

Research Article

Cite this article: Arzfi, B. P., Montessori, M., & Rusdinal. (2025). Development of Digital Game Based Learning Model Teaching Materials to Improve Learning Outcomes in Primary Schools. *Educational Process: International Journal*, 15, e2025114. <https://doi.org/10.22521/edupij.2025.15.114>

Received February 5, 2025

Accepted March 20, 2025


Published Online March 25, 2025

Keywords: Teaching materials, digital game based learning model, lumio by smart, pancasila education

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Development of Digital Game Based Learning Model Teaching Materials to Improve Learning Outcomes in Primary Schools

Bima Prakarsa Arzfi , Maria Montessori , Rusdinal 

Abstract

Background/purpose. The study addresses the challenge of integrating technology into Pancasila Education in Indonesian primary schools. Despite schools having technological facilities, teachers still rely on conventional teaching materials. The research aims to develop and validate digital game-based learning materials using the Lumio by Smart platform to improve learning outcomes in primary school Pancasila Education.

Materials/methods. The study employed R&D methodology using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) with three teachers and 80 fifth-grade students across three primary schools in Padang City.

Results. Expert validation revealed that the developed materials were highly valid across material, media, language, and evaluation aspects. Teacher and student responses indicated that the materials were very practical for classroom implementation. Effectiveness testing demonstrated significant improvement in student learning outcomes when comparing pre-test and post-test scores.

Conclusion. The study concludes that the Lumio by Smart-based Digital Game-Based Learning materials for Pancasila Education are highly valid, practical, and effective for improving primary school learning outcomes.

1. Introduction

Technological developments in the era of Industrial Revolution 4.0 and Society 5.0 have brought significant changes in various aspects of life, including in the world of education. One prominent form of change is the increasing use of digital teaching materials integrated with information and communication technology (ICT). In the context of education, the use of technology not only facilitates access to information (Kanber et al., 2025), but also presents more interactive and interesting learning methods, and adapts to the needs of students at various levels of education. Flexible and dynamic digital teaching materials provide great opportunities for teachers to optimize learning in the classroom by utilizing digital devices such as laptops, smartphones, and computers (Kantathanawat et al., 2025).

In line with these technological developments, the Merdeka Curriculum currently implemented in Indonesia also encourages the use of technology in the learning process, including in the subject of Pancasila Education. The purpose of Pancasila education is to form individuals who have attitudes, thoughts, and behaviors that are in line with the values of Pancasila. Pancasila education is expected not only to be a means of transferring knowledge but also as a medium of character building that is relevant to the challenges of the times. Thus, the development of teaching materials that are in accordance with technology and the needs of students is a must for educators.

However, based on the results of preliminary studies conducted in several primary schools in Padang City, it was found that teachers still tend to use conventional teaching materials, even though schools have been equipped with technological facilities such as Wi-Fi, projectors, and Chromebooks (Arzfi et al., 2023). Similar findings were reported by Sespen (2024) in their assessment of digital learning resource usage in Padang City primary schools. Despite the availability of technology, these schools continued to rely on conventional teaching materials. The predominant use of conventional teaching materials often results in students being less enthusiastic and more passive during lessons. On the other hand, teachers also face challenges in integrating technology into their teaching materials, particularly in subjects like Pancasila Education (Nurrahma, 2024). This highlights the urgent need to develop relevant and interactive digital teaching materials to enhance the quality of learning in primary schools.

To address this gap, the present study proposes the development of digital teaching materials based on the Digital Game-Based Learning (DGBL) model using the Lumio by Smart platform. The DGBL model integrates game elements into learning, making it more engaging, challenging, and enjoyable for students. This approach has proven effective in increasing student engagement, especially in subjects that require a deep understanding of complex concepts, such as Pancasila Education. Game-based learning provides students with opportunities to learn through exploration, trial and error, and real-world simulations, which are essential for fostering deeper comprehension and long-term retention of knowledge. Lumio by Smart, an interactive learning platform, enables teachers to create digital teaching materials enriched with visual elements, audio, video, and interactive quizzes, fostering an immersive and motivational learning environment.

The use of DGBL through Lumio by Smart not only enhances learning interest but also facilitates a deeper and more contextual understanding of Pancasila values. By incorporating game elements such as scores, levels, and challenges, students can explore abstract Pancasila concepts in realistic scenarios, bridging the gap between theoretical knowledge and practical application. Gamification elements encourage students to engage in problem-solving activities, apply critical thinking, and collaborate with their peers to complete tasks, thus reinforcing their understanding of Pancasila principles. Moreover, Lumio's collaborative features allow students to participate in online discussions and group activities, fostering social learning and reinforcing their understanding through

peer interaction. These interactive experiences mirror real-life situations where Pancasila values such as teamwork, tolerance, and mutual respect are applied in everyday contexts.

Furthermore, the platform provides real-time tracking of student progress, enabling teachers to offer immediate feedback and personalized interventions. This data-driven approach helps educators identify areas where students may struggle and adjust teaching strategies accordingly, ensuring a more tailored and effective learning experience. With the ability to analyze student responses and engagement patterns, teachers can modify instructional materials to better align with students' learning preferences and needs. This adaptability is particularly crucial in Pancasila Education, where the goal is not only knowledge acquisition but also the internalization and practice of national values in daily life. The integration of interactive assessments also ensures that students remain actively engaged while allowing teachers to measure learning outcomes more accurately (Montessori et al., 2024).

Given the importance of technology in creating an interactive and collaborative learning environment, digital teaching materials for Pancasila Education can significantly enhance students' ability to grasp and internalize Pancasila values. By leveraging Lumio by Smart, teachers can design lessons that encourage active participation, foster meaningful discussions, and create a more student-centered learning environment. The inclusion of multimedia elements such as animations, infographics, and interactive case studies further enriches the learning experience, making abstract Pancasila concepts more tangible and relatable. Additionally, the platform allows for differentiated instruction, where students can progress at their own pace, revisit challenging topics, and receive individualized support as needed.

Moreover, the development of digital teaching materials aligned with the Merdeka Curriculum ensures that students acquire essential 21st-century skills, including critical thinking, creativity, collaboration, and communication (Rusdinal et al., 2025). These competencies are not only fundamental to academic success but also crucial for preparing students to become responsible and ethical citizens in an increasingly digital world. By integrating technology into Pancasila Education, students develop digital literacy skills that will benefit them in various aspects of life, including future educational and professional pursuits.

The implementation of digital teaching materials through Lumio by Smart also aligns with the Indonesian government's vision of digital transformation in education. As schools continue to adopt technology-driven approaches, the need for effective and well-structured digital resources becomes even more apparent. Providing teachers with comprehensive digital teaching materials ensures consistency in lesson delivery and reduces the burden of developing materials from scratch. Additionally, digital resources offer scalability, allowing for widespread adoption across different schools and regions, thus promoting equitable access to quality education. (Pacheco-Velazquez et al., 2024).

The benefits of digital game-based learning extend beyond academic achievements, as they also contribute to students' socio-emotional development. Engaging in interactive learning experiences fosters resilience, perseverance, and adaptability—qualities that are essential for navigating the complexities of modern society. Furthermore, by immersing students in realistic problem-solving scenarios, digital learning platforms help cultivate a sense of civic responsibility, encouraging them to apply Pancasila values in their daily interactions and decision-making processes.

Despite the numerous advantages of integrating technology into Pancasila Education, it is essential to acknowledge the challenges that may arise during implementation. Some of these challenges include the need for teacher training on how to effectively use digital platforms, potential technical difficulties, and varying levels of digital infrastructure across schools. Addressing these issues requires a collaborative effort between educators, policymakers, and technology developers

to ensure that digital teaching materials are accessible, user-friendly, and adaptable to different educational contexts. Providing continuous professional development for teachers is crucial in equipping them with the skills and confidence needed to integrate technology into their teaching practices successfully.

Based on this background, this study aims to develop digital teaching materials for Pancasila Education based on the Digital Game-Based Learning model using the Lumio by Smart platform for grade V students in primary schools. The development of these teaching materials is expected to provide a solution for teachers to deliver more engaging, interactive, and technologically relevant lessons while enhancing students' understanding of Pancasila values. Additionally, this research seeks to contribute to the growing body of knowledge on digital learning innovations, offering insights into best practices for designing effective and engaging educational experiences in the digital age. The present study addresses the following question:

A) How can digital teaching materials based on the Lumio by Smart Digital Game-Based Learning model be developed to improve learning outcomes in primary school Pancasila Education?

2. Literature Review

2.1. Digital Game Based Learning Model

The advantages of using the Digital Game Based Learning model are that students can interact more and create a fun, happy, and cheerful learning atmosphere. The Digital Game Based Learning model is a learning method through learning and playing patterns using computer devices or smartphones (Tay et al., 2022). The Digital Game Based Learning model is also interpreted as a learning strategy that combines digital games and educational design. Ma'ruf & Alfurqan (2022) the purpose of the Digital Game Based Learning model is to help facilitate the learning process, make learning interesting and exciting. The Digital Game Based Learning model improves digital etiquette literacy and improves students' learning skills (Zheng et al., 2024).

The Digital Game Based Learning model can be effectively combined with open materials integrated with digital technology. Salgarayeva (2021) digital Game Based Learning has started to be broadly employed thanks to its advantages. This approach enhances learning motivation, engagement, and performance among students. Chung & Chang's (2017) findings indicated that Digital Game-Based Learning could help students acquire knowledge and better understand learning materials. The use of digital games in education has been linked to increased motivation and positive perceptions of learning environments (Ronimus et al., 2019).

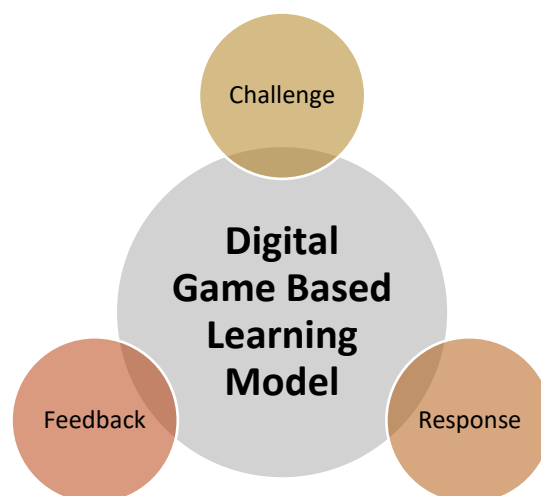


Figure 1. Technology acceptance model (Prensky, 2003)

2.2. Pancasila Education

Pancasila Education is a systematic effort to instill the values of Pancasila as the foundation of the state and the ideology of the Indonesian nation to citizens, especially the younger generation. Pancasila education is one of the subjects that when people hear about this subject, character education will come to mind (Silalahi & Yuwono, 2018). In line with Habibah & Fathurrahman (2025) Pancasila education, as character education, shapes students' values by encompassing various aspects of character development, including core principles and moral foundations. From the Pancasila education subject, it is also hoped that it will be able to produce a society with character. In essence, we, as Indonesian people, should have character that is characteristic of our national identity. Pancasila education can be defined as the process of taking basic values contained in the philosophy of Pancasila itself, where those basic values are used as a way of life for the Indonesian people (Riyanti et al., 2020).

In Pancasila Education, we can learn and find out what values are contained in Pancasila and how to apply these values in social life. such as main character education and also main character education (Montessori et al., 2024). The main character education consists of nationalist character education, obeying social rules, respecting diversity, being aware of rights and obligations, and being responsible (Sukriono & Sudirman, 2020). Meanwhile, basic character education contains values that are religious, honest, intelligent, tough, democratic, and caring. Pancasila education itself is part of a group of subjects in Indonesia's education unit or curriculum (Febriyanti & Sulistyawati, 2024).

2.3. Lumio by Smart

Lumio by smart is an innovative and collaborative digital learning platform designed for teachers and students to interact and collaborate in learning wherever they are. In line with Osipova E (2017), Lumio by Smart is considered a smart learning platform with strong linguo-didactic potential, which provides unique resources to create a comfortable environment for distance learning, new ways of curriculum delivery, novel forms of communicative interaction, and greater opportunities for immediate feedback. It is one of the digital platforms, a newer and more collaborative digital learning medium (Khodijah et al., 2024).

Lumio is an interactive learning media based on slides and quizzes that can involve or collaborate with students directly through each student's mobile phone or laptop. Therefore, it is important for a teacher to learn and apply technology-based learning in order to create a more enjoyable and meaningful classroom atmosphere.

3. Methodology

3.1. Research Design

This study employs a Research and Development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) to develop and validate digital game-based learning materials for Pancasila Education. The ADDIE model is a systematic instructional design framework that ensures the development of effective and practical teaching materials (Spatioti et al., 2022). This methodological choice aligns with educational technology development best practices, as it provides structured guidance for creating effective digital learning materials while emphasizing validation throughout the development cycle (Adrias et al., 2023). In the Analysis phase, researchers identified the challenges faced by teachers in integrating technology into Pancasila Education through observations, interviews, and questionnaires. This phase aimed to understand the gap between the availability of technological facilities and their underutilization in teaching. The design phase involved creating lesson plans, student worksheets (LKPD), and digital games that were aligned with the curriculum's learning objectives. The design process included collaboration with

teachers, content experts, and media/technology experts to ensure the materials were both engaging and educationally sound.

The Development phase focused on transforming these designs into digital formats using the Lumio by Smart platform, followed by expert validation. The materials were reviewed by content, media, language, and evaluation experts to ensure they met educational standards. The Implementation phase tested the materials in real classroom settings, involving small-group trials at one school and large-group trials at two other schools. This phase aimed to assess the practicality and effectiveness of the materials in improving student learning outcomes. Finally, the Evaluation phase involved formative and summative assessments to measure the overall effectiveness of the materials. The ADDIE model was chosen for its structured and iterative process, which allows for continuous refinement of the teaching materials, ensuring they are both educationally sound and practically applicable (Rarastika, 2022).

3.2. Research Sample

The study employed purposive sampling to select three primary schools in Padang City, West Sumatra: SDN 11 Lubuk Buaya, SDN 31 Jati Tanah Tinggi, and SDN Percobaan Padang. These schools, part of the “Sekolah Penggerak” initiative, were chosen for their technological infrastructure, implementation of the Merdeka Curriculum, and willingness to participate in educational innovation. The research involved 3 fifth-grade teachers (one from each school) selected based on their experience in Pancasila Education and technological competence, and 80 fifth-grade students aged 10-11 years, randomly selected across the schools. This sampling approach ensured the representation of diverse learning environments while maintaining feasibility for the research timeline (Akkaş & Meydan, 2024). For validation, five expert validators were purposely selected: three Pancasila education specialists, one media and graphics expert, one language expert, and one evaluation expert. This panel ensured comprehensive assessment of the developed materials. The sample size was deemed sufficient to provide meaningful insights into the practicality and effectiveness of the materials. Fifth-grade students were chosen as this level is critical for understanding Pancasila values, which form the foundation of Indonesian national identity. Teachers responsible for Pancasila Education ensured relevant feedback and implementation.

3.3. Research Instrument

The study employed various instruments for data collection, including observation sheets, interview guides, questionnaires, validation sheets, and pre-test/post-test assessments. Observation sheets were used to monitor classroom practices and the integration of technology in teaching Pancasila Education. Interviews provided deeper insights into teachers’ challenges and their perceptions of the digital materials. Questionnaires were distributed to both teachers and students to assess the practicality of the materials, focusing on ease of use, relevance, and engagement. Validation sheets were utilized by expert validators to evaluate the materials’ quality across content, media, language, and evaluation aspects. Pre-test and post-test assessments were administered to students to measure the effectiveness of the materials in improving learning outcomes. These instruments were designed to provide a comprehensive understanding of the materials’ impact on both teaching and learning processes, ensuring a thorough evaluation of their validity, practicality, and effectiveness (Hidayati et al., 2024).

3.4. Data Analysis

Data analysis in this study used qualitative and quantitative methods to assess the validity, practicality, and effectiveness of digital game-based learning materials. Qualitative data collected through observations, interviews, and open-ended questionnaires were analyzed thematically to identify recurring patterns and challenges. This approach provided valuable insights into teacher and

student experiences, uncovering areas for improvement and contextual factors influencing implementation (Ardani & Widodo, 2024). Thematic analysis helped researchers understand the impact of the materials on teaching practices and student engagement in Pancasila Education.

Quantitative data were analyzed using statistical methods to evaluate the quality and effectiveness of the materials. Expert validation scores assessed the materials across content, media, language, and evaluation aspects, while practicality was measured through teacher and student feedback. Effectiveness was determined by comparing pre-test and post-test results, with N-Gain scores used to measure learning gains. Validity and practicality data from Likert-scale questionnaires were analyzed using percentage calculations and categorized into predetermined ranges for interpretation. This mixed-methods approach provided a comprehensive evaluation, ensuring the materials were both educationally and practically useful for use in the classroom, while offering deeper insights into their impact on learning outcomes and teaching practices.

4. Results

4.1. Analysis Stage

The stage where researchers carry out a needs analysis by collecting information through interviews, observations and teacher and student questionnaires, with the aim of obtaining information related to the problems experienced by the school to be studied and the solution to the problem from the school to be studied. The analysis stage is used to identify the causes of gaps and the solutions needed to overcome them (Arzfi et al., 2023). In order to get the real situation at the school to be studied, the author conducted the initial interview first with the fifth-grade driving teacher at the driving primary school, then continued observation, then filled out the needs analysis questionnaire by teachers and students. Collecting data or information is beneficial for developing products that researchers develop.

The researcher conducted observations at three primary schools in Padang City, West Sumatra. The researcher asked for permission from the school to conduct observations and interviews with the fifth grade teacher. Researchers observed the curriculum, prota, promes and teaching materials used by the school. Based on observations, it was found that in the school, the teaching materials on the subject of Pancasila education were still conventional (printed). During an interview with the fifth grade teacher, it was known that the school had used the independent curriculum but had not been adjusted to the Regulation of the Minister of Education, Culture and Research No.12 of 2024.

Teachers also face difficulties in designing teaching materials for Pancasila Education that are integrated with technology and in accordance with the current independent curriculum, so that the utilization of digital teaching materials is not optimal. In the era of Industrial Revolution 4.0 and Society 5.0, education is required to utilize digitalization in the learning process (Rusdinal et al., 2024). Therefore, researchers agreed to develop teaching materials for the Digital Game Based Learning model based on Lumio by Smart on Pancasila Education in grade V of SD Penggerak.

This needs analysis is carried out after analyzing the curriculum, with the aim of knowing the basic problems needed in developing teaching materials for the Lumio by Smart-based Digital Game-Based Learning model. The needed analysis that the author does is to analyze the teaching materials used in accordance with the independent curriculum. The school only uses teaching materials that come from publishers and assessment sheets that are benchmarked by teachers in implementing learning. Therefore, the author analyzed the teaching materials used by the teacher. Based on the results of the analysis, it can be seen that teaching materials are needed that can direct students to be active and can create an interesting and enjoyable learning atmosphere in the Pancasila Education learning process.

4.2. Design Stage

After passing the analysis stage, the design stage followed. The design stage begins where researchers make designs related to solutions to problems identified during the needs analysis (Rarastika, 2022). At this design stage, researchers designed an application that could be used by students in the learning process and there were Pancasila education teaching materials in the application. The application used is the Lumio by Smart application. This teaching material is designed as an optimization of the rapid development of technology and can help and facilitate educators in the learning process. This teaching material is developed based on learning materials developed in reference to the learning objectives (TP) that have been formulated.

There are several programs that can be used to design teaching materials, such as PowerPoint, Canva, Prezi, Google Slides, Microsoft Sway, and so on. Researchers chose to use Lumio by Smart because it is easier to design materials and interactive and can make games digitally; in teaching materials using Lumio by Smart can be embedded images, videos, teaching materials, digital games, and other programs, such as from files stored on computers, web, youtube, QR Code, and so on. The materials used in this teaching material are taken entirely from student books and teacher books. Readings are directly transferred to Lumio by Smart. Some images are used from books, and some are downloaded or embedded from the web. Lumio by Smart teaching materials equipped with QR code for access, digital LKPD from liveworksheets.com, interactive games such as Speedup, Memory Match, Match 'Em Up', and Word Search. Digital calculations use keepthescore.com, and evaluation utilizes Quizizz.

The following is attached to the teaching materials for the Lumio by Smart-based Digital Game Based Learning model for Pancasila Education in grade V of the Mover Primary School which can be accessed by teachers and students:



Figure 2. Teaching Material Cover

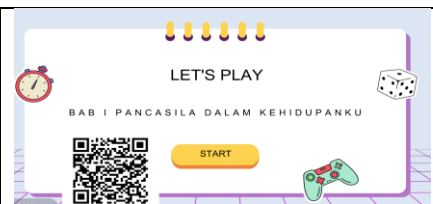


Figure 3. QR Code for Accessing Teaching Materials



Figure 4. E-LKPD



Figure 5 Game Speedup

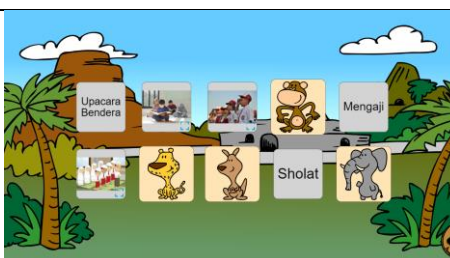


Figure 6. Game Memory Match

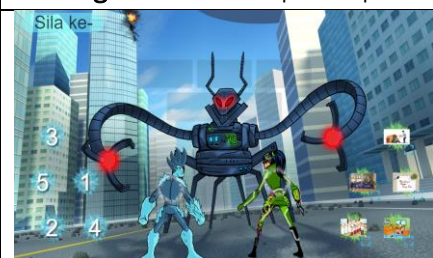


Figure 7. Game Match 'Em Up'

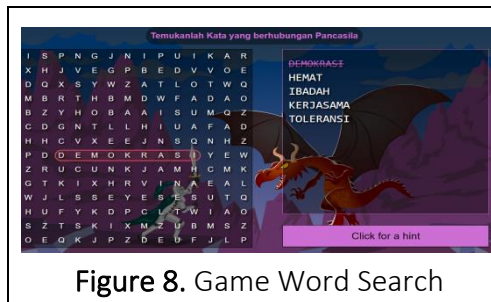


Figure 8. Game Word Search

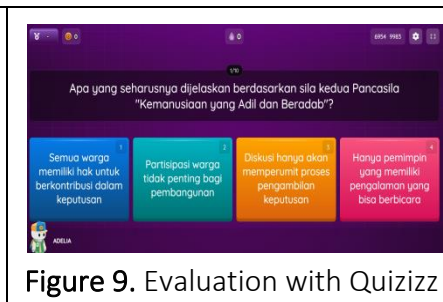


Figure 9. Evaluation with Quizizz

4.3. Development Stage

The third stage is development where the book design will be realized. At this stage, the product will be validated by expert validators (Lieung et al., 2021). After the expert validator assesses the results. In this stage, the researcher will revise the product by following the validator's expert advice.

4.3.1. Teaching Material Validation Results

The designed teaching materials were then validated by validators. Validation was carried out by five validators from universities and one person from a primary school teacher. In this activity, experts and practitioners were asked to assess the teaching materials for the Lumio by Smart-based Digital Game Based Learning model in Pancasila education subjects that had been made. The assessment includes content, presentation, language, graphics and evaluation.

Table 1. Validity Test Results on Material Aspects

Validator Material Expert	%	Category
I	90%	Very Valid
II	95%	Very Valid
III	95%	Very Valid
Total	280%	
Average Percentage	93,33%	Very Valid

4.3.2. Media Aspect Validator Results

The next aspect assessed at the teaching material validation stage is the media or graphic aspect presented in tabular form as follows:

Table 2. Validity Test Results on Media Aspects

Validator Media Expert	%	Category
I	91%	Very Valid

4.3.3. Language Aspect Validator Results

The results of the assessment of teaching materials for the Lumio by Smart-based Digital Game Based Learning model in Pancasila education subjects based on language aspects can be seen in the following table:

Table 3. Validity Test Results on Language Aspects

Validator Language Expert	%	Category
I	87,5 %	Very Valid

4.3.4. Evaluation Aspect Validator

The results of the assessment of teaching materials for the Lumio by Smart-based Digital Game Based Learning model in Pancasila education subjects based on evaluation aspects can be seen in the following table:

Table 4. Validity Test Results on Evaluation Aspects

Validator Language Expert	%	Category
I	90%	Very Valid

Based on the description above, the overall results of the validation of teaching materials can be seen in the following graph:

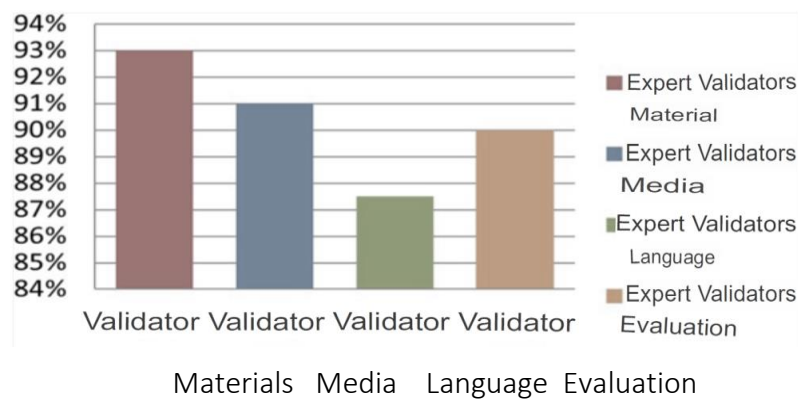


Figure 10. The Overall Results Of The Validation Of Teaching Materials

4.4. Implementation Stage

After being declared valid, the next stage is the implementation stage. The Implementation stage is the stage of applying the product, which is intended to get feedback on the product developed (Bancin et al., 2019). At this stage, researchers conducted a trial of teaching materials for the Lumio by Smart-based Digital Game Based Learning model for Pancasila Education in class V of the Mover Primary School to small/limited groups and large/large groups. The small group trial was conducted at one primary school, namely SDN 11 Lubuk Buaya, while the large group trial was conducted at two primary schools, namely SDN 31 Jati Tanah Tinggi and SDN Percobaan.

Product trials in small and large groups were carried out during Pancasila Education learning. Before and after conducting product trials, researchers conducted tests on students. Then, researchers distribute teacher and learner practicality instruments in the form of questionnaires. Then, researchers analyzed the data on the test instruments that had been given to students. This test instrument is used to show the effectiveness of the teaching materials of the Lumio by Smart-based Digital Game Based Learning model for Pancasila Education in grade V of the Movers Primary School that the researchers developed.

At this stage the researchers also carried out the stages of practicality and effectiveness. The process begins with the administration of the Pre-test, the implementation of material delivery activities using the teaching materials that the researchers developed, and ends with the Post-test. The following is a further explanation regarding the implementation stage that researchers have carried out:

4.4.1. Practicality Result

The practicality test was carried out after testing the developed product, both in small and large groups. The instrument that researchers use is a questionnaire. The practicality of the teaching

materials of the Lumio by Smart-based Digital Game Based Learning model for Pancasila Education in grade V of the Mover Primary School developed can be seen from the results of the practicality analysis by teachers and students

Table 5. Practicality Results of Class V Teacher Movers

No.	Class V Movers Teacher	Validation Value	Category
1	SDN 11 Lubuk Buaya	90%	Very Practical
2	SDN 31 Jati Tanah Tinggi	93,75%	Very Practical
3	SDN Percobaan Padang	85%	Very Practical
Total		268,75%	
Average		89,58 %	Very Practical

Table 6. Results of Class V Students' Practical Work at Driving School

No.	Drive School	Class	Number of Students	Validation Value	Category
1	SDN 11 Lubuk Buaya	V	29	88,90%	Very Practical
2	SDN 31 Jati Tanah Tinggi	V	23	90,76%	Very Practical
3	SDN Percobaan Padang	V	28	92,19%	Very Practical
Total			80	271,85%	
Average				90,62%	Very Practical

4.4.2 Effectiveness Results

After conducting the Practicality test, continued with the effectiveness test whose data source was obtained from the students' learning outcomes. Data on the learning outcomes of students taken, namely before and after following the learning process of the Lumio by Smart-based Digital Game Based Learning model teaching materials. Effectiveness is carried out to determine the extent to which the teaching materials developed are effective for improving student learning outcomes. To test the effectiveness of the research, researchers carry it out through the learning evaluation path, namely by using the pre-test and post-test instruments. The Pre-tests and Post-tests effectively measure knowledge acquisition and skill improvement as they assess changes in cognitive structure and learning outcomes over time (Bentri & Hidayati, 2023).

The effectiveness test is the suitability between the person carrying out the task and the intended target (Anggrayni, 2022). The process of implementing the program in an effort to achieve these goals is designed in an atmosphere that is conducive and attractive to students. The n-Gain score is used to determine the effectiveness of the product developed on integrated thematic learning from student learning outcomes, which is seen from the difference between the initial test

results and the final test. The following data on the results of effectiveness in the trial can be seen in the following table:

Table 7. Results of Recapitulation of Pre-Test and Post-Test Values and N-Gain Test

No.	School Name Drivers	Pre- Test	Post- Test	N-Gain Score	Category	N-Gain Score Percent	Category
1	SDN 11 Lubuk Buaya	48.62	88.28	0.7438	High	74.38	Simply Effective
2	SDN 31 Jati Tanah Tinggi	49.57	90.87	0.7596	High	75.96	Effective
3	SDN Percobaan	49.29	90.36	0.79	High	79	Effective
Total		147.47	269.5	2.29		229.38	
Average		49.16	89.83	0.7646		76.46	Effective

Furthermore, to see the difference between the Pre-test and Post-test scores can be seen in the following bar chart:

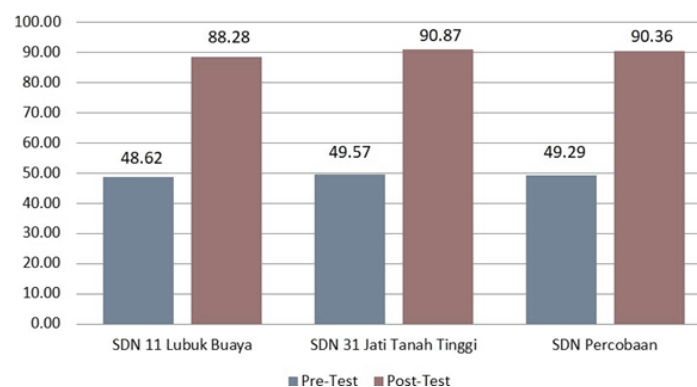


Figure 10. Graph of the Difference in Pre-test and Post-test Scores

Based on the results of the above value comparison, the average value of the Pre-test results was obtained with an average value of 49.16. Then, during the Post-test, it increased to 89.83. after using the product that the researcher developed. The results of the Post-test also show that there is an increase in student learning outcomes after using the Lumio by Smart-based Digital Game Based Learning model teaching materials for Pancasila Education in grade V of the Mover Primary School.

4.5. Evaluation Stage

The last stage is the evaluation stage. If there are still shortcomings or weaknesses in the implementation stage, an evaluation is carried out to improve the developed product. In line with Hadiyanto (2023), effective evaluation provides systematic feedback that fosters continuous improvement. This stage is related to the results of validation and practicality of the resulting product collected, analyzed, and concluded. At this evaluation stage, there are two evaluations that must be carried out, namely formative and summative evaluations. Formative evaluation is an evaluation that explains the quality results of the product that researchers develop, whether researchers will make revisions to the product or not. In this study, the formative evaluation has actually been carried out

in the previous stages. Summative evaluation is an evaluation conducted to determine students' mastery of the material developed with the material used by the teacher. This evaluation can be carried out by giving a Pre-test and Post-test. This has also been done by researchers in the previous stages. So both formative and summative evaluations, both of which researchers have carried out at the previous stage.

5. Discussion

The findings of this study demonstrate the effectiveness of the Digital Game Based Learning (DGBL) model based on Lumio by Smart for Pancasila Education in improving learning outcomes in primary schools. The high validity scores across material (93.33%), media (91%), language (87.5%), and evaluation (90%) aspects affirm that the developed teaching materials meet educational standards and are suitable for implementation. These results align with Herawati et al. (2021), who emphasized that DGBL creates a fun, happy, and interactive learning atmosphere, crucial elements for effective primary education. The integration of game-based learning into Pancasila Education not only enhances student engagement but also aligns with the global trend of incorporating digital tools in education to foster 21st-century skills (Zheng et al., 2024).

The practicality findings, with teachers and students rating the materials 89.58% and 90.62%, respectively, indicate strong user acceptance of the technology. This corresponds with the Technology Acceptance Model (Premsky, 2003) which posits that perceived usefulness and ease of use are primary determinants of technology adoption in educational settings. The high practicality scores suggest that both teachers and students found the Lumio platform intuitive and beneficial, overcoming the technology integration challenges identified in the preliminary studies. This finding is consistent with recent research by Pacheco-Velazquez et al. (2024), which highlights that digital platforms like Lumio can significantly reduce the barriers to technology adoption in classrooms, especially in subjects that traditionally rely on conventional teaching methods.

The effectiveness results are particularly noteworthy, with an average N-Gain score of 0.76 (76.46%), indicating a significant improvement in student learning outcomes after using the developed materials. The substantial increase from pre-test (49.16) to post-test (89.83) scores validates Salgarayeva et al. (2021) assertion that DGBL enhances learning motivation, engagement, and performance. This improvement demonstrates that integrating game elements with Pancasila Education content facilitated a deeper understanding of abstract concepts through interactive engagement. The use of interactive games such as Speedup, Memory Match, Match 'Em Up', and Word Search transformed traditionally passive Pancasila Education content into an engaging learning experience, addressing the issues identified in the preliminary studies where conventional teaching materials led to student passivity and disengagement (Ronimus et al., 2019).

Our results further support Chung & Chang's (2017) findings that DGBL helps students acquire knowledge and better understand learning materials. The interactive elements of Lumio by Smart, including Speedup, Memory Match, Match 'Em Up', and Word Search games, transformed traditionally passive Pancasila Education content into an engaging learning experience. This transformation addresses the issues identified in the preliminary studies where conventional teaching materials led to student passivity and disengagement. The effectiveness of these materials aligns with Ronimus et al. (2019) who linked digital games in education to increased motivation and positive perceptions of learning environments. By incorporating collaborative features and real-time feedback mechanisms, the Lumio platform facilitated both individual learning and social interaction, essential components for internalizing Pancasila values that emphasize community and cooperation.

In the context of Pancasila Education, which aims to develop character and national identity as noted by Habibah & Fathurrahman (2025), the DGBL model proved effective in making abstract values more accessible and meaningful to students. The digital approach facilitated the transition

from theoretical knowledge to practical understanding, addressing Montessori et al. (2024) concern about effectively teaching civic values. The integration of DGBL in Pancasila Education not only enhances students' understanding of national values but also prepares them for the challenges of the digital era, where critical thinking, creativity, and collaboration are essential (Tay et al., 2022).

From a technological perspective, these findings support Osipova (2017) characterization of Lumio by Smart as a platform with strong potential to create comfortable environments for learning and new forms of communicative interaction. The successful implementation of this technology in Pancasila Education demonstrates how digital tools can be effectively utilized to achieve the character-building objectives of the Merdeka Curriculum while preparing students for the demands of Industrial Revolution 4.0 and Society 5.0. The use of Lumio by Smart in this study aligns with the findings of Kantathanawat et al. (2025), who emphasize the importance of adaptive digital platforms in fostering student engagement and learning outcomes in diverse educational contexts.

However, this study is not without limitations. Firstly, the research was conducted with a relatively small sample size of 80 students and 3 teachers from three primary schools in Padang City, which limits the generalizability of the findings. Future studies should consider expanding the sample size and including schools from different regions to enhance the external validity of the results. Secondly, the study relied heavily on self-reported data from teachers and students, which may introduce biases. Incorporating more objective measures, such as classroom observations and longitudinal studies, could provide a more comprehensive understanding of the long-term impact of DGBL on student learning outcomes. Lastly, the study focused solely on Pancasila Education, and the findings may not be directly applicable to other subjects. Further research is needed to explore the effectiveness of DGBL in different subject areas and grade levels.

Despite these limitations, the study contributes to the growing body of literature on the use of digital game-based learning in primary education. The findings suggest that DGBL, when integrated with platforms like Lumio by Smart, can significantly enhance student engagement and learning outcomes, particularly in subjects that require the understanding of abstract concepts. The study also highlights the importance of teacher training and support in the successful implementation of digital learning tools, as noted by Arifin et al. (2025). Future research should focus on developing comprehensive training programs for teachers to ensure the effective use of digital platforms in the classroom.

6. Conclusion

Moreover, the research depends on self-reported data, hence potentially susceptible to biases and mistakes. The study's findings have major significance for theoretical understanding, as they enhance our knowledge of technology acceptability and usage, specifically in the context of language acquisition. The results obtained from this product development research are material expert validators scored 93,33%, media expert validators scored 91%, language expert validators scored 87.5%, and evaluation expert validators scored 90%, each of which were categorized as "very valid." For the practicality questionnaire, teacher and student reactions scored 89.58 and 90.62%, both of which were categorized as "very practical". Effectiveness testing showed a significant increase in learning outcomes, with an N-Gain Score of 0.76 and an effectiveness of 76.46%. This study concludes that the teaching materials of the Digital Game Based Learning model based on Lumio by Smart for Pancasila Education in class V of SD Penggerak are highly valid, highly practical and effective.

7. Suggestion

Based on the findings, it is recommended to integrate the Digital Game-Based Learning Model into more subjects and grade levels to enhance engagement and outcomes. Further research should explore long-term impacts, and teacher training needs for effective implementation.

Declarations

Author Contributions. All authors have read and approved the published version of the article.

Conflicts of Interest. The authors declare no conflict of interest.

Funding. This research was supported by the Institute for Research and Community Service of Padang State University with Contract Number: 069/E5/PG.02.00.PL/2024, dated June 11, 2024.

Data Availability Statement. The data supporting this study are available from the corresponding author upon reasonable request.

Acknowledgments. The authors extend their heartfelt gratitude to primary school teachers and students who participated in this research, sharing their valuable insights and experiences.

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