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Developing DADUALAM: An Integrated Science and Social Studies Learning Media to Enhance Fifth-Grade Students' Collaborative Skills

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Abstract: This study aims to develop DADUALAM (Natural Phenomena Dice), an integrated Science and Social Studies learning medium designed to enhance the collaborative skills of fifth-grade students. The study employed a Research and Development (R&D) approach using the ADDIE model, comprising five stages: analysis, design, development, implementation, and evaluation. The participants were fifth-grade students at SDN Tengah 03, East Jakarta, Indonesia. Data were collected through observations, teacher and student response questionnaires, expert validation questionnaires, and collaborative skills observation sheets. The data were analyzed using descriptive percentage analysis. The results showed that the DADUALAM medium achieved validation scores of 94% from subject-matter experts and 82% from media experts, indicating a high level of feasibility. Teacher and student responses both reached 94%, demonstrating a high level of practicality and acceptance. The implementation of DADUALAM also demonstrated improvements in students' collaborative skills across all assessed indicators. These findings suggest that DADUALAM is a feasible and practical instructional medium for integrated Science and Social Studies (IPAS) learning and has the potential to support the development of fifth-grade students' collaborative skills.

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Introduction

Teaching of Science and Social Studies (IPAS) at the elementary school level is an integrated approach that combines scientific and social concepts to help students understand natural phenomena and the social environment holistically (Surya & Pebriana, 2025). IPAS instruction focuses not only on knowledge acquisition but also promotes the development of students' social skills, critical thinking, and collaboration skills (Rahmayati & Prastowo, 2023). Therefore, teachers need to facilitate meaningful learning by using instructional media that are tailored to the characteristics of elementary school students.

Instructional media refers to any tool used to deliver information during the learning process, thereby supporting learning helping students understand the material being taught (Hanum & Sari, 2023). Instructional increases students' active engagement, facilitates their understanding of learning materials, and provides more meaningful and authentic learning experiences (Wulandari & Septikasari, 2025). However, IPAS instruction, particularly on the topic of natural phenomena, is often delivered primarily through verbal explanations, which makes abstract concepts difficult for students to understand (Farhatun Haya et al., 2025).

Natural phenomena include floods, tsunamis, landslides, volcanic eruptions, typhoons, and earthquakes (Munandar et al., 2023). Teaching this topic is important because it helps students understand natural events occurring in their surroundings and recognize the

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cause-and-effect relationships underlying such phenomena (Farhatun Haya et al., 2025). However, many natural phenomena cannot be observed directly by students; therefore, concrete instructional media are needed to help visualize these concepts.

In addition to conceptual understanding, collaboration skills are essential competencies that need to be developed among elementary education. Collaboration skills represent students' capacity to collaborate effectively with group members, share responsibilities, respect others' opinions, and actively participate in solving problems (Anggraini et al., 2024). According to Greenstein, collaboration skills are demonstrated through active participation, productive work, appreciation of each group member's contribution, responsibility, and the ability to make joint decisions (Greenstein, 2012).

Previous studies reported that dice-based learning media improved students' learning outcomes (Fadli et al., 2022) and were feasible for classroom implementation (Nisa et al., 2024). Raditya et al. (2023) also found that cooperative learning improved students' collaborative skills. However, these studies mainly focused on learning outcomes, media feasibility, or instructional models rather than on developing learning media specifically designed to foster collaborative skills. Therefore, there is still a need for instructional media that intentionally promotes collaboration in Science and Social Studies (IPAS) learning on natural phenomena. To address this gap, the present study develops the DADUALAM learning media, which integrates dice, content cards, discussion cards, and question cards to encourage active participation, shared responsibility, discussion, and joint decision-making among fifth-grade students.

Dice-based learning media support active and collaborative learning by engaging students in problem-solving activities through a six-sided instructional tool containing images or symbols (Agustin et al., 2025). Based on this concept, the DADUALAM (Natural Phenomena Dice) learning media is developed to facilitate the learning of natural phenomena. Media consist of a six-sided dice representing different natural phenomena and are accompanied by content and discussion cards that encourage interactive group learning and collaboration (Dewi et al., 2022).

The novelty of the DADUALAM learning media lies in its integration of dice, content cards, discussion cards, and question cards within a collaborative learning process. Unlike previous dice-based learning media that mainly focus on learning outcomes or media feasibility, DADUALAM is specifically designed to promote students' collaborative skills. Through structured group activities, students actively participate in discussions, share responsibilities, exchange ideas, and make decisions together. This integrated approach supports both conceptual understanding of natural phenomena and the development of collaborative skills among fifth-grade elementary school students.

Research Method

This study adopted the Research and Development (R&D) method to develop the DADUALAM (Natural Phenomena Dice) learning media and evaluate its feasibility for fifth-grade Science and Social Studies (IPAS) learning on the topic of natural phenomena (Ade Rahayu, 2025). The study employed ADDIE model, which consisted analysis, design, development, implementation, and evaluation (Sultan & Kasim, 2024). This model was selected because it provided a systematic development process with continuous evaluation to ensure that the learning media met students' needs and quality standards (Andi Rustandi & Rismayanti, 2021).

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The study involved 32 fifth-grade students (N = 32) from SDN Tengah 03 Jakarta Timur, selected through purposive sampling to evaluate the DADUALAM learning media and its role in facilitating collaborative skills. During the Analysis phase, students' needs, collaboration skills, learning challenges, and curriculum content were identified. The Design phase included developing the media layout, storyboard, discussion cards, question cards, and a six-sided dice representing natural phenomena. In the Development phase, the media were produced, validated by one media expert and one subject matter expert, and revised based on their feedback. The Implementation phase involved classroom use of DADUALAM, while the Evaluation phase examined the validation results, teacher and student responses, and observations of students' collaborative skills to refine the final product (Hanum & Sari, 2023).

Prior to the implementation stage, the DADUALAM learning media and its instructional content were evaluated by one media expert and one subject matter expert to determine their suitability for classroom use. The teacher and student questionnaires, together with the collaborative skills observation sheet, were developed based on the research objectives and the collaborative skill indicators proposed by (Greenstein, 2012). These instruments were used to collect supporting data during the implementation of the developed media. The questionnaires employed a four-point Likert scale, with scores ranging from 1 (Poor) to 4 (Very Good). The percentage analysis and interpreted according predetermined feasibility criteria (Najib et al., 2024). The analysis described the level of achievement for each indicator before and after the implementation of the DADUALAM learning media. To measure the enhancement of students' collaboration skills, the Normalized Gain was calculated using the average percentage scores derived from observation sheets completed before and after the use of the DADUALAM learning media. The following formula was used to calculate the percentage score for each assessment aspect:

$$P = \frac{f}{N} X\ 100$$

Notes:
P: Validity Percentage
f: Total from Data Collection
N: Maximum Score

Based on this framework, the level of success in product development was determined based on the degree of feasibility and the required product revisions. The feasibility criteria are presented in Table 1.

Table 1. Feasibility Criteria

Percentage	Criteria
81% - 100%	Highly Feasible
61% - 80%	Feasible
41% - 60%	Moderately Feasible
21% - 40%	Less Feasible
0% - 20%	Not Feasible

Source: Modified version of (Nuramalia et al., 2025).

The percentage score for each collaboration skills indicator, according to (Herdiansyah et al., 2025).

$$\% = \frac{n}{N} x\ 100$$

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Notes:
%: Percentage of collaborative skills as reported by students
n: Score obtained
N: Total number of scores

The results from the observation sheet on students' collaboration skills were analyzed using five performance categories, as presented in Table 2.

Table 2. Collaboration Skills Criteria

Percentage	Criteria
81% - 100%	Excellent
61% - 80%	Good
41% - 60%	Fair
21% - 40%	Poor
0% - 20%	Very Poor

Source: Modified version of (Ramadhan et al., 2025).

Results and Discussion

The DADUALAM learning media uses a six-sided dice because it represents the six natural phenomena included in the learning material. Each side combines images and text to help students recognize concepts more easily and support meaningful discussion. This visual-verbal design aligns with Dual Coding Theory and the Principles of Multimedia Learning, which suggest that integrating visual and verbal information facilitates students' understanding and learning. DADUALAM learning media was developed using thee ADDIE model, which consisted phases: analysis, design, development, implementation, and evaluation. This model was selected because it provided a systematic framework for developing and evaluating the learning media. The development process at each phase is described as follows.

Analysis Phase, observations and learning needs analysis were conducted at SDN Tengah 03, East Jakarta. The findings showed that students experienced difficulties in understanding natural phenomena because the concepts were abstract. Learning also relied primarily on lecture-based instruction with limited use of instructional media, resulting in low student participation and underdeveloped collaboration skills. Therefore, concrete and engaging learning media were needed to support IPAS learning (Rahmayati & Prastowo, 2023).

Design Phase on the analysis results, flowcharts, storyboards, visual designs, content cards, discussion cards, and question cards were prepared as components of the DADUALAM learning media. The media was designed as a six-sided dice featuring natural phenomena aligned with the Grade 5 IPAS curriculum. The accompanying cards supported concept understanding while encouraging discussion, idea sharing, and collaborative problem-solving (Greenstein, 2012). All components developed during this phase were then visualized into a preliminary design of the DADUALAM learning media, which served as a guideline for the Development phase. The front view of the DADUALAM learning media is presented in Figure 1. The learning media that had been developed were then supplemented with content tailored to the topic of natural phenomena. The content of the DADUALAM learning media was shown Figure 2.

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Figure 1. Front View



Figure 2. Content View

During the Development phase, the DADUALAM learning media were developed based on the designed specifications using durable and student-friendly materials. The completed media were validated by subject matter and media experts to evaluate their functionality, visual design, content accuracy, and classroom suitability. The validation results are presented in Table 3.

Table 3. Results of the Media Expert Validation

Assessment Criteria	Percentage	Category
Appearance	81%	Highly Feasible
Functionality	88%	Highly Feasible
Suitability	80%	Feasible
Total	82%	Highly Feasible
Suggestion: For the DADUALAM media, add a card storage compartment and replace the media compartment with a more permanent design.		

Based on Table 3, the DADUALAM media achieved an overall percentage of 82%, placing it in the "highly suitable" The functionality aspect received the highest percentage of 88%, indicating that the media was easy to use during learning activities. The visual presentation aspect received a percentage of 81%, showing that the media's design was

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visually appealing. Meanwhile, the suitability aspect received a score of 80%, Placing it the "feasible" category.

The appearance aspect received a score of 81%, falling "highly feasible". These results indicated that the media's design, including the color selection, images, layout, and font size. The functionality aspect received a score of 88%, falling into the "highly feasible". Results indicated that the DADUALAM media was easy to use, functioned in accordance with the learning objectives, and effectively supported students' learning activities. These findings were supported by previous research, which reported that instructional media that were easy to operate improved the effectiveness of the learning process (Firdha & Zulyusri, 2022). Finally, the suitability aspect received score of 80% falling "feasible." Indicated DADUALAM media met the criteria in classroom use, although it still required several improvements based on the validators' suggestions. Next, the media were validated by subject-matter experts, and the results in Table 4.

Table 4. Results Subject Matter Expert Validation

Assessment Criteria	Percentage	Category
Content	94%	Highly Feasible
Instruction	100%	Highly Feasible
Assessment	92%	HighlyFeasible
Language	88%	Highly Feasible
Total	94%	Highly Feasible

Suggestion: Add images to the media cards and shorten the questions on the discussion cards to make them more engaging, communicative, and easy for elementary school students to understand.

According to Table 4, the DADUALAM learning media obtained an overall score of 94%, which placed it in the "highly suitable". Among the assessed aspects, the instruction aspect achieved the highest score of 100%, demonstrating that the learning media supported the learning objectives and learning outcomes of IPAS. The content aspect recorded a score of 94%, indicating that the materials were appropriate for the characteristics of elementary school students and the intended competencies. The assessment aspect reached 92%, suggesting that the discussion cards were consistent with the learning content and effectively assessed students' understanding. In addition, the language aspect obtained a score of 88%, indicating that the language used was clear, communicative, and appropriate for the comprehension level of elementary school students.

The content aspect received a score of 94%, falling into the "highly feasible". Indicated that the content on natural phenomena aligned with the learning outcomes, conceptual accuracy, and the characteristics of elementary school students. This finding consistent previous research, which reported that content suitability was a key indicator of the quality of instructional media (Afifah et al., 2022). Furthermore, the intruction aspect received a score of 100%, falling in "highly feasible". These results indicated that the DADUALAM learning media supported the achievement of the learning objectives, increased student engagement, and facilitated a more meaningful learning process. These findings were supported by previous research, which reported that instructional media designed to meet learning needs increased student engagement in the learning process (Apriyani et al., 2022).

The assessment aspect achieved 92% and was categorized as highly feasible, indicating that the discussion cards and questions appropriately supported the learning objectives and assessed students' understanding of natural phenomena (Taqiya & Prabawati,

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2022). The language aspect scored 88%, also classified as highly feasible, showing that the language was clear and suitable for elementary school students, although several questions required minor revision. This finding was consistent with Hidayatullah et al. (2022).

The Implementation phase involved a pilot study with 32 fifth-grade students at SDN Tengah 03 Jakarta Timur. Students worked in small groups by rolling the DADUALAM dice, observing the displayed natural phenomena, and discussing the related content and discussion cards. These activities encouraged active participation, idea sharing, and collaborative problem-solving while providing a more concrete learning experience than conventional instruction (Zahro, 2024). After the implementation, teacher feedback was collected to evaluate the media in terms of suitability, practicality, instructional quality, and feasibility. The results are presented in Table 5.

Table 5. Teachers' Responses

Assessment Criteria	Percentage	Category
Media Suitability	83%	Excellent
Media Practicality	100%	Excellent
Learning Suitability	100%	Excellent
Media Feasibility	92%	Excellent
Total	94%	Excellent
Comment: The presentation of the material was clear, well-structured, and easy for fifth-grade students to understand.		

Based on Table 5, the DADUALAM media received an overall percentage of 94%, falling "very good". The aspects media practicality and learning suitability received the highest percentage 100% indicating DADUALAM media is easy to use and aligned with the IPAS learning objectives for the topic of natural phenomena. The media's suitability aspect received a score of 92%, while the media's appropriateness aspect received a score of 83%.

The media suitability of 83%, placing it in the "very good". Indicated that the content, appearance, and presentation of the media were aligned with the students' characteristics and learning objectives, thereby supporting a more effective learning process (Jaiz et al., 2022). Furthermore, the media practicality aspect received a score of 100%, placing it in the "very good". These results indicated that the DADUALAM learning media was easy for teachers to use, was practical for classroom implementation, and did not require complicated procedures (Fitrahtunnisa et al., 2022). Next, the instructional suitability aspect received a score of 100%, placing it in the "very good".

Finally, the media feasibility aspect received a score of 92%, placing it in the "very good" category. These results indicated that the DADUALAM learning media met the criteria for a learning medium suitable for use in elementary school instruction (Fachrunnisak & Susanti, 2022). Then to determine the students' reactions to the use of the DADUALAM learning media during the learning process. The assessment was based on the media and instructional aspects. The results of the student responses are presented in Table 6.

Table 6. Student Response Results

Assessment Criteria	Percentage	Category
Media	95%	Excellent
Learning	93%	Excellent
Total	94%	Excellent

According to Table 6, the media aspect obtained a score of 95%, whereas the learning aspect recorded 93%. Overall, the DADUALAM learning media achieved an average student response score of 94%. These findings indicated that students considered the DADUALAM

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learning media attractive, easy to operate, helpful in understanding the topic of natural phenomena, and effective in creating a more engaging and enjoyable learning experience.

The media aspect achieved 95% (highly feasible), indicating that the visual design and usability of DADUALAM attracted students' interest and supported active participation. This finding was consistent with Kusuma et al. (2024), who reported that attractive and practical learning media enhanced students' responses. The learning aspect scored 93% (highly feasible), showing that DADUALAM improved students' understanding and classroom engagement. This result also agreed with Wati et al. (2025), who found that instructional media promoted active participation and learning motivation.

Next, students' collaboration skills were observed before and after use DADUALAM learning media using five indicators: working productively, participating actively, making joint decisions, taking responsibility, and valuing the contributions of each group member. The observation results were presented in Figure 3.

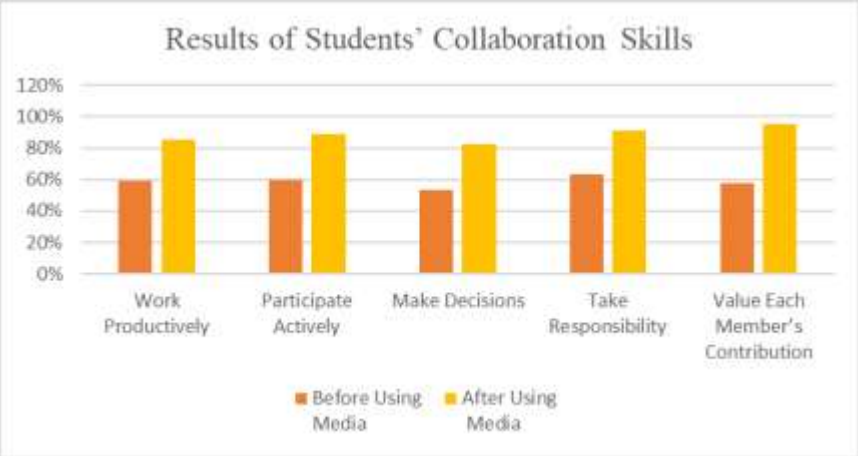


Figure 3. Results of Students' Collaboration Skills

Based Figure 3, all indicators showed an increase after instruction using the DADUALAM learning media. Before the instruction, the percentage of collaboration skills ranged from 53% to 60% and then increased to 83%–95% after the instruction. The greatest increase occurred in the indicator of valuing each member's contribution, which increased from 58% to 95%, followed by the responsibility indicator, which increased from 63% to 91%, and the active participation indicator, which increased from 60% to 89%. Meanwhile, the indicators of working productively and making joint decisions increased to 85% and 83%, respectively.

The highest increase in the indicator of valuing each member's contribution occurred because the learning activities using the DADUALAM learning media were designed to facilitate collaborative group work, positioning each student as an essential contributor to task completion. During the implementation phase, each group took turns rolling the dice, observed the images of natural phenomena that appeared, and discussed the corresponding content cards, discussion cards, and question cards to reach a collective answer. Consequently, the DADUALAM learning media, which integrated collaborative discussion and problem-solving activities, encouraged more intensive interaction among students. As a result, the indicator of valuing each member's contribution showed the greatest improvement compared with the other collaboration skill indicators. Collaboration skills after the implementation of the DADUALAM learning media, an N-Gain analysis. The results analysis in Table 7.

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Table 7. Results of the N-Gain Analysis of Collaboration Skills

N-Gain	Category
0,71	High

The results of the Table 7, a score of 0,71 was obtained, which was classified as "high." These results indicated that the use of the DADUALAM learning media significantly improved students' collaboration skills after they participated in IPAS lessons on natural phenomena. The high N-Gain score suggested that learning activities integrating the DADUALAM learning media with group discussions provided a more meaningful learning experience than the lessons conducted before the implementation of the learning media.

The findings showed that DADUALAM addressed several limitations of previous natural phenomena learning media, which mainly emphasized content delivery or individual learning activities. By integrating dice with discussion cards, the media required students to exchange ideas, share responsibilities, and make decisions collaboratively while solving learning tasks. This design supports active engagement and collaborative problem-solving more effectively than conventional lecture-based instruction, where students often play a passive role. The combination of visual materials and structured group discussions also facilitates meaningful interaction, enabling students to construct knowledge together while strengthening their collaborative skills. These results indicated that the DADUALAM learning media not only met the criteria for feasibility as an instructional medium but also had a positive impact on students' collaboration skills.

Evaluation phase reviewed expert validation results, teacher and student feedback, and observations of students' collaborative skills to refine the learning media. Based on the evaluation, DADUALAM was considered appropriate for IPAS learning on natural phenomena. The final product consisted of a six-sided dice, content cards, discussion cards, and question cards designed to support students' understanding of natural phenomena while promoting collaborative skills (Sultan & Kasim, 2024).

Conclusion

According to the validation results, the medium received feasibility scores of 82% from media specialists and 94% from subject-matter experts, suggesting that it was appropriate for use in classrooms following adjustments. Teacher and student responses each reached 94%, demonstrating that the learning media was practical, engaging, and easy to use.

The implementation of the DADUALAM learning media improved students' collaboration skills in working productively, participating actively, making shared decisions, taking responsibility, and respecting group members' contributions. Overall, the DADUALAM learning media is a feasible, practical, and effective instructional medium for IPAS learning that enhances the collaboration skills of fifth-grade elementary school students through active and student-centered learning.

Recommendation

Elementary school teachers are encouraged to integrate DADUALAM into Science and Social Studies (IPAS) learning by combining it with Problem-Based Learning (PBL) or Cooperative Learning to promote students' active participation and collaborative skills. Future studies are encouraged to involve larger and more diverse samples, apply experimental or quasi-experimental designs, and examine the use of DADUALAM in different learning topics or to develop other 21st-century skills.

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