

Designing a Project-Based Training Model for Enhancing Pedagogical Competence of Prospective Elementary Teachers Through Interactive Media Development

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ABSTRACT

This study was motivated by the limited skills of prospective elementary school teachers in designing interactive instructional media due to minimal practical experience and the lack of systematic guidelines. The research aimed to develop and examine the effectiveness of a project-based training model supported by Flip PDF, using a sequential mixed-methods design. The study involved 60 participants from two teacher education institutions in two countries: Indonesia (32 participants) and Uzbekistan (28 participants). Data were collected through in-depth interviews, classroom observations, questionnaires, pre- and post-tests, and product assessments, and then analyzed using content analysis for qualitative data and paired sample t-tests for quantitative data. The qualitative findings revealed five main themes: the need for systematic technical guidance, positive perceptions of digital media, limited technological mastery, the importance of collaboration and feedback, and expectations for ready-to-use products. These findings informed the development of a six-stage training model, under the acronym CREATE (Conceptualize, Research, Execute, Assess, Transform, Evaluate), encompassing idea formulation, reference exploration, prototype development, rubric-based assessment, revision through feedback, and final evaluation. Quantitative results showed a significant improvement in pedagogical competence: pretest scores in Indonesia increased from 54.59 to 82.78 ($t = 81.427$; $p < 0.05$), while Uzbekistan increased from 53.54 to 80.50 ($t = 73.785$; $p < 0.05$). Product assessments yielded scores of 3.35 (Indonesia) and 3.34 (Uzbekistan), while model acceptance surveys achieved 3.54 (Indonesia) and 3.49 (Uzbekistan), all categorized as Excellent. The CREATE model proved to be effective, systematic, and innovative in enhancing skills for designing interactive instructional media and is deemed feasible for adoption in twenty first century teacher education.

KEYWORDS

Project based training; Flip PDF; CREATE model; prospective elementary school teachers; interactive instructional media.

INTRODUCTION

In twenty-first-century education, prospective elementary school teachers are required to possess high levels of creativity and strong pedagogical competence in designing instructional media (Lapcharoen, 2021). Instructional media play a crucial role in helping students grasp abstract concepts in a more concrete way, stimulating learning interest, and facilitating active learning experiences aligned with their developmental stages (Aziz et al., 2011; Dewi, 2020). However, a preliminary survey of 178 prospective teachers in Indonesia and Uzbekistan revealed that 62% still relied on conventional media, only 23% were able to independently create interactive digital media, and 15% merely used ready-made media without modification. These findings indicate that, despite exposure to theoretical knowledge in teacher education programs, many prospective teachers lack sufficient practical experience in developing interactive instructional media. Furthermore, the absence of structured and systematic guidelines within existing training practices contributes to the limited variety and interactivity of instructional media, thereby reducing their effectiveness in fostering critical thinking, creativity, and collaboration (Oluwajana et al., 2019; Saputra et al., 2023). These conditions highlight the urgent need for a simple, accessible, and beginner-friendly platform that supports multimedia integration.

Various applications for developing instructional media are available; however, many require advanced technical skills or costly licenses, making them less accessible for novice teacher candidates. Flip PDF emerges as a viable solution as it can transform conventional teaching materials into interactive digital media with a book-like appearance, equipped with features such as hyperlinks, videos, quizzes, and audio (Komikesari et al., 2020). This application offers a user-friendly interface, supports collaborative design, and is compatible with various devices (Yoshino et al., 2017). Therefore, developing a project-based training model using Flip PDF is essential to train prospective teachers to creatively produce interactive media while addressing the challenges of digital transformation in elementary education and fostering the emergence of adaptive, innovative teachers aligned with sustainable development agendas (Mohanty, 2018).

Several studies have highlighted the integration of technology in teacher training. Bygstad et al., (2022) examined digital transformation through digital learning spaces, aligning digitalization with subject areas, repositioning the roles of lecturers and students, and transcending physical boundaries; however, their focus remained at a macro level. Lyublinskaya and Du (2024), demonstrated that project-based training enhances novice teachers' creativity, yet it did not emphasize the use of specific technologies. Reisoğlu and Çebi (2020), through a 70-hour DigComp-based program, improved participants' digital literacy, collaboration, and content creation skills, but the training did not result in tangible products. Similarly, Humida et al., (2022) reported the effectiveness of e-learning tools without linking project work to a specific platform for interactive media. Collectively, these studies provide evidence of the effectiveness of project-based training and technology in enhancing teachers' skills; however,

none have specifically developed a project-based training model utilizing Flip PDF to improve the pedagogical competence of prospective elementary school teachers in designing interactive instructional media. This research gap forms the basis of the study's novelty while supporting the digital transformation of elementary education and contributing to the achievement of Sustainable Development Goal 4 on Quality Education (Awini et al., 2024).

Referring to the findings of previous studies and the identified research gap, this study is designed to address the following key research questions:

RQ1. What are the needs of prospective elementary school teachers regarding a project-based training model using Flip PDF for developing interactive instructional media?

RQ2. What are the stages involved in developing a project-based training model using Flip PDF to enhance the pedagogical competence of prospective elementary school teachers?

RQ3. How effective is the project-based training model using Flip PDF in improving the ability of prospective elementary school teachers to design interactive instructional media?

THEORETICAL FRAMEWORK

Pedagogical Competence and the Challenges of 21st-Century Education

Pedagogical competence is an essential aspect for prospective teachers in designing, implementing, and evaluating effective and innovative learning that aligns with the characteristics of elementary school students. This competence includes mastery of learning theories, understanding of child development, classroom management strategies, and the use of instructional technology (Ranta et al., 2023; Shi & Blau, 2020). In the 21st century, the teacher's role has shifted from being a mere transmitter of knowledge to a facilitator who fosters collaboration, creativity, critical thinking, and effective communication in line with the 4Cs paradigm (Bygstad et al., 2022; Lapcharoen, 2021). Prospective teachers are also required to possess digital literacy and the ability to design contextual interactive instructional media (Brega & Kruglyakova, 2025). Without these competencies, learning risks becoming static and irrelevant.

The challenges of 21st-century education are not limited to mastering technology but also include sensitivity to learner diversity and a commitment to inclusivity and sustainability (Awini et al., 2024). Studies have shown that teachers with innovation-based pedagogical competence can enhance student engagement and learning outcomes through diverse digital media (Dewi, 2020; Reisoğlu & Çebi, 2020). However, surveys reveal that many prospective teachers still rely on conventional media, have limited experience in producing interactive media, and struggle to apply design thinking (Oluwajana et al., 2019; Saputra et al., 2023). This underscores the urgency of developing a project-based training model that integrates pedagogical theory with practical digital media creation to produce adaptive, creative, and professional teachers, highlighting the need for experiential and practice-oriented learning approaches that bridge theory and real-world application.

Project-Based Training Approach in Teacher Professional Development

To meet the demands of pedagogical competence and 21st-century skills, an applicative training approach is required. One proven effective method is project-based training, which bridges theory and real-world practice in teacher professional development (Lyublinskaya & Du, 2024). This approach positions prospective teachers as both designers and implementers of activities that produce instructional products, grounded in the paradigm of social constructivism that emphasizes knowledge construction through authentic experiences, interaction, and reflection (Miroslavljević, 2022). Research has shown that active engagement in projects encourages the application of pedagogical theories in practical contexts, thereby enhancing critical thinking, creativity, and collaboration (Reisoğlu & Çebi, 2020).

Unlike conventional training, project-based training facilitates the creation of tangible products such as interactive media or digital modules by integrating design thinking and contextual problem-solving (Fakhruddin et al., 2024). Its core principles include product orientation, collaboration, continuous evaluation, and alignment with field-based needs (Lyublinskaya & Du, 2024). Empirical evidence indicates that such training enhances teachers' technological literacy, instructional innovation, and professional reflection (Ergün et al., 2019; Uerz et al., 2018), while also fostering ongoing development in line with curricular and technological changes (Orakova et al., 2024). Thus, project-based training is effective in shaping adaptive, innovative teachers with strong pedagogical and digital competence (Velempini, 2025), particularly when supported by appropriate digital tools that facilitate the development of interactive instructional media.

Integration of Digital Technology in Designing Interactive Instructional Media

The effectiveness of project-based training in developing prospective teachers' pedagogical competence can be further optimized when supported by the integration of relevant and easily implementable digital technology. Integrating technology into the development of interactive media has become a crucial focus because it expands the ways teachers deliver content while enriching students' learning experiences (Pandita & Kiran, 2023). According to the Technological Pedagogical Content Knowledge (TPACK) framework, successful integration depends not only on software proficiency but also on the alignment of content, pedagogy, and technology (Lachner et al., 2021; Magocha et al., 2025; Maphoto, K., & Suliman, 2024; Mosia & Matabane, 2022). Technology enables the presentation of abstract concepts through dynamic visualizations, simulations, and interactivity that encourage independent exploration (Warmi et al., 2024).

Various studies show that the use of digital media can increase student engagement, deepen conceptual understanding, and foster collaboration (Lachner et al., 2021; Mpiti et al., 2023; Pandita & Kiran, 2023; Reisoğlu & Çebi, 2020; Warmi et al., 2024). In the context of teacher education, early exposure to designing digital media during pre-service training is a crucial foundation for meeting the demands of 21st-century education. Integrating technology in

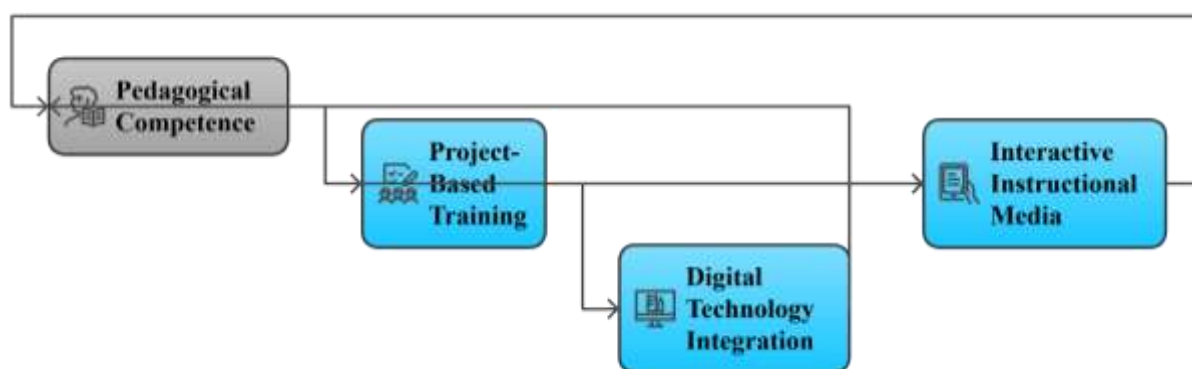
teaching is not merely a technical innovation but also a pedagogical strategy that supports the achievement of learning goals effectively and sustainably (Orakova et al., 2024; Torre, 2023).

Flip PDF is a concrete example of digital technology that can transform modules or worksheets into interactive media equipped with hyperlinks, quizzes, audio, and video (Komikesari et al., 2020; Yoshino et al., 2017). Survey results indicate that many prospective teachers still struggle to design digital media due to a lack of practical guidance (Oluwajana et al., 2019). Therefore, developing a project-based training model using Flip PDF combines technical and interactive pedagogical aspects, forming the basis of educational innovation to produce adaptive, creative teachers who are relevant to the demands of 21st-century education.

Based on the theoretical perspectives discussed above, this study integrates pedagogical competence, project-based learning, and digital technology into a unified conceptual framework. Pedagogical competence is positioned as the primary outcome, reflecting prospective teachers' ability to design effective instructional media. Project-based training serves as the pedagogical approach that facilitates active, experiential, and collaborative learning. Meanwhile, Flip PDF functions as a technological tool that supports the development of interactive instructional media through accessible and user-friendly features. The interaction among these components forms an integrated learning system in which project-based training, supported by digital technology, enhances pedagogical competence through hands-on experience and iterative feedback, as illustrated in Figure 1.

Figure 1.

Integrated Conceptual Framework for Teacher Professional Development



METHOD

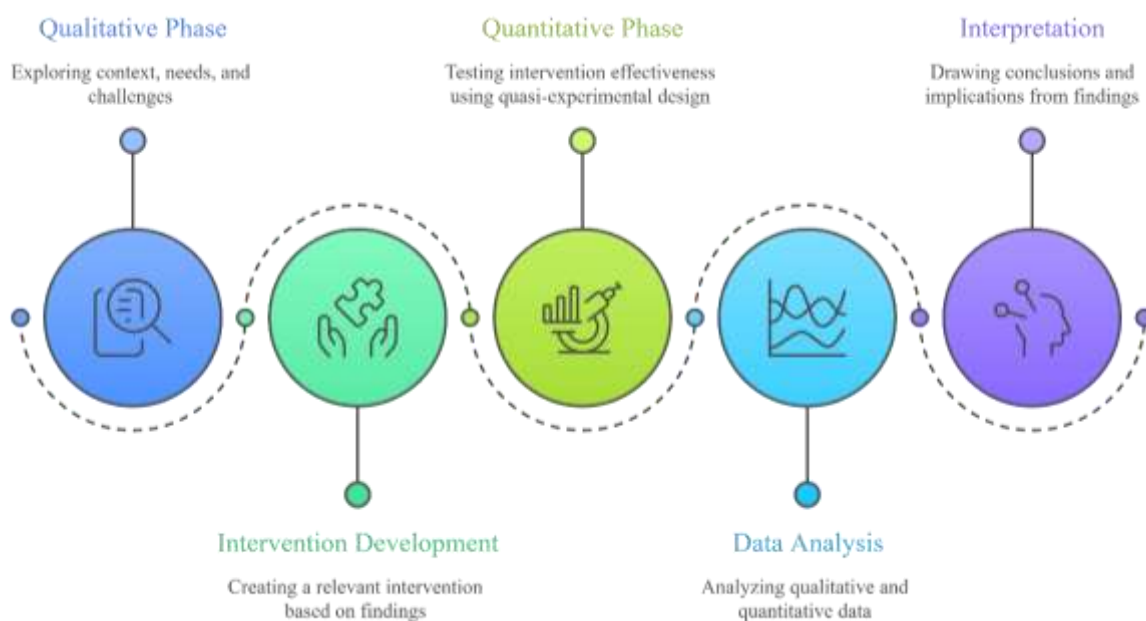
Design and Procedure

This study employed a mixed-methods approach using a sequential exploratory design to generate a comprehensive understanding alongside robust empirical validation, as illustrated in Figure 2. The research began with a qualitative phase aimed at systematically identifying the context, needs, and challenges faced by prospective teachers, ensuring that the developed intervention was contextually grounded and empirically informed; the findings from this phase

subsequently served as the conceptual foundation for intervention development as well as the basis for instrument construction. In the subsequent stage, the study proceeded with a quantitative phase using a quasi-experimental (pretest–posttest) design to examine the effectiveness of the developed intervention. This methodological approach was selected as it enables the systematic integration of qualitative exploration and quantitative testing, thereby strengthening construct validity while producing measurable, reliable, and scientifically accountable empirical evidence (Creswell & Plano Clark, 2023; Tashakkori & Teddlie, 2010).

Figure 2.

Mixed-Methods Research Design



Participants and Research Setting

The participants of this study consisted of 60 prospective elementary school teachers drawn from two teacher education institutions in Indonesia ($n = 32$) and Uzbekistan ($n = 28$). The participants were selected based on their enrollment in teacher education programs that include components related to instructional media and digital learning. The research was conducted through a combination of online and offline training sessions at the respective institutions, ensuring that participants engaged in both theoretical and practical learning activities within authentic educational settings.

In the qualitative phase, 20 participants (12 from Indonesia and 8 from Uzbekistan) were selected using purposive sampling to ensure representation of variation in key characteristics, including prior experience with digital media, level of study, and familiarity with instructional technology (Campbell et al., 2020). This approach enabled the researchers to capture diverse perspectives regarding participants' needs, perceptions, and challenges in designing interactive instructional media. The findings from this phase were subsequently used to inform the development of instruments and the design of the training model for the quantitative phase.

Although the qualitative participants were drawn from the larger sample, this design was intentionally adopted to ensure continuity between the exploratory and intervention phases, consistent with the principles of sequential mixed-methods research (Creswell & Plano Clark, 2023). To minimize potential bias arising from participant overlap, the quantitative phase employed structured instruments and objective measurements, including pretest–posttest assessments and rubric-based product evaluation. This design ensured that the findings remained robust and reflective of participants’ actual learning outcomes.

Data Collection

In the qualitative phase, data were collected from 20 purposively selected participants (12 from Indonesia and 8 from Uzbekistan) through semi-structured in-depth interviews conducted via Zoom, each lasting approximately 45–60 minutes, audio-recorded with participants’ consent, and transcribed verbatim. The interviews were guided by a structured protocol to explore participants’ needs, perceptions, and challenges in designing interactive instructional media. In addition, non-participant observations were conducted during initial training sessions using structured observation sheets to capture participants’ engagement, interaction patterns, and technical difficulties in utilizing digital media tools. The findings from the qualitative phase were subsequently used to inform the development of instruments for the quantitative phase. In the quantitative phase, data were collected from all 60 participants (32 from Indonesia and 28 from Uzbekistan) using multiple instruments, including a 20-item Likert-scale questionnaire (scale 1–4), pretests and posttests to measure changes in pedagogical competence, and product assessment rubrics evaluating interactive instructional media based on design creativity, feature interactivity, content relevance, and technology integration. Additionally, a model acceptance survey was administered to assess participants’ perceptions of the training model. All instruments were validated by three experts prior to implementation, and the training was conducted through a combination of online and offline sessions.

Data Analysis

Data analysis was conducted in an integrated manner following a mixed-methods approach, in which qualitative data obtained from interviews and observations were analyzed using thematic content analysis through systematic stages of transcription, open coding, categorization, and theme development to identify patterns related to participants’ needs, perceptions, and challenges (Anney, 2014). To enhance the reliability of the qualitative analysis, two researchers independently conducted the coding process, and discrepancies were discussed until consensus was reached, ensuring intercoder agreement. The identified themes were subsequently used as the basis for developing indicators and instruments for the quantitative phase, in which each theme was systematically translated into measurable constructs and operationalized into multiple questionnaire items aligned with the study variables.

Quantitative data were analyzed using SPSS software, where descriptive statistics were employed to summarize data trends, and paired-sample t-tests were conducted to examine differences between pretest and posttest scores. Prior to hypothesis testing, the assumption of

normality was assessed using the Shapiro–Wilk test to ensure the appropriateness of parametric analysis. Furthermore, product assessment data were analyzed using rubric-based scoring, and model acceptance data were interpreted using mean score analysis to determine participants' level of agreement regarding the effectiveness and usability of the training model. The pedagogical competence instrument consisted of five indicators—understanding of instructional media concepts, design skills, technology integration, interactivity, and evaluation ability—with a summary of the instrument provided in the appendix to enhance transparency.

Validity and Reliability

Instrument validity was established through expert judgment by three experts in educational technology and instructional media development. Each item was reviewed to ensure alignment with the research indicators, and expert feedback was used to refine the wording, concepts, and item relevance until strong content validity was achieved. The Likert-scale questionnaire, administered via Google Forms, was then piloted with 20 respondents with characteristics similar to the main participants. The results showed a Cronbach's Alpha of 0.86, exceeding the 0.70 threshold, indicating that the instrument was reliable and suitable for use (Cohen et al., 2017).

Ethical Considerations and Data Availability

This study was conducted in accordance with established ethical research principles. Permission to conduct the study was obtained from the respective educational institutions in Indonesia and Uzbekistan. All participants were informed about the purpose and procedures of the study and provided informed consent prior to participation. Participation was voluntary, and participants had the right to withdraw at any time without any consequences. Confidentiality and anonymity were strictly maintained, and all data were used solely for research purposes and stored securely. The data supporting the findings of this study are available from the corresponding author upon reasonable request and are not publicly available due to privacy and ethical considerations.

RESULT

This section comprises three main components: qualitative findings, the design of the training model, and quantitative findings. The initial qualitative exploration identified the participants' needs, perceptions, and challenges in designing interactive media, which then served as the conceptual foundation for developing the training model.

Qualitative Phase: Identifying Needs, Perceptions, and Challenges

The analysis of in-depth interviews with 20 prospective elementary school teachers from Indonesia and Uzbekistan generated 675 significant statements that were synthesized into five major thematic findings. These five themes are as follows:

1. The Need for Practical Guidelines in Developing Interactive Media

The majority of participants emphasized the importance of clear and applicable technical guidance in designing interactive media. Up to now, the training they had received tended to be

theoretical with insufficient practical support. This was evident in several participant statements:

"We are often asked to create digital media, but we are never given detailed steps." (P7, Indonesia)

"If there were a structured guidebook, we would feel more confident in practicing it." (P4, Uzbekistan)

"So far, only general examples have been provided without clear practical guidance." (P10, Indonesia)

"Previous training was too theoretical and lacked technical instructions." (P2, Indonesia)

These findings indicate a gap between the demand for interactive media production and the availability of technical guidance, leading prospective teachers to rely on trial-and-error methods with suboptimal results. Therefore, training needs to be designed with systematic technical guidelines, clear workflows, and practical examples to effectively bridge theory and practice.

2. Positive Perceptions of Digital Media

Participants expressed positive views of digital media as a pedagogical tool that is relevant and engaging for students. Several statements supported this:

"Students nowadays are more interested in media that moves and has sound." (P3, Uzbekistan)

"Digital media makes difficult material easier to understand." (P5, Indonesia)

"Using videos or interactive quizzes makes the class more lively." (P8, Indonesia)

"We see that peers who use digital media get better learning responses from students." (P11, Uzbekistan)

These positive perceptions reflect strong psychological readiness and high motivation to use digital media, which is an important asset for training. With their belief in the relevance and benefits of interactive media, training is likely to be well-received and to encourage active participant engagement throughout each development stage.

3. Challenges in Technology Mastery

Although participants recognized the potential of digital media, most experienced limitations in mastering technical aspects, particularly in integrating multimedia elements, editing processes, and managing interactivity features. This was evident from their statements:

"I have not yet mastered how to insert videos or audio into a module." (P12, Indonesia)

"Creating interactive media is far more difficult than creating conventional media." (P6, Uzbekistan)

"We are rarely introduced to specific software for creating media." (P9, Indonesia)

"I feel less confident because of my limited technical skills." (P1, Indonesia)

These technical difficulties highlight the low level of technology literacy that needs to be addressed through practice-based training. The training program must provide hands-on experience, technical guidance, and repeated exploration so that participants can build confidence and acquire adequate technological competence.

4. The Need for Collaboration and Feedback

Participants desired a training environment that supported collaboration and continuous feedback. This was evident from several statements:

“Discussions with peers help generate new ideas.” (P13, Indonesia)

“We need reviews from lecturers to know which parts need improvement.” (P5, Uzbekistan)

“Group work makes the process more efficient and complementary.” (P10, Indonesia)

“The feedback given during the development process is very useful.” (P14, Uzbekistan)

These findings show that participants view collaboration and feedback as key to improving the quality of media. Discussions, idea exchanges, and peer evaluations spark creativity and reduce design errors, so training needs to facilitate intensive interaction, continuous review, and collective reflection.

5. Expectations for a Tangible, Ready-to-Use Product

Participants expressed strong expectations that training should not stop at concepts or drafts but lead to a final product ready to be implemented in teaching practice. This was evident from their comments:

“We hope that after the training we will have media that is truly ready to use.” (P9, Indonesia)

“Training that is only theoretical often leaves no lasting impression and is easily forgotten.” (P4, Uzbekistan)

“We want the media developed in training to be directly usable in our teaching practice.” (P7, Indonesia)

“A tangible product makes our efforts feel more worthwhile.” (P11, Uzbekistan)

Participants’ expectations for a ready-to-use product underscore the importance of a practical orientation in every stage of training, ensuring that the outcomes are not merely conceptual but take the form of interactive media that are relevant, innovative, and immediately applicable in classroom practice.

Overall, these five themes demonstrate that while prospective teachers show high motivation to develop interactive media, they are constrained by a lack of technical guidance, limited technological skills, and minimal collaborative experience. On the other hand, they possess positive perceptions of digital media and expect training to be product-oriented. These findings form the conceptual basis for designing the Flip PDF-assisted project-based training model in the subsequent phase.

Training Model

Based on the qualitative exploration and theoretical synthesis, this study developed a project-based training model named CREATE, an acronym for Conceptualize – Research – Execute – Assess – Transform – Evaluate. These stages represent a systematic framework designed to equip prospective elementary school teachers with the skills to develop interactive instructional media using Flip PDF. The model is structured to ensure that training participants not only understand the concepts but are also able to practice, evaluate, and refine the media products they create.

The Conceptualize stage begins with identifying the required content and formulating ideas for interactive media that align with the curriculum. This is followed by the Research stage, which focuses on exploring references, technological features, and examples of innovative media. In the Execute stage, participants implement their concepts by creating media prototypes, which are then assessed in the Assess stage using a rubric emphasizing creativity, interactivity, relevance, and technological integration. Feedback from this stage is utilized in the Transform stage to collaboratively revise and refine the media. Finally, the Evaluate stage is conducted to ensure the effectiveness of the product through trials and reflection, resulting in media ready to be implemented in real classroom settings.

To provide a clearer overview of the steps in the CREATE model, Table 1 presents the stages, descriptions, learning activities, and expected outcomes for each stage.

Table 1.

Steps of the CREATE Model

Stage (CREATE)	Process Description	Learning Activities	Expected Outcomes
C – Conceptualize	Identify content needs and formulate ideas for interactive media.	Needs discussion, brainstorming, curriculum analysis.	Participants are able to formulate relevant media concepts.
R – Research	Explore references, Flip PDF features, and examples of innovative media.	Literature review, application exploration, feature demonstrations.	Participants understand features and gain design inspiration.
E – Execute	Apply concepts by creating an interactive media prototype.	Hands on practice, technical tutorials, guided sessions.	Participants produce an initial draft of interactive media.
A – Assess	Evaluate the quality of the draft using an assessment rubric.	Peer review, rubric-based assessment, result discussions.	Participants identify aspects that need improvement.
T – Transform	Revise based on feedback and reflection.	Collaboration, improvement discussions, and product revision.	Participants refine media until it meets established standards.
E – Evaluate	Evaluate the effectiveness of media through simulated teaching.	Simulation, final reflection, validation.	Participants produce ready to use interactive media.

As shown in Table 1, each stage in the CREATE model is designed to guide participants from conceptualization to a validated final product. Through the integration of conceptual planning, technological exploration, hands-on practice, and continuous evaluation, participants are empowered to produce innovative, contextual, and classroom-ready interactive digital

media. Grounded in constructivism, design thinking, and project-based learning, this model offers authentic learning experiences while meeting the demands of 21st-century education relevant to elementary teaching.

Model Validation Test

After the CREATE model was designed, a validation test was conducted to ensure that each component aligned with pedagogical principles and field needs. The validation involved three experts: a learning model specialist, an educational technology expert, and a program evaluation expert. They assessed the appropriateness of the objectives, clarity of the steps, relevance of the content, and feasibility of implementation using a 1–4 scale (1 = not appropriate, 4 = highly appropriate). The results of the experts' assessments are presented in Table 2.

Table 2.

Results of the CREATE Model Validation Test

Assessed Aspect	Expert 1 Score	Expert 2 Score	Expert 3 Score	Average	Category
Alignment of model objectives	3.75	3.50	4.00	3.75	Highly Feasible
Clarity of model stages	3.50	3.75	3.75	3.67	Highly Feasible
Relevance of material & content	3.75	3.50	3.50	3.58	Highly Feasible
Feasibility of implementation	3.75	3.75	3.75	3.75	Highly Feasible
Overall Average	3.69	3.63	3.75	3.72	Highly Feasible

Table 2 shows that each validation aspect achieved a score above 3.50, with an overall average of 3.72 out of 4.00, indicating that the CREATE model is highly feasible for implementation. In addition to quantitative scores, the experts provided specific feedback on the Conceptualize and Research stages, particularly concerning needs analysis, goal formulation, and the clarity of references and technological features. These inputs were integrated through material refinement without altering the step structure, ensuring that the model remains consistent while becoming more practical and relevant for training prospective elementary school teachers.

Pilot Test

Before full-scale implementation, a pilot test was conducted with 10 prospective elementary school teachers who had characteristics similar to the main participants. All stages of the CREATE Model, from Conceptualize to Evaluate, were applied sequentially while observing participants' engagement, comprehension of each step, and the smoothness of Flip PDF usage. A summary of the pilot test results is presented in Table 3.

Table 3 shows that each stage of the CREATE Model in the pilot test was well understood by participants. The Conceptualize, Execute, Assess, and Transform stages received positive evaluations with no revisions required, while the Research stage received technical input for

more detailed explanations and additional media examples. These inputs have been accommodated without altering the step structure. These results confirm that the CREATE Model is feasible and ready to be implemented in the main testing phase.

Table 3.

Results of the CREATE Model Pilot Test

Observed Aspect	Pilot Test Findings	Follow-Up Action
Comprehension of the stage	Participants demonstrated a good understanding of needs analysis	No revision required
Comprehension of the Research stage	Participants required additional reference examples and feature guidance	Research materials enriched with media examples and Flip PDF exploration guides
Implementation of the Execute stage	Participants were able to create prototypes with minimal guidance	No revision required
Alignment of Assess and Transform stages	Participants understood the rubric and feedback well	No revision required
Supportive training materials	Materials were clear but needed additional illustrations	Materials enhanced with sample media and step by step visualizations

Quantitative Phase

After completing the pilot test and making technical refinements, the CREATE Model was implemented in the quantitative phase with 60 participants: 32 from Indonesia and 28 from Uzbekistan.

1. Pedagogical Competence

To measure participants' pedagogical competence before and after the training, descriptive statistical analysis was conducted on their pretest and posttest scores in both groups. These scores represent the average across five pedagogical competence indicators: understanding of interactive media concepts, needs analysis and design, mastery of Flip PDF features, application of design principles, and media evaluation and revision. Table 4 presents the number of participants (N), mean scores, and standard deviations (SD) for each group by country.

Table 4.

Descriptive Statistics of Pretest and Posttest Scores of Pedagogical Competence by Country

Country	N	Mean Pre	Mean Post	SD Pre	SD Post
Indonesia	32	54.59	82.78	2.87	3.59
Uzbekistan	28	53.54	80.50	2.63	3.45

The descriptive statistics indicate an increase in the mean scores from pretest to posttest in both groups after training with the CREATE model. The Indonesian group (n = 32) improved

from 54.59 to 82.78, while the Uzbek group ($n = 28$) improved from 53.54 to 80.50. The low standard deviations (pretest SD 2.87–2.63; posttest SD 3.59–3.45) indicate homogeneous score distributions. Overall, these findings show that the CREATE model training had a positive and consistent impact on enhancing participants' pedagogical competence in both countries.

To ensure the data met parametric assumptions, a normality test was performed using the Shapiro–Wilk method as the sample size was less than 200. The results are shown in Table 5.

Table 5.

Shapiro–Wilk Normality Test for Pretest and Posttest Scores of Pedagogical Competence

Variabel	Statistic	df	Sig.
Pretest	0.979	60	0.385
Posttest	0.983	60	0.582

As shown in Table 5, the significance values for the pretest (0.385) and posttest (0.582) scores are both greater than 0.05, indicating that the pretest and posttest score distributions are normal. Next, a homogeneity of variance test using Levene's Test was conducted to confirm equality of variances between the two groups. The results are presented in Table 6.

Table 6.

Levene's Test for Homogeneity of Variance

Gain Score of Pedagogical Competence	Levene Statistic	df1	df2	Sig.
Gain Score (Posttest–Pretest)	0.276	1	58	0.601

As shown in Table 6, the significance value of 0.601 (> 0.05) indicates that the gain score variances between the Indonesian and Uzbek groups are homogeneous. With both normality and homogeneity assumptions satisfied, further analysis was conducted using parametric statistics.

The first analysis used a paired-samples t-test to examine differences between pretest and posttest scores within each group. The results are shown in Table 7.

As shown in Table 7, both groups demonstrated a significant increase in scores from pretest to posttest following the implementation of the CREATE model. The Indonesian group improved from a mean score of 54.59 to 82.78, while the Uzbek group increased from 53.54 to 80.50. The relatively low standard deviations indicate a consistent distribution of scores within each group. The paired-samples t-test results showed significance values below 0.05 for both groups, confirming that the improvements were statistically significant. These findings suggest that the CREATE model effectively enhanced participants' pedagogical competence in designing interactive instructional media.

The scores were measured on a 0–100 scale, which contributes to the magnitude of the observed differences between pretest and posttest scores. The relatively small standard

deviations suggest that participants demonstrated homogeneous performance, particularly after the training, indicating consistent learning outcomes across individuals. The large *t*-values reflect the considerable difference between pretest and posttest scores, highlighting the strong effect of the intervention rather than a statistical anomaly. Overall, these findings provide robust evidence that the CREATE model had a strong and consistent impact on enhancing pedagogical competence in both groups.

Table 7.

Paired Samples t-Test for Pretest–Posttest Scores in Indonesia and Uzbekistan

Group	N	Mean Pre	Mean Post	SD Pre	SD Post	df	Sig. (2-tailed)
Indonesia	32	54.59	82.78	2.87	3.59	31	0.000
Uzbekistan	28	53.54	80.50	2.63	3.45	27	0.000

Finally, an independent samples *t*-test was conducted on the gain scores (posttest–pretest) to examine whether there were significant differences in improvement between the Indonesian and Uzbek groups. In addition to statistical significance, effect size was calculated using Cohen's *d* to assess the practical significance of the observed differences. The results are presented in Table 8.

Table 8.

Independent Samples t-Test on Gain Scores

Variabel	t	df	Sig. (2-tailed)	Mean Difference	Cohen's d
Gain Score	2.428	58	0.018	Higher in Indonesia	0.63

As shown in Table 8, the significance value of 0.018 (< 0.05) indicates a statistically significant difference in gain scores between the Indonesian and Uzbek groups. The mean gain score for participants in Indonesia was higher than that of participants in Uzbekistan, suggesting a greater improvement in pedagogical competence among the Indonesian group. To further assess the practical significance of this difference, Cohen's *d* was calculated, yielding a value of 0.63, which falls within the moderate to large effect size category. This result indicates that the difference in improvement between the two groups is not only statistically significant but also meaningful in practical terms. This moderate effect size contrasts with the substantial within-group improvements observed in Table 7, indicating that although both groups experienced strong gains in pedagogical competence, the difference between the two groups remained moderate. Overall, these findings suggest that the CREATE model was effective in enhancing pedagogical competence across both contexts, while demonstrating a relatively stronger impact in the Indonesian group.

2. Product Assessment

In addition to the improvement in competence as shown by pretest and posttest results, the quality of participants' interactive instructional media was evaluated based on four indicators: design creativity, feature interactivity, content relevance, and technology integration. A summary of the product assessment results is presented in Table 9.

Table 9.

Average Product Assessment Scores per Indicator

Indicator	Indonesia	Uzbekistan	Category
Design Creativity	3.20	3.18	Good
Feature Interactivity	3.28	3.35	Very Good
Content Relevance	3.70	3.60	Very Good
Technology Integration	3.22	3.26	Good
Overall Average	3.35	3.34	Very Good

As shown in Table 9, participants from Indonesia achieved an overall average score of 3.35 and those from Uzbekistan 3.34, both falling into the Very Good category (score range 3.25–4.00). The scores were derived from the average rubric scores for each indicator and converted into quality categories. Participants from Uzbekistan scored slightly higher in feature interactivity, whereas the other indicators were generally higher among participants from Indonesia.

3. Model Acceptance

The acceptance of the CREATE model was evaluated through a Likert-scale survey (1–4) covering four aspects: clarity of steps, ease of implementation, relevance to participant needs, and overall satisfaction. The evaluation categories followed the same conversion as the product assessment, with an average score of 3.25–4.00 classified as Very Good and 2.50–3.24 as Good. A summary of the model acceptance survey results is presented in Table 10.

Table 10.

Evaluation Results of CREATE Model Acceptance

Model Acceptance Aspect	Indonesia (n = 32)	Uzbekistan (n = 28)	Category
Clarity of training steps	3.60	3.55	Very Good
Ease of implementation	3.30	3.28	Very Good
Relevance to participant needs	3.75	3.68	Very Good
Overall satisfaction	3.50	3.45	Very Good
Overall Average	3.54	3.49	Very Good

As shown in Table 10, all aspects of model acceptance fall into the Very Good category. The highest scores were for relevance to participant needs (Indonesia 3.75; Uzbekistan 3.68), indicating that the training content aligned well with participants' expectations. The lowest

scores were for ease of implementation (Indonesia 3.30; Uzbekistan 3.28), which—while still Very Good—suggest a need for improvement by adding more practical examples, simplifying technical steps, or providing more intensive support. Overall, the average acceptance scores of 3.54 in Indonesia and 3.49 in Uzbekistan confirm that the CREATE model was very well received in both countries.

DISCUSSION

The findings of this study indicate that prospective elementary school teachers in Indonesia and Uzbekistan have an urgent need for a project-based training model utilizing Flip PDF. The qualitative results revealed that most participants struggled to design interactive instructional media due to limited experience and the absence of practical guidance. This finding answers Research Question 1. It aligns with Upadhyay (2017), who reported students' dependence on conventional media, with Dewi (2020), who highlighted the importance of innovative media for enhancing conceptual understanding, and with Lapcharoen (2021), who emphasized the demand for teacher creativity in the 21st century. These findings highlight a skill gap that must be bridged through project-based training.

In response to these needs, this study formulated the conceptual framework of the CREATE Model, consisting of six main stages: Conceptualize (formulating ideas for interactive media according to student needs), Research (exploring pedagogical references, content, and technology), Execute (developing interactive media using Flip PDF), Assess (evaluating the media using standardized rubrics), Transform (revising the product based on feedback from peers and instructors), and Evaluate (reviewing the final product in terms of creativity, interactivity, relevance, and technology integration). This description answers Research Question 2 regarding the step-by-step development of a project-based training model with Flip PDF. These findings are consistent with Lyublinskaya and Du (2024), who reported that project-based training supported by technology effectively enhances novice teachers' creativity. They also align with Mirosavljević (2022), who emphasized the importance of social constructivism in teacher professional development, and with Reisoğlu & Çebi (2020), who demonstrated improved digital literacy through project-based approaches. These results provide empirical support for developing an applicable training model for prospective elementary school teachers.

The effectiveness of the CREATE Model is evident from the quantitative results. The pretest–posttest analysis showed a significant increase in participants' pedagogical competence and technical skills in designing interactive media, with posttest averages markedly higher than pretest scores, confirmed by significant paired-samples t-test results. Product assessments also reported improvements in creativity, interactivity, and content relevance. These findings answer Research Question 3 regarding the effectiveness of the project-based training model with Flip PDF. The results are in line with Reisoğlu and Çebi, (2020), who reported enhanced digital competence through project-based training, supported by Ergün et al. (2019), who

documented improvements in teachers' technological literacy, and by Orakova et al. (2024), who highlighted the link between pedagogical competence and digital literacy.

While both groups demonstrated significant improvement, the higher gain scores observed in the Indonesian group compared to the Uzbek group require further interpretation.] The difference may be influenced by several contextual factors. One possible explanation is the variation in prior exposure to digital learning environments and instructional media design, which may have provided Indonesian participants with stronger initial readiness. In addition, differences in institutional support, including access to digital infrastructure, learning resources, and technological facilitation, may have contributed to more optimal learning conditions. Language factors may also have played a role, particularly if instructional materials and software interfaces were more accessible to one group than the other. Furthermore, differences in learning culture and familiarity with collaborative and project-based approaches may have influenced participants' engagement and learning outcomes. These findings suggest that while the CREATE model is effective across contexts, its impact may be moderated by contextual and institutional factors.

These findings are further supported by Komikesari et al. (2020), who demonstrated that Flip PDF can improve instructional media quality through interactive features such as videos, quizzes, and hyperlinks. They are also consistent with Yoshino et al. (2017), who reported the effectiveness of Flip PDF's interface in enhancing learning experiences, and with Warmi et al. (2024), who confirmed that animation-based digital media can foster student creativity. Collectively, these results affirm the relevance of this study's approach, strengthening both the theoretical and empirical foundations that Flip PDF is a practical tool for enabling prospective teachers to produce creative, responsive digital media that meet 21st-century educational demands.

CONCLUSION

This study concludes that the development of a project-based training model supported by the Flip PDF application—formulated through the CREATE stages (Conceptualize, Research, Execute, Assess, Transform, Evaluate)—has proven to provide a concrete solution to the needs of prospective elementary school teachers in designing interactive instructional media. Through these stages, participants were trained to conceptualize ideas, explore relevant theories and supporting content, execute their designs using Flip PDF, conduct assessments and transformations through feedback, and finally evaluate the end products to meet standards of creativity, interactivity, and relevance. This systematic process not only enabled participants to produce higher-quality media products but also demonstrated significant improvement in their pedagogical competence. The findings extend previous studies on project-based training and technology integration, while offering a practical contribution in the form of the CREATE model—an applicable, easy-to-implement, innovative, and contextually relevant framework

that aligns with the demands of 21st-century education and supports the development of adaptive and creative teachers.

Suggestion

Based on the findings and conclusions of this study, it is recommended that teacher education institutions integrate the project-based training model with the CREATE stages (Conceptualize, Research, Execute, Assess, Transform, Evaluate) into their training programs for prospective elementary school teachers, in order to develop their skills in designing interactive instructional media from the early stages of their studies. Lecturers and facilitators are encouraged to adapt the CREATE stages to the characteristics of their participants and to utilize Flip PDF or similar platforms. Future researchers may test this model in other subject areas, with a larger pool of participants, or using different digital platforms to further refine and enhance the model.

Limitation

This study has several limitations that should be acknowledged. First, the number of participants was relatively limited and involved only two teacher education institutions in Indonesia and Uzbekistan, so the generalization of the findings should be approached with caution. Second, the focus of this study was solely on the ability to design interactive instructional media using the Flip PDF application, and therefore it has not yet been tested on other platforms or within different subject-matter contexts. These limitations provide a foundation for future research to broaden the scope and deepen the analysis.

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