratings across all material aspects, with an average score of 4.00 on a five-point scale. This result placed the instructional material in the "Feasible" category, indicating that it was developed through a rigorous academic approach and a strong sensitivity to pedagogical principles. The material was not only comprehensive and logically structured but also successfully bridged the gap between the prescribed learning objectives and the real-world conditions encountered by students in the context of dance education.

Beyond numerical scoring, the validation process involved reflective and constructive dialogues. In these open discussions, the validators emphasized that within arts education, meaning is not solely embedded in textual or explicit content but often emerges from learning experiences designed with authenticity and affective engagement. They underscored the importance of maintaining equilibrium between conceptual rigor and interpretive openness, creating pedagogical spaces that encourage creative exploration. Consequently, the teaching materials were recognized not merely as sources of information but as instruments of inspiration. This validation confirmed that the developed teaching materials successfully harmonize content relevance with humanistic values in arts education. Rather than existing as a static compilation of instructional content, the materials serve as a medium for authentic learning experiences, a dialogic space where theory, skill, and aesthetic values coexist and evolve. In developing interactive thematic materials for dance education, the researchers intentionally prioritized not only informational density but also the aesthetic quality, communicative flow, and structural coherence of the learning experience. This approach stems from the belief that in arts education, how knowledge is conveyed is as significant as what is conveyed. Therefore, the materials were validated comprehensively in terms of systematics, aesthetics, and adherence to multimedia design principles.

The validation was conducted by three experts from distinct domains: an arts educator proficient in pedagogical and aesthetic expression, a multimedia specialist with expertise in visual, audio, and digital presentation design, and a practitioner educator representing field application. These experts evaluated fifteen indicators, encompassing layout organization, graphical resolution, narrative and audio quality, text–background color contrast, and the application of key multimedia design principles such as spatial contiguity, signaling, and modality. The validation results indicated that the teaching materials achieved a total score of 61 out of 75, yielding an average of 4.1, which places the product in the "Suitable" category. This outcome demonstrates that the product has met aesthetic and technical standards at an optimal level, though minor refinements could further enhance the user experience. The validators commended the visual harmony and color composition for fostering an engaging learning atmosphere, as well as the effective audio-visual integration that strengthened conceptual

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understanding. Nevertheless, constructive feedback was provided during the discussion sessions, highlighting the need to refine visual transitions to minimize distractions and to enhance signaling elements so that visual cues become more intuitive, particularly for novice users.

This validation reinforces the understanding that aesthetics in learning are not merely supplementary but constitute an integral component of the educational process[49]. The implementation of sound multimedia design principles enables the integration of visual appeal with pedagogical effectiveness [50]. Consequently, teaching materials become not only visually engaging but also function as cognitive and affective instruments that support deeper learning [51]. From this perspective, the results reaffirm that visual design and aesthetics extend beyond surface appearance; they operate as a secondary language within the learning process, one that shapes and influences how learners think, feel, and comprehend [52]. Through this validation, it can be asserted that the visual language embedded in the teaching materials communicates meaning with clarity, evokes emotional engagement, and conveys depth to each user [53]. Based on a feasibility assessment conducted by three experts, the developed interactive thematic teaching materials were classified as "Feasible," meeting academic, technical, and aesthetic standards. The product effectively integrates digital literacy with humanistic values, serving not only as an informational resource but also as an inspirational medium that encourages students' creative exploration[54]. Survey results indicate that the majority of students demonstrated strong capabilities in developing interactive teaching materials with innovative designs, though refinement is still needed in visual transitions, signaling elements, and visual creativity. Overall, the product shows substantial potential to enhance students' competencies across multiple dimensions.

Furthermore, analysis of students' design performance, based on five evaluation aspects, reveals that most participants exhibited commendable proficiency in developing interactive teaching materials. Pre-post assessment data demonstrate significant competency gains: multimedia design skills increased from M=62.4 (SD=8.7) to M=84.3 (SD=6.2), $t(26)=12.45$, $p<.001$, $d=2.83$; TPACK knowledge scores improved from M=58.7 (SD=9.3) to M=81.6 (SD=7.1), $t(26)=10.87$, $p<.001$, $d=2.73$; creative self-efficacy rose from M=3.2/5.0 (SD=0.8) to M=4.3/5.0 (SD=0.5), $t(26)=8.34$, $p<.001$, $d=1.65$. The aspect of design innovation received positive feedback from 74.0% of respondents, satisfactory feedback from 24.42%, while only 1.48% indicated a need for improvement in visual creativity and structural coherence, Fig. 6. Portfolio analysis revealed that 81.5% of final products successfully integrated at least four multimedia elements (text, image, audio, video, interactive features), compared to 11.1% in initial prototypes.

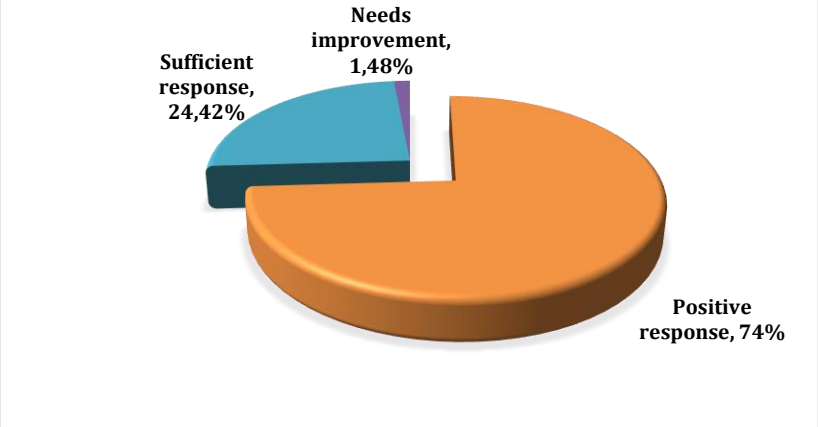

Fig. 6. Overall percentage graph of student creativity assessment

Students demonstrated a relatively strong understanding of the relevance of literacy. The developed teaching materials comprise five key components: (1) interactive PowerPoint or Canva media serving as visual navigation tools that integrate motion sequences with audio

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narration; (2) digital books providing movement descriptions, aesthetic values, and audiovisual links to support independent learning; (3) digital comics that present contextual visual narratives to enhance conceptual understanding; (4) animated videos of contemporary dance illustrating dynamic movement demonstrations; and (5) interactive quizzes incorporating visual and animated elements to assess technical accuracy, movement interpretation, and alignment with musical accompaniment [55]. The findings indicate that the integration of multimedia literacy not only diversifies the representation of teaching materials but also fosters students' active participation, cognitive engagement, and aesthetic appreciation in understanding dance as a contextual and transformative art for [56]. Furthermore, results from the ANOVA test reveal that the regression model using Multimedia Literacy Awareness as a predictor of Multimedia Product Creation Ability is statistically significant (p = 0.002). This confirms that Multimedia Literacy Awareness exerts a substantial and meaningful influence on students' ability to create multimedia-based products [57], Table 1.

Table 1. Regression Analysis of Literacy Awareness on Multimedia Product Creation Skills

Coefficients[a]						
Model		***Unstandardized Coefficients***		***Standardized Coefficients***	***t***	***Sig.***
		B	***Std. Error***	***Beta***		
1	(Constant)	72.690	5.586		13.012	<.001
	Multimedia Literacy Awareness	.234	.068	.568	3.447	.002
a. Dependent Variable: Ability to Create Multimedia Products						

The Coefficients table presents the regression analysis results, with Multimedia Product Creation Ability as the dependent variable and Literacy Awareness and Multimedia Awareness as the independent variables. The constant value of 72.690 indicates the baseline level of multimedia product creation ability in the absence of influence from either independent variable. The coefficient of 0.234 for Literacy Awareness suggests that a one-unit increase in this variable leads to a 0.234-point improvement in multimedia product creation ability. The standardized Beta value of 0.568 further demonstrates that Literacy Awareness exerts a substantial and dominant influence, positioning it as a key determinant in enhancing the quality of multimedia production skills [58]. The t-value of 3.447 with a significance level of 0.002 (p < 0.05) confirms that Literacy Awareness has a statistically significant effect on multimedia product creation ability, underscoring its relevance within the regression model. Overall, the ANOVA results indicate that the regression model incorporating Multimedia Literacy Awareness as a predictor has a significant effect on Multimedia Product Creation Ability (F = 8.555, p = 0.007) [59]. Based on the Coefficients Table 2, the relationship between Multimedia Literacy Use (X) and Multimedia Product Creation Ability (Y) is represented by the regression equation Y = 76.080 + 0.186X. The constant value of 76.080 indicates that, in the absence of multimedia literacy utilization, the baseline ability to create multimedia products remains at that level. The coefficient of 0.186 suggests that for every one-unit increase in Multimedia Literacy Use, the ability to create multimedia products increases by 0.186 units. The significance test results show that the constant has a t-value of 14.025 with a p-value < 0.001, indicating statistical significance. The Multimedia Literacy Utilization variable obtained a t-value of 2.925 with a p-value of 0.007 (p < 0.05), demonstrating a significant influence on Multimedia Product Creation Ability [60].

Table 2. Results of Regression Coefficient Analysis between Multimedia Literacy Awareness Variables and Multimedia Product Creation Skills

Coefficients[a]						
Model		***Unstandardized Coefficients***		***Standardized Coefficients***	***t***	***Sig.***
		B	***Std. Error***	***Beta***		
1	(Constant)	76.080	5.425		14.025	<.001
	Use of Multimedia Literacy Results	.186	.064	.505	2.925	.007
a. Dependent Variable: Ability to Create Multimedia Products						

 ISSN 2655-9153

The standardized Beta coefficient (β = 0.505) indicates a moderate effect, meaning that higher levels of multimedia literacy utilization are associated with greater multimedia production skills [58]. Overall, the regression analysis confirms that the use of multimedia literacy outcomes significantly affects students' ability to create multimedia products (p = 0.007). This finding implies that the more frequently and effectively students apply their multimedia literacy, the higher their creative production competence. However, the relatively small regression coefficient (0.186) also suggests that other factors contribute to students' abilities beyond this variable [61]. Regarding the applicability of students' creative teaching materials in practice, descriptive analysis of eight learning aspects assessed by 30 respondents revealed consistently high scores, ranging from an average of 10.63 to 11.80 out of a maximum of 12. The Attractiveness aspect achieved the highest mean score (11.80), equivalent to 98.3% of the maximum, with the lowest standard deviation (SD = 0.805), Fig. 7. This indicates a high level of agreement among respondents and confirms that the interactive and aesthetic qualities of the thematic materials were perceived as highly engaging and broadly appreciated [62].

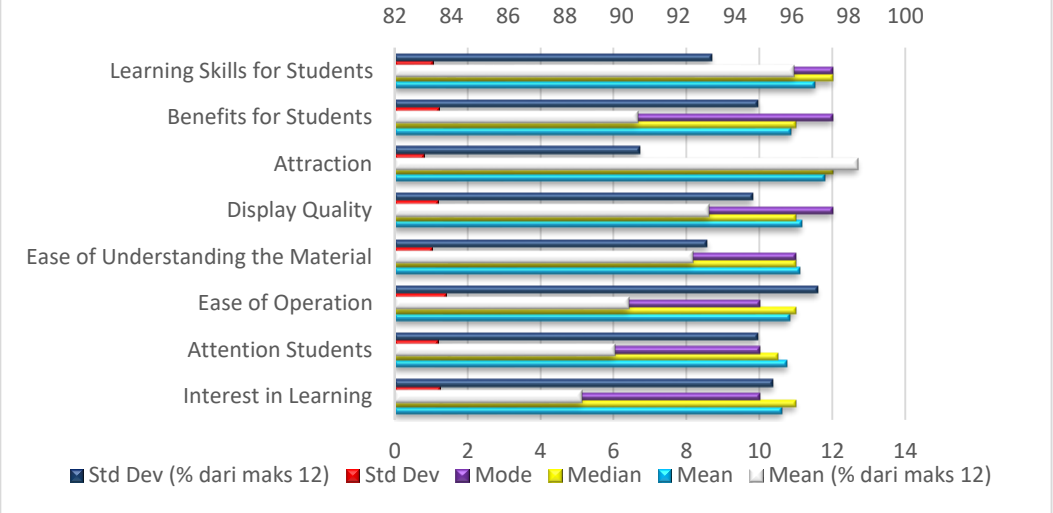

Fig. 7. Product applicability

On the other hand, the Learning Interest aspect obtained the lowest average score, 10.63 or 88.6% of the maximum value, with a standard deviation of 1.245. Although this score is still categorized as high, it indicates potential areas for improving students' motivation and engagement. Learning interest could be further enhanced through strategies such as gamification, providing varied learning options, and designing progressive challenges aligned with students' individual competencies [63]. The Ease of Operation aspect recorded an average score of 10.83 (90.3%) with the highest standard deviation among all aspects (SD = 1.392). This variation suggests that while most respondents found the materials easy to navigate, a small number encountered technical or interface-related difficulties [64]. Therefore, layout standardization, consistent iconography, and concise operational guidelines are recommended to ensure seamless usability across all user groups [65]. Other dimensions, including Student Attention (10.77 or 89.8%), Ease of Understanding the Material (11.10 or 92.5%), Display Quality (11.17 or 93.1%), Usefulness for Students (10.87 or 90.6%), and Learning Skills Development (11.53 or 96.1%), also received very positive evaluations. The high ratings in Ease of Understanding and Display Quality confirm that the teaching materials effectively present information in a clear, contextual, and aesthetically engaging manner [66]. Meanwhile, the elevated score in Learning Skills Development highlights the effectiveness of these materials in fostering independent learning through structured note-taking, assessment rubrics, and self-evaluation checklists [67]. In summary, when ranked from highest to lowest, the average scores are as follows: Attractiveness (98.3%), Learning Skills Development (96.1%), Display Quality (93.1%), Ease of Understanding the Material (92.5%), Usefulness (90.6%), Ease of Operation (90.3%), Student Attention (89.8%), and Learning Interest (88.6%). Collectively, these findings demonstrate that the developed interactive thematic teaching materials received strong positive evaluations across nearly all criteria, with a few areas still open for optimization to

 ISSN 2655-9153

enhance students' overall learning experience [68]. This distribution is presented in the following Table 3.

Table 3. Product applicability results.

Learning Aspect	Percentage	Category
Attractiveness	98,3%	Very Good
Learning skills	96,1%	Very Good
Display quality	93,1%	Very Good
Ease of understanding the material	92,5%	Very Good
Ease of operation	90,3%	Very Good
Interest in learning	88,6%	Very Good

All assessed learning aspects received highly positive evaluations from respondents, with average scores exceeding 88% of the maximum value. Attractiveness achieved the highest and most consistent score, demonstrating the success of the interactive design and aesthetic components in capturing learners' attention. Similarly, Learning Skills and Display Quality obtained excellent ratings, reflecting the significant contribution of the developed materials to the enhancement of learning strategies and the effectiveness of visual presentation [66]. Conversely, Learning Interest and Ease of Operation ranked relatively lower, although both remained within the "very good" category. These findings suggest that refinements in these two areas, such as incorporating gamification elements and optimizing navigation, could further enhance student engagement and usability [69]. Overall, the results confirm that the interactive thematic teaching materials are pedagogically sound, technically feasible, and hold strong potential for improving learning quality, while still allowing for minor adjustments to achieve optimal performance [68]. The interactive thematic materials were also verified as both feasible and effective for use in the target schools, with all learning aspects scoring above 88% of the maximum. Attractiveness again emerged as the highest-rated dimension, followed by Learning Skills, Display Quality, and Ease of Understanding the Material, all of which performed at excellent levels [57]. Although Learning Interest and Ease of Operation scored slightly lower, they remained within the "very good" range and can be further improved through strategies such as gamified engagement, refined interface navigation, and concise instructional guides [63]. In general, these findings underscore the strong potential of the developed product to enhance learning quality and foster deeper student engagement. Consistent with prior research emphasizing that digital literacy, as a foundational competency in modern education, requires the integration of authentic digital projects to improve content understanding, critical thinking, collaboration, and problem-solving. Students in this study also demonstrated growing awareness in tailoring digital content to the characteristics of digital learners, particularly through visual, communicative, and meaningful modes of presentation.

4. Conclusion

This study successfully developed and validated interactive thematic dance teaching materials integrating multimedia literacy through a competency-based approach, making four distinct theoretical contributions: (1) the first empirically validated adaptation of Majumdar's model for kinesthetic-aesthetic learning domains, (2) evidence challenging deficit assumptions about arts educators' technological capacity (β=0.505, p=0.007), (3) a six-stage pedagogical framework preserving artistic authenticity while systematically incorporating technology, and (4) operationalization of multimedia literacy as both developmental process and measurable outcome. Pedagogically, the model demonstrates that pre-service teachers, when provided structured literacy development, function as sophisticated content creators rather than passive technology adopters, with products achieving 98.3% attractiveness ratings and >88% effectiveness across all learning dimensions. This framework advances 21st-century arts education by demonstrating that disciplinary epistemology and digital innovation need not conflict—technology integration can enhance rather than compromise aesthetic and humanistic values when grounded in domain-specific pedagogical architectures. Future research should examine scalability across diverse arts disciplines and longitudinal impacts on teaching practices.

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