

QR Code-Based Smartbox Media Innovation: Encouraging Generation Alpha to Improve Learning Outcomes

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Abstract: This study aims to develop a QR Code-based Smartbox media and determine the level of validity, practicality, and effectiveness of QR Code-based smartbox media in improving the learning outcomes of the Alpha generation in Pancasila Education learning. This study uses a research and development method with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The subjects of the study were second-grade elementary school students in three schools, namely SDN Badas 2 Kediri, SDN Plandi 1 Jombang, and SDN Sengon Jombang. The research instruments included expert validation sheets, teacher and student response questionnaires, and learning outcome tests in the form of pretests and posttests. Data analysis was carried out using descriptive and quantitative analysis, including paired samples t-tests and N-Gain analysis. The results showed that the QR Code-based Smartbox media was declared valid and practical, and effective in improving student learning outcomes. This was indicated by the significance value of the t-test results which was smaller than 0.05. Thus, QR Code-based Smartbox media is suitable for use as an alternative innovative learning media that is in accordance with the characteristics of the Alpha generation and supports the implementation of student-centered learning.

Keyword: Smartbox; QR Code, learning outcomes; Alpha generation, Pancasila Education

PRELIMINARY

The development of digital technology in the Industrial Revolution 4.0 era has brought significant changes to various aspects of life, including education. Digital transformation has driven the emergence of various learning innovations that require educators not only to master the material but also to be able to integrate technology creatively and meaningfully into the learning process (Setiyono et al., 2025). Education is no longer understood merely as a process of transferring knowledge, but rather as a planned process to develop students' potential holistically, encompassing cognitive, affective, and psychomotor aspects (Sri Handayani et al., 2025).

In line with the implementation of the Independent Curriculum, learning is directed at developing active, reflective, and independent students through enjoyable and meaningful learning experiences (Nuralmira et al., 2025). This curriculum requires the use of learning strategies and media that foster critical thinking, creativity, and problem-solving skills as 21st-century competencies (Isandi & Nuruddin, 2024). One subject that plays a strategic role in strengthening character is Pancasila Education. This subject not only serves as a means of introducing national values but also as a vehicle for character development in students from elementary school (Dewi, 2022). However, the reality of learning in the field shows a gap between curriculum demands and ongoing learning practices. Observations at SDN Badas 2 Kediri, SDN Sengon Jombang, and SDN Plandi 1 Jombang indicate that the Pancasila Education learning process is still dominated by the use of conventional media in the form of printed images and verbal explanations from teachers. The learning media used have not optimally utilized digital technology, especially those that align with the characteristics of Generation Alpha. This condition results in suboptimal conceptual understanding and application of Pancasila values. This is evidenced by learning outcome data, which shows that 60% of students have not achieved the completion criteria, with average class scores still below the minimum standard. Furthermore, low learning outcomes can be seen in students' limitations in applying Pancasila values.

Generation Alpha is a generation born and raised in an environment very familiar with digital technology. They are accustomed to interacting with digital devices from an early age and have a tendency to learn through visuals, interactions, and direct experiences (Dakhi & Telaumbanua, 2023). The mismatch between Generation Alpha's characteristics and static and monotonous learning media has the potential to reduce student interest and learning outcomes. Therefore, innovative learning media are needed that can harmoniously integrate physical and digital elements to make learning more contextual and meaningful.

Learning media plays a crucial role as a medium for conveying learning messages from educators to students. Systematically designed media tailored to student needs can enhance learning effectiveness and help students understand the material more deeply (Salamah, 2017; Pratiwi et al., 2023). Advances in information technology open up opportunities for the use of interactive learning media that not only present information but also actively engage students in the learning process (Saleh et al., 2023).

One form of innovative learning media with potential for development is the smart box. A smart box is a box-shaped learning medium containing materials, activities, and educational games designed to engage students (Aminah & Yusnaldi, 2024). This medium is effective in creating a fun learning environment and increasing student focus and engagement (Sumiyati et al., 2025). When combined with Quick Response (QR) Code technology, a smart box can serve as a bridge between the real and digital worlds in learning.

QR Codes are a two-dimensional code technology capable of storing and presenting various digital information that can be quickly accessed via mobile devices (Kasmawati et al., 2025). The use of QR Codes in learning allows students to independently access additional materials, learning videos, and interactive questions. The integration of QR Codes into learning media not only increases learning flexibility but also encourages students' independence and digital literacy.

Based on these conditions, efforts are needed to develop innovative, interactive learning media that align with the characteristics of Generation Alpha, particularly in Pancasila Education learning. The development of QR Code-based smart box media is seen as a relevant solution to address the problem of low student engagement and learning outcomes. This media is expected to provide active learning through physical activity, while enriching the learning experience through integrated digital content. Theoretically, the development of this media is based on constructivism theory, which emphasizes that knowledge is actively constructed by students through experience and social interaction (Suryadi et al., 2022). QR Code-based smart box media allows students to develop an understanding of Pancasila concepts through play, exploration, and reflection, ensuring that learning is not passive. Therefore, this media aligns with the principles of constructivist learning, which positions students as active participants in the learning process.

Based on the problem description and theoretical analysis, this research aims to develop a valid, practical, and effective QR Code-based smart box media to improve the learning outcomes of Generation Alpha students on the topic "I Love Pancasila." This research is also expected to provide theoretical contributions to the development of technology-based learning media and practical contributions for teachers and schools in creating innovative, enjoyable, and character-oriented Pancasila Education learning.

METHOD

This research used a research and development approach. This method aims to produce a product in the form of a QR Code-based Smart Box learning media and to test the product's quality in terms of validity, practicality, and effectiveness in improving student learning outcomes. Research and development is a method used to design, develop, and test the feasibility of an educational product so that it can be used effectively in the learning process (Sugiyono, 2025).

The development model used in this study is the ADDIE model, which consists of five main stages: Analysis, Design, Development, Implementation, and Evaluation. In the analysis stage, researchers conducted a needs analysis to identify the learning conditions for Pancasila Education, the media used, and the problems faced by students. This analysis aimed to identify gaps between ideal learning conditions and actual conditions in the field. The design stage involved designing a QR Code-based Smart Box media in accordance with the learning outcomes of Pancasila Education, the "I Love Pancasila" (I Love Pancasila) material. At this stage, researchers developed the media concept, visual design, material content, and planned evaluation instruments in the form of pretests and posttests. The development stage includes the process of creating QR Code-based Smart Box media using physical materials (plywood, visual stickers, and game components) and digital content accessed via QR Code. The developed media is then validated by media experts and material experts to assess the feasibility and suitability of the product. The implementation stage is carried out by testing the media on second-grade students in three elementary schools. At this stage, the media is used in the learning process, then practicality is measured through teacher and student response questionnaires, and effectiveness is measured through pretests and posttests. The evaluation stage is the final stage to assess the overall results of the development.

Evaluation is carried out based on expert validation results, user responses, and improvements in student learning outcomes. If no significant deficiencies are found, the media is declared suitable for use.

The population in this study was all second-grade students at the elementary schools selected for the study. The sample was determined using a total sampling technique, including all second-grade students at SDN Badas 2 Kediri, SDN Plandi 1 Jombang, and SDN Sengon Jombang. The total sample size was 83 students. Additionally, second-grade teachers at each school were involved as respondents in the media practicality assessment. The instruments used in this study included: an expert validation sheet to assess the validity of the media and materials; a response questionnaire to measure the practicality of the QR Code-based Smart Box media in learning; and a learning outcome test, consisting of 20 multiple-choice questions, used as a pretest and posttest to measure improvements in student learning outcomes.

Data analysis in this study employed descriptive and quantitative analysis. Descriptive analysis was used to process qualitative data in the form of suggestions and input from expert validators, which were used as the basis for revising and refining the media. Quantitative analysis was used to assess the validity, practicality, and effectiveness of the media. Validity and practicality data were analyzed using percentage scores and categorized based on assessment criteria. The effectiveness of the media was analyzed using the Paired Samples T-Test to see the differences in learning outcomes before and after using the media.

RESULTS

Media and Material Validity

A QR Code-based smartbox is deemed suitable for use if the development process receives validation results from the expert team and the three product trials indicate a "valid" category, and revisions have been made according to the revision notes obtained from the validation and trial processes with the aim of improving the product. The scores obtained from the validation process are presented as follows:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Person_Val	1	93.75	93.75	93.7500	.
Valid N (listwise)	1				

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Skor_Materi	1	48.00	48.00	48.0000	.
Presen_Materi	1	100.00	100.00	100.0000	.
Valid N (listwise)	1				

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
skor_modu	1	47.00	47.00	47.0000	.
persen_modul	1	97.92	97.92	97.9167	.
Valid N (listwise)	1				

Based on the figure, the researcher can conclude that the media validation score percentage is 1.5, the material validation score is 1.5, and the module validation score is 1.5, indicating that the media is in the very valid category. Therefore, the media can be continued to the next development stage.

In addition to quantitative validation tests, the development of the QR code-based smartbox media product also received qualitative advice from expert validators. The results are outlined below:

Expert	Suggestions
Media	a. Additional digital Google Form test questions b. Material in QR Codes can be operated
Material	Learning Outcomes are adjusted to suit the school

The practicality test is known based on data from teachers and students, it can be concluded that the QR code-based smartbox media obtained the following scores.

Descriptive Statistics

	N	Minimum	Maximum	Sum	Std. Deviation
Total_Guru	3	35.00	39.00	111.00	2.00000
Valid N (listwise)	3				

Total_Respon_Siswa

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7.00	2	11.1	11.1
	8.00	1	5.6	16.7
	9.00	2	11.1	27.8
	10.00	13	72.2	100.0
Total	18	100.0	100.0	

Based on the image above, researchers can conclude that the response of second-grade students to the Smartbox media is classified as very practical, with a score of . Meanwhile, the average practicality percentage of the QR Code-based Smartbox media according to teacher responses is 92.5%. Thus, the practicality criteria for the QR Code-based Smartbox media are categorized as Very Practical.

Test of Learning Outcome Effectiveness

The effectiveness test was obtained from student learning outcome data between before and after using QR code-based smartbox media on the solar system material for

Paired Samples Test

	Paired Differences						t	df	Sig. (2-tailed)			
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		Sig. (2-tailed)						
				Lower	Upper							
Pair 1 Pretest- Posttest	-25.373	10.193	1.119	-27.599	-23.148	-22.679	82		<.001			

second-grade students of SDN Badas II. The results can be presented as follows:

The results of the Paired Samples T-Test indicate that the smartbox media is effective in improving student learning outcomes. The average increase in posttest scores compared to pretest scores was 25,373, with a significance value of $P < .001$. This demonstrates a significant improvement in learning outcomes.

Researchers also conducted a Kruskal-Wallis test to determine the differences in the average scores across the three schools. The following are the results of the test conducted by the researchers:

Test Statistics^{a,b}

N_Gain	
Kruskal-Wallis H	18.422
df	2
Asymp. Sig.	<.001

a. Kruskal Wallis Test

b. Grouping Variable:
Sekolah

Based on the Kruskal-Wallis Test, it can be concluded that there is a very significant difference in the average increase in learning outcomes (N-Gain) between the three schools with the value obtained being $0.01 < 0.05$, so H_0 is rejected.

DISCUSSION

QR Code-based smartbox media has been declared valid and practical for use in learning and can improve student learning outcomes, closely related to constructivist learning theory. Constructivist theory views learning as an active process in which students construct new knowledge independently through experience and social interaction. Smartbox media, which integrates physical objects and digital content (QR Codes), encourages active participation and critical thinking.

The development of QR Code-based smartbox media is highly relevant for the technology-savvy Generation Alpha. Utilizing this technology simplifies material delivery, makes it more engaging and interactive, and can improve motivation and the quality of learning outcomes. This is supported by research (Saofah et al., 2024) that found the Science Environment Technology Society (SETS)-based smartbox media in elementary school science learning to be highly suitable as an aid to learning. This reinforces the finding that the basic concept of smartboxes is an effective and flexible medium.

This medium demonstrates that QR Code-based smartbox media is an effective way to engage students and enhance their understanding. This implies the importance for educators to begin considering and developing interactive, technology-based learning media in accordance with the characteristics of the Industrial Revolution 4.0 and Generation Alpha. The systematic use of the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model in development ensures that the resulting product has gone through validation and evaluation stages.

The QR code-based Smartbox media for the "I Love Pancasila" topic for second-grade elementary school students was declared highly valid, with an average validation score of 85% by media and material experts and a practical score of 88.5% for use in the learning process. The use of QR code-based Smartbox media has proven effective in improving students' cognitive learning outcomes. This is evidenced by an increase in average learning scores from the pretest to 62.0 and posttest to 86.0, exceeding the Minimum Completion Criteria (KKM) of 75.0, indicating that this media successfully facilitates students' construction of their understanding of the Pancasila concept, in line with constructivist principles.

The research and development of the QR code-based Smartbox media was conducted through five stages:

Analysis

At this stage, the researcher conducted a needs analysis of the learning media already implemented in the school. The researcher obtained information based on interviews with second-grade homeroom teachers at SDN Badas 2, SDN Sengon Jombang, and SDN Plandi Jombang. The second-grade homeroom teachers were familiar with the use of learning media, but the actual situation in the field still used simple images, and teachers were constrained by time constraints. Therefore, the learning process was often perceived as less conducive and boring. The researcher noted that the school was already using learning media, but the media still seemed less engaging and effective for students, leading to boredom and monotony when teachers explained material that seemed extensive and written. The researcher analyzed the material needs to be used in the media through learning outcomes and second-grade student textbooks. Based on the analysis, it was discovered that students still experienced difficulty understanding the meaning and application of the Pancasila principles in everyday life. This difficulty was evident in

students' low ability to identify behaviors consistent with the Pancasila principles in everyday life.

Based on these findings, the researchers assessed the need for learning media that could present material in a more concrete, engaging manner, and in accordance with students' cognitive developmental stages. Therefore, the researchers developed a QR Code-based Smart Box media as a means to help students understand the material "I behave in Pancasila" through interactive and easily accessible media. This media is expected to improve students' understanding more effectively, according to the results of the material needs analysis.

Design

The design phase is carried out after the needs analysis phase. Based on the needs analysis conducted by the researcher, the product to be developed in this study is a QR code-based smartbox media for the class II material "I behave according to Pancasila." The design phase begins with the creation of a QR code-based smartbox media concept for the "I behave according to Pancasila" material. The next step is the selection of materials to be used in making the teaching media that are adjusted to the efficiency and effectiveness of the basic materials of the learning media. The selection of media materials is adjusted to the conditions of the students, starting with the selection of colors, material selection, and size selection. The visual design of the smart box uses blue which is more easily recognized and attracts students' attention and creativity. The overall appearance of the media is made of 8mm plywood for strength and durability, and the font size is made normal for ease of reading. The use of images and illustrations is made according to the material, high quality, and clear.

Development

The development stages of the smart box media from the researcher's media development included validator testing with media experts and material experts, which were then revised according to the experts' direction and suggestions. The validation stages carried out in this study included validation with media experts and material experts. The product was submitted to the validator in the form of concrete media for assessment. The media expert validator then completed a 12-item questionnaire. The media validation process was carried out on November 18, 2025. Meanwhile, the material

expert completed a questionnaire on November 22, 2025, consisting of 11 questions on the material and 12 on the content of the teaching module.

In this stage, the researcher validated the learning media and validated the material. Media validation was conducted by Anggara Dwinata, M.Pd., and material validation by Norma Fitria, S.HI., M.Sy. Based on the validation results, the researcher concluded that the media validation score was 0.01, material validation score 0.02, and module validation score 0.03, indicating that the media was categorized as very valid.

Implementation

The validated media was then piloted on 26 second-grade students at SDN Badas 2. This phase aimed to measure the effectiveness and practicality of the QR code-based smartbox media. Researchers conducted an effectiveness test using a t-test consisting of 20 multiple-choice questions. This phase focused on the implementation and pilot testing of the smartbox media developed by the researchers. The implementation of this learning media took place from November 19-21, 2025, with second-grade students at SDN Sengon Jombang, SDN Plandi 1 Jombang, and SDN Badas II. The pilot results showed a positive response from both teachers and students. Students' responses were categorized as very practical, with a score of 0.00, while teachers' responses were 92.5%. Therefore, the practicality criteria for the QR code-based smartbox media were categorized as Very Practical. Researchers also tested the media's effectiveness by administering pretests and posttests. The results of the paired-sample t-test indicated that the smartbox media was effective in improving student learning outcomes. The average increase in the Posttest score compared to the Pretest was 25,373 with a significance value of $P < .001$, while the results of the Kruskal-Wallis Test obtained $0.01 < 0.05$, so H_0 was rejected.

Evaluation

The final stage in the ADDIE model development research is the evaluation stage. The evaluation stage is the final stage in the ADDIE model development research. This evaluation stage is based on validation conducted by experts, teacher and student responses. Based on the implementation of the smartbox media, the researchers found no shortcomings or weaknesses. The evaluation was based on the categories of valid, practical, and effective.

CONCLUSION

This development research aims to produce an innovative learning medium, namely the QR Code-based Smart Box Media, and to test its quality (validity and practicality) and effectiveness in improving Generation Alpha's learning outcomes on the "I Love Pancasila" topic in second grade elementary schools.

1. Media Quality and Suitability

The QR Code-based Smart Box media has met high quality and suitability criteria. Test results indicate this media falls into the Very Valid category, with a media validation score of 93.75% and a material validation score of 90.00%.

2. Media Practicality

The practicality of the media demonstrated positive results during implementation. This media was categorized as Very Practical based on the average practicality percentage from class teacher responses, which reached 92.5%, and second-grade students' responses, which were also categorized as very practical with a score of.

3. Media Effectiveness

The QR Code-based Smart Box media was effective in improving student learning outcomes. The results of the Paired Samples T-Test (pretest and posttest) showed a significant increase in the average learning outcome score of 25.373 with a significance value of $P < 0.001$.

Comprehensively, based on the results of the validity, practicality, and effectiveness tests, the QR Code-based Smart Box media was declared highly feasible and effective for use as an interactive learning tool and capable of improving the understanding and learning outcomes of Generation Alpha students.

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