Strengthening Digital Literacy Through the Development of Augmented Reality-Based Educational Profession Books for UNIMED PGSD Students

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Abstract. This study aimed to explore the feasibility, practicality, and effectiveness of elementary school profession books utilizing Augmented Reality. The research was conducted using the 4-D model, encompassing the stages of Define, Design, Develop, and Disseminate. Data were collected through observations, interviews, and questionnaires, and analyzed using both descriptive quantitative and qualitative methods. The study involved 30 students as research participants. The findings revealed expert validation ratings of 92.11% for content experts, 92.5% for media experts, and 78.7% for design experts. Student responses were highly positive, with an average score of 81.67% in a small-scale trial involving 6 students and 90.42% in a larger trial with 30 participants.

Keywords: Books, Educational Profession, Augmented Reality, Digital Literacy

1 Introduction

The Industrial Revolution 4.0 is marked by rapid advancements in digital systems, connectivity, artificial intelligence, and streamlined communication processes. These technological developments have significantly transformed human life, particularly in accessing and utilizing information. As highlighted by Mulyadi and Rusdinal (2021), the Industrial Revolution 4.0 has fostered new societal habits through computerization and widespread internet usage, embedding technology deeply into daily routines.

In the field of education, particularly in higher education institutions, technology plays a crucial role in equipping future generations to harness these innovations effectively. According to Naufal (2021), universities are expected to implement digital-based learning environments to meet these demands. As Ahmad and Hodsay (2020) emphasize, teacher education programs must prepare future educators to engage with modern educational tools and methodologies, such as Augmented Reality (AR), to stay relevant in the ever-evolving educational landscape. However, observations within the PGSD UNIMED Study Program reveal a gap: there are no

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textbooks that integrate digital technology in the educational profession course. Consequently, students often lack adequate digital literacy skills, a critical competency in the current era.

Digital literacy, defined as the ability to understand and utilize information from digital sources Glister in Ahsani (2021), can be significantly enhanced through technological integration. One promising solution is the use of Augmented Reality (AR), which has been demonstrated to improve student comprehension compared to traditional text-based materials. As Halimatussakdiah et al. (2023) suggest, literacy improvement programs are essential in helping students engage more deeply with educational content. Similarly, incorporating Augmented Reality into textbooks has the potential to enhance students' reading abilities by making learning more interactive and aligned with their interests. This idea aligns with the findings of Suryaningsih (2019), who demonstrated that AR technology can improve student comprehension compared to traditional text-based materials. Additionally, Putra et al. (2023) emphasized that AR fosters more engaging and interactive learning experiences, which encourages active participation and deeper learning.. Furthermore, research by Lissa'adah and Widiyatmoko (2023) underscores that AR-based learning media not only increases student interest but also enhances learning outcomes.

In light of this, the development of AR-based educational professional textbooks tailored for elementary school teacher education is expected to bridge this gap and enhance the digital literacy skills of PGSD UNIMED students. This study focuses on designing and developing these innovative textbooks, as reflected in the research title: “Development of AR-based Elementary School Education Profession Books in Improving Digital Literacy Skills of PGSD UNIMED Students.”

2 Method

This study was conducted as part of the Elementary School Teacher Training program under the Faculty of Education at the State University of Medan, spanning from February to December 2024. The research employed a four-dimensional model, consisting of four stages: definition, design, development, and dissemination. In the definition phase, the focus was on analyzing students' needs, assigned tasks, and learning objectives. The design stage involved the preparation of standardized tests, the selection of appropriate media, and the creation of an initial design. During the development phase, AR-based professional textbooks were created to meet criteria of validity, practicality, and effectiveness, with their quality evaluated through various tests. The dissemination stage included distributing the textbooks, publishing them in academic journals, and presenting the findings at seminars.

The development of the AR-based educational profession textbooks followed guidelines provided by DIPP (2022), which outline best practices for creating effective and engaging educational materials. These guidelines were essential in ensuring that the textbooks adhered to professional standards and met the needs of the target audience.

Data collection was conducted through validation processes, observations, questionnaires, and interviews. The analysis combined both quantitative and qualitative approaches. Data from expert evaluations and small group tests were analyzed using percentages and qualitative descriptions, while field tests and assessments of digital literacy improvement were analyzed through both quantitative metrics and qualitative insights.

3 Result And Discussion

3.1 Result

Initial description of product development

The initial phase of this development research involved a needs analysis conducted through questionnaires. The findings revealed that 100% of the students expressed a strong need for AR-based learning books to enhance their digital literacy skills. Moreover, all participants agreed that such books are essential for making the learning process more engaging and effective.

To further explore this, additional questionnaires and interviews were carried out with PGSD UNIMED students before initiating the textbook design process. The results highlighted two key issues: (a) students had no prior experience in creating AR-based educational profession books, and (b) existing textbooks were perceived as unappealing and monotonous, contributing to reduced interest in learning.

In response to these insights, the next phase focused on developing an AR-based educational profession book. This innovative resource features educational profession content enriched with vibrant visuals and interactive elements, ensuring alignment with current educational needs. The material is designed to simplify complex concepts, stimulate curiosity, and inspire students to pose questions, generate creative ideas, and actively share information with their peers.

Description of data from product trial results

Material expert validation

The development of AR-based educational profession books was evaluated by a material expert, Prof. Dr. Wildansyah, M.Pd. The quantitative results of the validation process are presented in Table 1.

Table 1. Recapitulation of Material Expert Validation Results

Validation Stage	Validation Score	Percentage
First	84	77%
Second	96	88%

The material expert's evaluation indicated a significant improvement, with the validation score increasing from 77% to 88% after revisions. This score falls under the "very valid" category. The expert recommended refining and emphasizing the operational terminology used in the book to enhance clarity. Additionally, while the material aligns well with the Kompetensi Dasar (KD) and the concepts within the learning media are commendable, further refinements are needed in certain sections to ensure greater focus on material relevance and accessibility for students.

Learning design expert validation

The evaluation of the AR-based educational profession textbook's learning design was conducted by Prof. Dr. Sugiharto, M.Si, a faculty member in the Postgraduate Program at Universitas Negeri Medan. The assessment focused on several key aspects, including the textbook's physical attractiveness, design accuracy, format suitability, alignment with the characteristics of the target audience, clarity of instructions, presentation of materials, and the

relevance of the evaluation components to the content. The results of this evaluation are summarized in Table 2.

Table 2. Recapitulation of Learning Design Expert Validation Results

Validation Stage	Validation Score	Percentage
First	68	80%
Second	80	91%

The assessment by the learning design expert revealed an improvement in the score, increasing from 80% in Stage I to 91% in Stage II, placing it in the "Very Good" category (85-100). The design media expert recommended enhancing the layout's appeal and replacing cartoons with real images for a more realistic presentation. Based on these evaluations, it can be concluded that the AR-based educational profession book is suitable for field testing, provided that the suggested revisions are implemented.

Learning media expert validation

The validation of the AR-based educational profession book by a learning media design expert was conducted by Dr. R. Mursid, ST, M.Pd, a postgraduate lecturer at Universitas Negeri Medan. The assessment was based on a validation instrument provided to the learning media design expert, evaluating the quality of the AR-based educational profession book across various aspects. The results of this evaluation, covering all areas outlined in the validation sheet, are summarized in Table 3 below.

Table 3. Recapitulation of Learning Media Expert Validation Results

Validation stage	Validation Score	Percentage
First	68	82%
Second	74	92,5%

Based on the results presented in Table 3, the evaluation conducted by the learning media design experts revealed the following: Media Design Expert 1 achieved a score of 80%, which falls within the 75-85 range and is categorized as "Good." On the other hand, Media Design Expert 2 received a score of 92.5%, placing it within the 85-95 range, and is therefore categorized as "Very Good." The assessment covered key aspects such as media display design, media programming design, and media content design.

Discussion

To assess the feasibility of the AR-based educational profession books, validity tests were conducted by material experts, learning design experts, and media design experts. Each expert evaluated key indicators outlined in the learning media validation sheet using a quantitative descriptive assessment questionnaire. The results were presented in terms of score distributions and rating scale categories, providing an in-depth understanding of the strengths and weaknesses of the textbook design.

The development and validation of Augmented Reality-based textbooks are crucial for their effective use in the learning process. According to Saputra et al. (2020), AR-based learning media have been proven to engage students better than traditional methods by providing

interactive, immersive experiences that facilitate deeper understanding. This is consistent with findings by Lissa'adah and Widiyatmoko (2023), who demonstrated that AR-based media significantly increased students' interest and academic performance, especially in science subjects. Their study on Assemblr Edu-based AR media found a marked improvement in student cognitive outcomes and engagement. The results suggest that AR offers significant advantages in fostering higher-order thinking skills and enhancing student participation during lessons.

Similarly, Setiawati et al. (2022) emphasize that AR technologies, when integrated into educational materials, facilitate better comprehension and promote active student engagement, particularly in challenging subjects like natural science. By visualizing complex concepts through AR, students not only gain a clearer understanding but also remain more engaged throughout the learning process. This aligns with the findings in this study, where the validation results from material experts indicated that the AR-based textbook met the required standards of clarity and accessibility for students.

Sutaryono and Setyasto (2021) also emphasized the importance of digital media in improving teachers' and students' digital literacy, particularly in elementary education. Their research shows that AR can be a key tool in bridging the gap between traditional teaching methods and the demands of digital-era learning environments. AR not only makes learning more dynamic but also provides students with more immediate feedback and deeper understanding.

The validation process was carried out using discussion techniques, where the initial design of the AR-based textbooks was reviewed by the experts. The validation involved three main categories: design, material, and media. The material expert's initial validation score was 84.62%, which increased to 92.11% after revisions, meeting the "very valid" category. The revisions were based on suggestions to simplify the language used in the textbook, ensuring that the content is more accessible and culturally relevant to the students. This is in line with recommendations by Setiawati et al. (2022), who suggest that AR-based media should be adapted to local cultural contexts to enhance their effectiveness and relevance.

The learning design expert's validation also showed significant improvement, with the score increasing from 80% in the first stage to 91% in the second stage. This score falls within the "Very Good" category, reflecting the effectiveness of the design in engaging students visually and contextually. The design expert suggested enhancing the layout and using real images instead of cartoons, which was incorporated in the revisions. This recommendation was further supported by studies, such as those by Lissa'adah and Widiyatmoko (2023), who emphasized that realistic visuals help maintain students' attention and improve their engagement during lessons.

Furthermore, the media design expert's validation scores ranged from 80% to 92.5%, showing that the AR-based educational profession book was well-received. Expert feedback highlighted the importance of ensuring that the media content is clear and appropriately presented. These revisions focused on improving the overall media display, programming design, and content relevance. As highlighted by Liansari and Nuroh (2018), integrating engaging and relevant media content significantly enhances students' engagement and learning outcomes. This is in line with the findings of Triana and Tamba (2020), who noted that AR's ability to visualize complex concepts, like geometric shapes, makes it a powerful tool for enhancing spatial thinking and problem-solving skills among students.

The AR-based educational profession textbook has undergone a rigorous validation process with positive results. The revisions based on expert feedback led to significant improvements,

with all experts giving it high ratings—material experts (88%), learning design experts (91%), and media design experts (92.25%). These results indicate that the textbook is ready for field testing and holds great potential for enhancing digital literacy skills among PGSD UNIMED students. The validation results not only confirm the feasibility of using AR in education but also highlight its effectiveness in improving engagement, understanding, and overall student learning outcomes.

4 Conclusion

The validation process for the Augmented Reality-based educational profession textbooks involved a comprehensive review by material experts, learning design experts, and media design experts, all of whom contributed valuable feedback to improve the textbooks' quality. Initially, experts recommended several revisions, such as simplifying sentence structures, integrating content with local wisdom, and enhancing the visual layout to increase engagement. Following these revisions, the textbooks were reassessed, resulting in high validation scores: 88% from material experts, 91% from learning design experts, and 92.25% from media design experts. These scores, all falling within the "very feasible" category, indicate that the textbooks meet educational standards and are both well-structured and effective for learning. The successful validation process affirms that these Augmented Reality-based textbooks are ready for practical classroom use, providing a modern, interactive approach to education that aligns with current pedagogical needs.

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