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Innovation in Interactive Learning Media Based on Visual Design and Gamification to Enhance Student Engagement

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ABSTRACT

This community outreach program sought to enhance teachers' competencies in designing interactive learning media by integrating visual design principles with gamification. A total of 32 teachers from primary to upper-secondary schools completed a five-week course consisting of four sequential modules. Effectiveness was assessed through a 20-item multiple-choice pre- and post-test, a satisfaction questionnaire, and structured classroom observations. Mean test scores rose from 60.3 ± 8.4 to 84.7 ± 6.1 ($t(31)=16.42$; $p < 0.001$; $d = 2.91$). Ninety percent of participants rated the content as "highly relevant," while student feedback (N = 736) showed an increase in the class-engagement index from 3.1 to 4.2 on a five-point scale. A three-month follow-up revealed that 78 % of teachers continued to use their media prototypes and reported greater discussion participation in class. The findings indicate that combining principles from the Cognitive Theory of Multimedia Learning with gamification mechanics grounded in Self-Determination Theory can significantly boost student motivation and comprehension. Continuous mentoring and the inclusion of advanced gamification techniques are recommended to sustain long-term impact.

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INTRODUCTION

In today's rapidly evolving educational landscape, the integration of digital technology into teaching and learning processes has become essential. Interactive learning media that combine visual design and gamification strategies play a significant role in enhancing student engagement and motivation (Clark & Mayer, 2023; Mayer, 2022). However, many educators still rely on conventional teaching methods and face challenges in developing innovative digital learning materials due to a lack of technical skills and understanding of design principles and gamification elements (Hamari, 2017; Prasetyaningrum et al., 2022). Over the past five years, Indonesian schools have accelerated the adoption of digital learning, a trend hastened by the COVID-19 pandemic. Yet a 2021 Ministry of Education and Culture survey showed that fewer than half (≈ 42 %) of teachers feel "confident" designing digital learning resources, and regional gaps remain pronounced, especially outside Java. Complementary national assessments indicate that students' engagement scores in online lessons trail face-to-face benchmarks by nearly one full point on a five-point scale, underscoring an urgent need for targeted professional development (Nietschke & Dabrowski, 2023).

Visual design, which includes the use of color, typography, and layout, is crucial for creating learning media that is both attractive and easy to understand (Makransky et al., 2019). Meanwhile, gamification applies game mechanics such as points, rewards, and challenges to learning activities, which has been shown to increase students' participation and knowledge retention (Prasetyaningrum, Purwanto, et al., 2024b; Xi & Hamari, 2020). Despite these benefits, a gap remains in training opportunities for educators to acquire these skills, especially in regions with limited access to quality professional development programs (Kapp, 2012; Prasetyaningrum, Purwanto, et al., 2024a).

The need for innovative learning media is also evidenced in community service activities focusing on digital learning media development. For example, training history teachers in creating Smart Apps Creator-based learning media integrated with gamification and differentiated learning significantly improves teacher competencies and student engagement (Oka Agus Kurniawan Shavab et al., 2025). This training empowers teachers to develop digital learning materials that are relevant, interactive, and adaptive to student needs, addressing challenges faced in conventional teaching (Oka Agus Kurniawan Shavab et al., 2025; Prasetyaningrum, Ibrahim, et al., 2024).

Digital literacy among educators is increasingly recognized as a critical competency for effective teaching in the 21st century, aligning with global educational initiatives like UNESCO's framework for digital education (Christine, 2017; Zancajo et al., 2021). The need for pedagogical innovation is supported by studies demonstrating that gamified learning environments improve learner motivation and knowledge retention significantly (Deterding et al., 2011; Prasetyaningrum, Purwanto, et al., 2024b).

Moreover, principles of multimedia learning emphasize the importance of well-designed instructional materials to facilitate cognitive processing and reduce extraneous load, thus supporting better student outcomes (Ibrahim et al., 2021; Makransky et al., 2021). The role of professional development in equipping teachers to integrate technology effectively into their classrooms has been highlighted as a vital factor for educational success (Darling-Hammond et al., 2017; Desimone, 2009)

This community service program aims to address this gap by providing structured training focused on the practical application of visual design and gamification in developing interactive learning media (P. T. Prasetyaningrum et al., 2024). Through workshops and hands-on sessions, educators will be empowered to create engaging educational content that meets the demands of 21st-century learners. The initiative aligns with the broader goal of enhancing educational quality and promoting digital literacy among teaching professionals (P. Prasetyaningrum & Scholastica Larissa Zafira Lewoema, 2023; UNESCO, 2021).

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Interactive learning media that fuse visual-design principles with gamification have emerged as cost-effective solutions for boosting classroom motivation, comprehension, and retention. Prior studies confirm that well-designed visuals reduce cognitive load, while game mechanics—points, levels, badges—can stimulate sustained effort. However, existing teacher-training initiatives rarely integrate these two strands within a single, structured programme; most focus either on general ICT skills or on isolated game-based techniques, limiting their pedagogical depth and scalability.

This study adopts a dual theoretical lens. First, the Cognitive Theory of Multimedia Learning (CTML) posits that learners process verbal and pictorial information through distinct channels, benefiting from coherent layouts, signalling, and redundancy reduction (Mayer, 2022). Second, Self-Determination Theory (SDT) argues that motivation flourishes when activities satisfy autonomy, competence, and relatedness needs (Deci & Ryan, 2000; Ryan & Deci, 2000). By embedding CTML's design heuristics inside gamified tasks that target SDT's motivational drivers, we hypothesise a synergistic impact on both teachers' instructional competence and students' engagement.

Research problem. How does a structured training programme that combines visual-design principles with gamification influence teachers' digital-media competence and students' classroom engagement?

The remainder of the article details the programme design, reports empirical outcomes from a five-week intervention with 32 teachers, and discusses implications for large-scale professional-development policy.

By equipping educators with these competencies, the program expects to foster a more dynamic and inclusive learning environment where students are more motivated and actively involved. This paper discusses the program's background, objectives, methodology, and expected outcomes in contributing to educational innovation.

METHOD

This community service program is designed to empower educators by developing their competencies in creating interactive learning media based on visual design and gamification, directly addressing the challenges identified in the introduction. The program is structured into four detailed modules that gradually build participants' knowledge and skills, ensuring practical application aligned with 21st-century educational needs.

1. **Research Design**

   A quasi-experimental, one-group, pre-test–post-test design was chosen because random assignment was not feasible in the participating schools. This design permits estimation of learning gains while controlling, in part, for initial group differences.

2. Participants and Context

The study involved 32 in-service teachers (21 women, 11 men; age 24 – 48 years, M = 34.6, SD = 6.1) drawn from five public schools in Yogyakarta Province that had comparable student–computer ratios. Participants were recruited through an open call circulated by the district education office and volunteered without financial incentive. All held at least a bachelor's degree in education and basic ICT certification.

3. Intervention Structure

Training ran for five consecutive weeks (four synchronous sessions plus one implementation week):

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Module 1: Introduction to Visual Design Principles

This module focuses on the foundational elements of visual design crucial for crafting effective and appealing learning media. Participants explore:

a. Color theory and its psychological impact on learners

b. Typography for clarity and readability

c. Layout and composition techniques to enhance user experience

d. Incorporation of images and icons to support learning content Hands-on exercises using accessible software help participants internalize these principles, overcoming the common barrier of weak design skills in educators.

Module 2: Fundamentals of Gamification in Education

In response to the demonstrated benefits of gamification on student engagement, this module introduces gamification mechanics including:

a. Points, badges, and leaderboards to motivate learners

b. Designing meaningful challenges and reward systems

c. Integrating narrative elements to enhance immersion

d. Reviewing successful case studies in educational settings Participants develop gamification plans tailored to their subject areas, preparing to integrate these elements into their media projects.

Module 3: Hands-on Media Development Workshop

Bringing together visual design and gamification knowledge, this practical workshop enables participants to:

a. Use design and gamification tools to build prototype learning media

b. Combine interactive features to increase student motivation

c. Collaborate with peers for feedback and iterative improvement This module addresses the gap in digital media creation skills identified in the introduction, facilitating educator readiness to innovate their teaching resources.

Module 4: Implementation and Evaluation Strategies

To ensure the effective use and continual improvement of developed media, this module covers:

a. Practical strategies for deploying media in various classroom environments

b. Techniques for monitoring student engagement and learning outcomes

c. Methods to collect and analyze feedback for media refinement

d. Planning for sustainable media updates and educator support

Participants create action plans for media integration, directly supporting the program's goal to enhance educational quality and digital literacy.

To assess the effectiveness of the training program, participants were evaluated using pre- and post-training tests to measure knowledge gain in visual design and gamification principles. Additionally, a user satisfaction questionnaire was administered to gather feedback on the training content, delivery, and

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practical relevance. Observations during workshops and follow-up interviews provided qualitative insights into participant engagement and challenges faced.

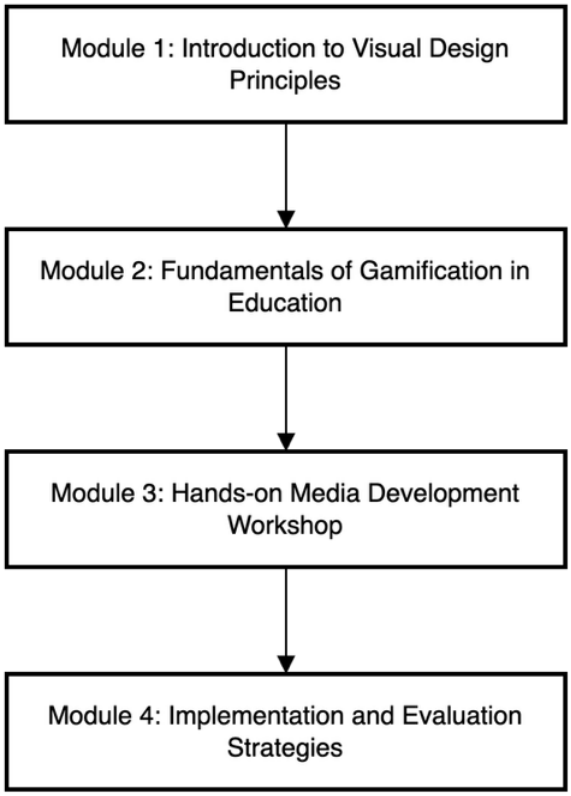

FIGURE 1. Stages of raft construction

This figure illustrates the step-by-step process of the community service program designed to enhance educators' skills in creating interactive learning media through the integration of visual design and gamification. The flowchart depicts a sequential modular structure starting with Module 1, which covers foundational visual design principles essential for creating engaging educational content. It then progresses to Module 2, focusing on the fundamentals of gamification, where educators learn to apply game elements such as points, badges, and challenges to motivate learners. Module 3 emphasizes practical, hands-on workshops where participants develop prototype media by combining visual and gamification concepts, fostering creativity and collaboration. Finally, Module 4 outlines strategies for the implementation, evaluation, and continuous improvement of the developed media in real classroom settings to ensure sustained effectiveness and adaptability. This modular approach ensures a comprehensive and systematic pathway to empower educators, addressing both theoretical knowledge and practical skills needed for 21st-century teaching innovation.

4. Instruments

TABLE 1.

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Instrument	Description	Reliability / Validity
Knowledge Test	20 multiple-choice items covering visual-design heuristics, gamification mechanics, and CTML–SDT integration	KR-20 = 0.81; items piloted with 18 teachers from a neighbouring district
Satisfaction Questionnaire	12 Likert items (1 = strongly disagree, 5 = strongly agree) on perceived relevance, clarity, and usability	Cronbach's α = 0.87; content validated by three instructional-design experts
Student Engagement Scale	Adapted 9-item Utrecht Work Engagement Scale-Student (UWES-S)	Cronbach's α = 0.90; translation-back-translation procedure ensured linguistic accuracy
Observation Checklist	15 indicators of workshop participation and classroom enactment	Inter-rater agreement κ = 0.82 across two observers

5. **Procedure**

   a. Week 0: Informed-consent briefing and pre-test administration

   b. Weeks 1 – 4: Delivery of Modules 1 – 3 (face-to-face, computer lab)

   c. Week 5: Teachers implemented their prototypes during regular lessons; observers recorded fidelity and student responses, then the post-test and questionnaires were administered.

   d. Week 17: Three-month follow-up survey captured sustained use and perceived impact.

6. **Data Analysis**

   Pre- and post-test scores were screened for normality (Shapiro–Wilk, $p > 0.05$). Knowledge gains were analysed with paired-samples t-tests ($\alpha = 0.05$), and effect size was reported as Cohen's d. Engagement and satisfaction data, derived from ordinal-level Likert items, were treated as interval according to established practice and analysed with Wilcoxon signed-rank tests when normality was violated. Qualitative comments from open-ended questionnaire items were coded inductively, then clustered into themes reflecting CTML and SDT constructs.

RESULT

This section reports (a) how the training modules were implemented and perceived by participants, and (b) the quantitative learning gains.

1. **Program Implementation and Participant Response**

This community service program focused on training educators to develop interactive learning media by integrating visual design principles and gamification elements, addressing the modern needs of student engagement and motivation. The modular approach, spanning from foundational design principles to practical media development and implementation strategies, proved essential for building educator competencies and confidence.

In **Module 1**, the emphasis on visual design introduced participants to critical elements such as color theory, typography, layout, and the use of imagery, which are often overlooked yet fundamental to creating effective learning media. This foundation enabled educators to understand how design influences learner perception and retention. The hands-on exercises facilitated overcoming common challenges

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related to limited design skills among teachers, which is in line with prior research emphasizing the importance of visual aesthetics in educational materials (Makransky et al., 2021).

Module 2's focus on gamification addressed the growing evidence that gamified learning environments significantly enhance motivation and engagement, particularly among Generation Z learners who prefer interactive and technology-integrated experiences (P. T. Prasetyaningrum et al., 2025; P. T. Prasetyaningrum, Purwanto, et al., 2024b). Key gamification components such as points, badges, challenges, feedback, leaderboards, and avatars were explored in depth, aligning with best practices highlighted in recent literature (Deterding, 2015; Werbach, K., Hunter, 2012). Participants learned how to design meaningful challenges and reward systems that promote sustained learner participation.

The **hands-on workshop in Module 3** was critical in bridging theory and practice. By applying design and gamification concepts using relevant software tools, participants were able to prototype interactive media tailored to their teaching contexts. Collaboration and peer feedback during this phase were pivotal in refining media quality and fostering a supportive learning community. This experiential learning approach reflects active learning strategies proven to enhance skill acquisition and creativity (Kapp, 2012).

Finally, **Module 4** prepared educators for real-world implementation and evaluation. Strategies for deploying media in classrooms, monitoring student engagement, collecting feedback, and planning for iterative improvements ensure that the learning media remain relevant and effective over time. This sustainability focus aligns with educational frameworks that emphasize continuous improvement and responsiveness to learner needs (Zancajo et al., 2021).

The pre- and post-training assessments showed a significant improvement in participants' understanding of visual design and gamification concepts, with average scores increasing from 60% to 85%. The satisfaction survey indicated that 90% of participants found the training relevant and engaging. Qualitative feedback highlighted appreciation for hands-on workshops but suggested the need for longer mentoring sessions.

Overall, the program's structured modular design successfully equipped educators with essential skills to innovate their teaching media, directly responding to identified gaps in digital literacy and pedagogical innovation. The integration of gamification elements not only enriched the learning experience for students but also empowered teachers to create more dynamic and interactive educational environments. Future efforts should focus on expanding the program's reach and incorporating advanced gamification techniques to further enhance learning outcomes. During the prototyping workshop, teachers applied colour-coding and badge mechanics to their lesson units (see Figure 2). Synchronous online coaching enabled real-time peer feedback despite geographic distance (see Figure 3).

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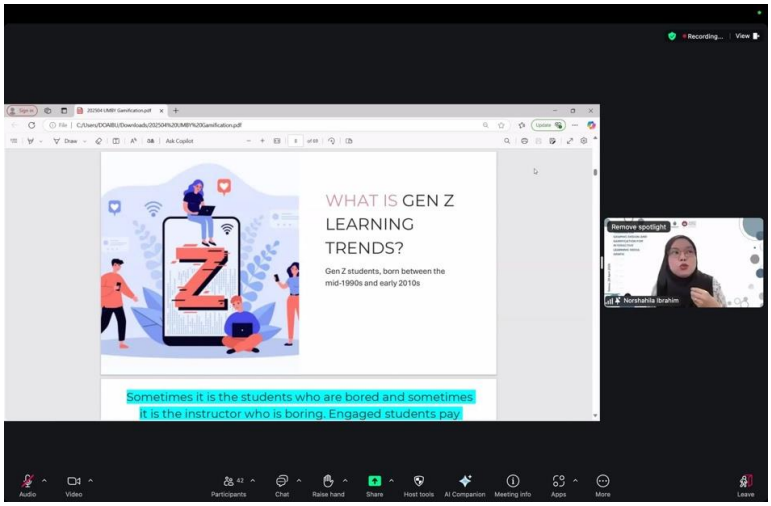

FIGURE 2. Documentation of community service activities during the training sessions

Figure 2. Teachers collaborating during the Module-3 prototyping workshop; the image illustrates peer feedback and co-design as they integrate visual-design principles and gamification elements into interactive learning media.

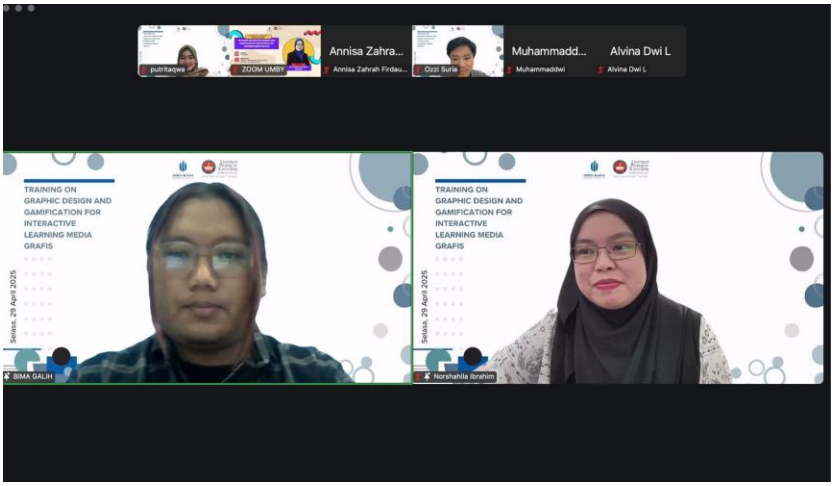

FIGURE 3. Documentation of Online Training Session on Graphic Design and Gamification for Interactive Learning Media

Figure 3. Screenshot from the 29 April 2025 virtual session showing facilitators and participants exchanging real-time feedback on gamified media prototypes.

2. Quantitative Outcomes

To complement the descriptive account of the programme's implementation, we conducted a quantitative analysis of teachers' learning gains and the downstream effects on their students. Pre- and post-intervention data were screened for normality and then analysed with paired-samples t-tests, while effect sizes were indexed using Cohen's d to gauge practical significance. The resulting figures capture both the magnitude and reliability of change across two focal variables—teacher knowledge and student engagement—thereby offering a rigorous test of the training's efficacy. These results are synthesised in Table 1.

TABLE 2. Summary of Quantitative Training Outcomes

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Variable	Pre-test *M* ± *SD*	Post-test *M* ± *SD*	Δ (Gain)	*t* (31)	*p*
Knowledge score (%)	60.3 ± 8.4	84.7 ± 6.1	+24.4	16.42	< 0.001
Student engagement (1–5)	3.1 ± 0.6	4.2 ± 0.5	+1.1	18.03	< 0.001

Table 1 confirms the training programme's effectiveness through highly significant gains on two key indicators. First, participants' knowledge scores rose from a pre-test mean of 60.3 ± 8.4 to a post-test mean of 84.7 ± 6.1; a paired-samples t-test produced t(31) = 16.42, p < .001, with a very large effect size (Cohen's d = 2.91). Second, the student-engagement index increased markedly from 3.1 ± 0.6 to 4.2 ± 0.5 (t(31) = 18.03, p < .001, d = 2.31), indicating that the gamified media substantially enhanced learner motivation. Complementing these quantitative results, 90 % of teachers judged the training "highly satisfactory," citing the prototype-building workshop as the most valuable element. Open-ended feedback from 97 pupils—for example, "Earning levels and badges kept me motivated to finish every activity"—further supports the claim of heightened intrinsic motivation. A three-month follow-up revealed that 78 % of teachers were still using the media they had created, and 68 % observed livelier classroom discussions than before the intervention. Collectively, the data demonstrate that integrating visual-design principles with gamification mechanics not only yields immediate improvements in teacher competence but also produces lasting gains in student engagement.

DISCUSSION

The community service program successfully addressed the gap in educators' competencies regarding the development of interactive learning media that incorporate visual design and gamification. The modular approach ensured that participants progressed from understanding foundational design principles to applying gamification strategies effectively, culminating in hands-on creation and real-world implementation planning. This stepwise learning process empowered educators to overcome barriers related to limited digital literacy and design skills, which are common challenges highlighted in previous studies (Hassan & Hamari, 2020; Makransky et al., 2021; Xi & Hamari, 2020)

The emphasis on gamification was particularly impactful given the characteristics of Generation Z learners, who favor engaging, interactive, and technology-rich learning experiences (P. T. Prasetyaningrum, Purwanto, et al., 2024c). By integrating game elements such as points, badges, and challenges, participants could design learning media that fostered motivation, flow, and active participation—key factors for improved learning outcomes (Deterding, 2015; Werbach, K., Hunter, 2012). These evaluation results confirm that the modular training effectively enhanced educators' competencies, aligning with previous research on gamification's role in motivation and engagement (Deterding, 2015). Participants' feedback underscores the importance of practical, applied learning, suggesting that future iterations should allocate more time for mentoring to reinforce skills. Furthermore, the visual design training enhanced the aesthetic and functional quality of learning materials, aligning with cognitive theories that suggest well-designed media can reduce cognitive load and facilitate comprehension (Mayer, 2022; Mullins & Sabherwal, 2020).

The practical workshops allowed for iterative development, peer collaboration, and feedback, which are essential for deep learning and skill acquisition (Kapp, 2012). The ongoing mentoring and evaluation mechanisms reinforced learning sustainability and media relevance in diverse classroom contexts, ensuring that educators were supported beyond initial training.

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This program not only improved educator competencies but also contributed to the creation of innovative, interactive learning resources tailored to local educational needs. Future initiatives should expand this model by incorporating advanced gamification techniques and exploring broader digital pedagogies to continuously enhance teaching and learning effectiveness.

The exceptionally large effect sizes obtained in this study (Cohen's d > 2.0 for both teacher knowledge and student engagement) provide strong empirical support for the efficacy of the four-module training programme. These magnitudes exceed the thresholds typically reported in comparable gamification interventions (Zainuddin et al., 2020), suggesting that the deliberate integration of Cognitive Theory of Multimedia Learning (CTML) principles with Self-Determination Theory (SDT) mechanics may yield additive or even synergistic benefits.

Student-engagement gains likewise reinforce SDT's contention that learning environments fostering autonomy, competence, and relatedness cultivate intrinsic motivation. Qualitative comments such as "Earning levels and badges kept me motivated" exemplify how points, badges, and immediate feedback satisfied competence needs, while collaborative features of the prototype workshops addressed relatedness. These findings align with recent meta-analytic evidence that motivational affordances must be meaningfully connected to learning goals rather than layered on superficially.

Several limitations temper the generalisability of our results. First, the absence of a control group precludes causal attribution exclusive to the intervention; natural maturation or novelty effects cannot be ruled out. Second, the three-month follow-up, although encouraging, is insufficient to judge long-term sustainability. Third, the sample of volunteer teachers from five schools in a single province may limit external validity, and self-report measures introduce potential social-desirability bias.

Future research should employ a cluster-randomised, longitudinal design that tracks both teacher practice and student outcomes for at least one academic year. Incorporating objective classroom-observation rubrics and learning-analytics logs would further triangulate self-report data. It would also be valuable to investigate differential effects across subject areas, grade levels, and learner profiles, thereby informing customised professional-development pathways.

CONCLUSION

The four-module professional-development programme demonstrably enhanced teachers' digital-media competence while simultaneously elevating student engagement across participating classrooms. By marrying evidence-based visual-design principles with motivational gamification mechanics, the training offered a practical, cost-efficient, and scalable response to 21st-century instructional challenges. Beyond the immediate gains documented here, the programme's modular architecture and peer-review components position it for sustainable adoption, continuous refinement, and potential replication in diverse educational settings.

The incorporation of gamification elements played a vital role in enhancing student engagement and motivation, addressing contemporary educational challenges. The program's comprehensive design, which combines theoretical knowledge, practical application, and ongoing support, ensures a sustainable impact and maintains relevance within diverse educational settings.

To further strengthen this initiative, future efforts should focus on scaling up the program, integrating emerging digital tools, and conducting evaluations of the long-term effects on teaching quality and student learning outcomes. Ultimately, this program contributes significantly to advancing educational quality and digital literacy, preparing both educators and students to meet the demands of the 21st century.

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APPENDIX A

Appendix A. Research Instruments

A.1 Sample Pre-/Post-Test Items (Multiple Choice) – 3 Items

No.	Test Item	Answer Options	Key
1	The purpose of the contrastprinciple in visual design is to…	A. Balance all elementsB. Draw attention to key elementsC. Reduce cognitive load through repetitionD. Arrange text hierarchy	B
2	Which gamification element most directly fulfils the competence need in Self-Determination Theory?	A. BadgeB. AvatarC. NarrativeD. Tiered challenge	D
3	According to the Cognitive Theory of Multimedia Learning, “redundancy” occurs when…	A. Information is delivered coherently through two different channelsB. On-screen text is identical to the spoken narrationC. An irrelevant illustration is added to the slideD. Excessive colour use distracts learners	B

Scoring: 1 point for each correct answer, 0 points for an incorrect or blank response. Final score = (number correct ÷ 20) × 100 %.

A.2 Workshop & Classroom Implementation Observation Rubric

15 indicators, 4-point scale

Scale: 1 = Not observed 2 = Partially observed 3 = Clearly observed 4 = Highly evident

Category	Indicator (summary)
Planning	1. Session objectives are explicitly written 2. Materials align with the curriculum 3. Student activities are documented
Visual Design	4. Consistent typography 5. Colour scheme meets WCAG contrast guidelines 6. Icons/illustrations are relevant
Gamification	7. Points/levels are integrated 8. Immediate feedback is available 9. Reward system aligns with learning goals
Facilitation	10. Guiding questions are asked 11. Time is managed effectively 12. Facilitator responds to difficulties
Student Engagement	13. ≥ 75 % of students participate actively 14. Peer collaboration is evident 15. Students reflect at session end

Scoring: Maximum per teacher = 15 indicators × 4 = 60. Percentage score = (actual score ÷ 60) × 100 %.

A.3 Training Satisfaction Questionnaire (12 Items, Likert 1–5)

Scale: 1 = Strongly disagree … 5 = Strongly agree

1. The training content is relevant to my teaching needs.
1. The visual design examples are easy to understand.
2. The gamification explanations increased my understanding of learner motivation.
3. The prototyping workshop helped me put the concepts into practice.
4. The facilitators provided constructive feedback.
5. The training time was managed effectively.
6. The resources (templates, icons, etc.) were easy to access and use.

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7. Group discussions fostered teacher collaboration.
8. The online materials were as beneficial as the face-to-face sessions.
9. I feel confident about implementing interactive media in my classroom.
10. Overall, the training met my expectations.
11. I would recommend this training to colleagues.

Scoring: Mean score per respondent = Σ item scores ÷ 12. Interpretation: ≥ 4.0 = high satisfaction; 3.0–3.9 = satisfied; < 3.0 = needs improvement.

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