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Development of Android-Based Interactive Learning Media Assisted by Smart Apps Creator to Improve Science Learning Outcomes in Elementary Schools

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Abstract: This research is motivated by the minimal use of technology as a learning medium which has an impact on low student learning outcomes. The purpose of this study is to develop an interactive learning media design based on Android with the help of Smart Apps Creator and to test the aspects of feasibility, practicality, and effectiveness. The research method used is Research and Development (R&D) with the Borg and Gall model. The data collection process is carried out through test techniques (posttest and pretest) and non-test (documentation, questionnaires, interviews, and observations). The results of the product validation assessment by expert validators showed a percentage score of 93.57% and 92%, with a very feasible category. The results of filling out the response questionnaire showed that the interactive learning media designed by the researcher received a very positive response from students and teachers. The results of the pretest and posttest showed that the learning media designed by the researcher was able to improve student learning outcomes, as shown by an increase in the average pretest score of 54.17 to 84.57 at the time of the posttest and the N-gain test value reached 0.71 with high criteria. Therefore, interactive learning media based on Android using Smart Apps Creator has proven to be feasible and practical to be used in the learning process and is effective in improving student learning outcomes in the content of science subjects in grade IV.

Keywords: Android; Interactive learning media; IPAS; Learning outcomes; Smart apps creator

Introduction

Education plays an important role in creating superior and quality generations, in accordance with the mandate of the 1945 Constitution, paragraph four, namely to educate the nation's life. To realize education in accordance with the direction of national education goals, an education curriculum is needed. Currently, the Merdeka Curriculum is the curriculum that applies in Indonesia. The Merdeka Curriculum is present as an answer to the challenges of education in the digital era and globalization (Saa, 2024). The Independent Curriculum emphasizes education on the formation of students with 21st century skills and the development of students with character according to the Pancasila Student Profile in order to prepare the golden generation of 2045. In order to support the implementation of the Independent Curriculum, the implementation of learning must be carried out in an inspiring, challenging, interactive, enjoyable learning atmosphere, encourage student activity, and provide sufficient space for students (Amirahma & Setyasto, 2024).

One of the subjects in elementary school in the Independent Curriculum is Science, which studies living and non-living things and their interactions in the world, including human life as individuals and social beings related to their surrounding environment (Wardani et al., 2023). Science learning aims to foster students' curiosity and sensitivity to environmental phenomena, so that they understand how the universe works and its

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interactions with human life (Mukaromah et al., 2024). This understanding enables students to identify and solve problems by connecting scientific and social aspects to achieve sustainable development goals (Fadhlurrohman & Bektiningsih, 2024). The importance of the content of science subjects in elementary schools requires teachers to design effective and efficient learning, one of which is through the use of learning media (Mukaromah et al., 2024).

However, the facts on the ground show that there are still various problems in learning in elementary schools. Previous research found that the learning activities carried out were still centered on teachers (Arisandhi et al., 2023). In the learning process, teachers are more dominant in using conventional methods (Maula & Fatmawati, 2020). Other findings revealed that the learning media used were less interesting and were still conventional media, resulting in low student interest in learning. The lack of use of learning media in the learning process resulted in low student learning outcomes (Rohmah & Tegeh, 2022; Bersih & Margunayasa, 2021). The same problem also occurred at SDN Sumbaga 01, Tegal Regency. The results of interviews and observations of learning practices in class IV showed that learning activities in class were more dominated by teachers, where teachers were more dominant in using the lecture method when delivering material. In addition, the limited learning media in schools meant that teachers did not always use learning media when delivering material. Teachers were also less than optimal in utilizing technology as a learning medium.

The learning media that teachers often used were conventional media such as whiteboards and concrete objects, while digital media such as PPT and videos displayed via LCD were only used as a diversion. In fact, there were school facilities, such as LCDs and internet networks that could be used by teachers. The results of filling out the questionnaire also showed that students already had Smartphones that could be used in the learning process at school. The lack of use of interactive learning media caused low student interest in participating in learning activities. During the learning process, students were seen not paying attention to the teacher and were instead busy chatting. This resulted in decreased learning outcomes. Documentation of student learning outcomes in the content of the IPAS lesson in class IV showed that there were still students who had not passed the KKM, especially in the material on the form of matter and its changes. Of the 36 students, only 14 students (41.67%) completed, while the remaining 21 students (58.33%) had not completed the KKM, where the KKM value for the science subject matter in grade IV was 70. Based on the existing problems, the researcher offers a solution through the development of interactive learning media through the use of technology. Interactive learning media is one of the learning media that is useful for teachers to attract students' attention because it combines elements of images, text, audio, animation, and video (Ismawati et al., 2023).

The attractiveness of interactive learning media is able to produce a pleasant learning atmosphere. Interactive learning media that can be operated directly by students is able to foster student activity in the learning process. The use of interactive learning media is also able to encourage student motivation and improve learning outcomes (Sinta et al., 2021). Interactive learning media can be made based on Android. Android refers to an operating system specifically made for touchscreen mobile devices based on Linux, such as tablets and smartphones (Ejiyi et al., 2021; Bakhri et al., 2023). The advantage of Android as an open source platform allows teachers to create and customize learning media applications in line with student needs (Wulandari & Handayani, 2021). Android is also able to help students to learn flexibly, both in terms of time and place (Rany et al., 2020).

Android-based interactive learning media can be designed with various types of software, one of which is Smart Apps Creator, a desktop application that is useful for creating iOS and Android mobile applications and producing output in the form of files in EXE, HTML 5 and APK formats (Pawani et al., 2021). One of the advantages of Smart Apps Creator is that it is easy for anyone to use to create learning media because it does not require a programming language (Mahuda et al., 2021). Smart Apps Creator is also able to combine elements of images, text, audio, video, and animation in an interesting way so that it can increase students' enthusiasm for learning. Other studies relevant to this study prove that learning media based on Smart Apps Creator are validated to be able to support teaching and learning activities in elementary schools (Hidayah et al., 2024). Research conducted by Hidayah et al. (2024) shows that multimedia based on Smart Apps Creator is able to optimize students' understanding and motivation to learn. Android-based learning media that uses Smart Apps Creator is interesting for students in elementary schools so that they are happier and more enthusiastic in learning (Arnandi et al., 2022).

Based on this background, the researcher developed an interactive android-based learning media about the material of the form of matter and its changes with the help of Smart Apps Creator to improve the learning outcomes of grade IV students at SDN Sumbaga 01 Tegal Regency, especially in the content of science subjects. The purpose of this study is to test the aspects of feasibility, practicality, and effectiveness of learning media. The development of this media will help students to access materials anytime and anywhere, by combining elements of writing, images, sound, video, and animation. The development of this media will be

interspersed with educational games and interactive quizzes that students can work on after accessing the material.

Method

The Research and Development (R&D) method in this research is used to develop a product and assess its level of effectiveness (Lee et al., 2017). In this case, the product created by the researcher is an interactive learning media based on Android designed using Smart Apps Creator software, with the aim of improving the learning outcomes of grade IV students, especially in the content of science subjects in the material of the form of matter and its changes. The process of developing this product follows the Borg and Gall model development procedure which includes ten stages, including: identification of potential and problems; data collection; product design; design validation; design improvement; initial product testing; improvements based on initial test results; usage trials; further improvements; and mass production. However, due to time and cost constraints, the researcher only used 8 stages. The research scheme is contained in Figure 1.

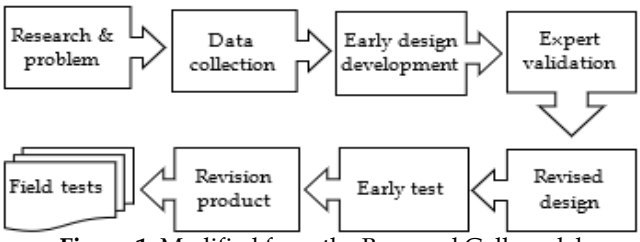


Figure 1. Modified from the Borg and Gall model

This research was conducted at SDN Sumbaga 01, Bumijawa District, Tegal Regency. The subjects of this study included media expert lecturers and material experts, 23 grade IV students and 12 grade V students at SDN Sumbaga 01, and grade IV and V teachers at SDN Sumbaga 01. The data collection techniques used were test and non-test techniques. The test technique was carried out through a pretest and posttest using 30 multiple-choice questions, while the non-test technique was carried out through interviews, observations, distributing questionnaires, and documentation. The data for this study are primary data, which are directly obtained from the research, including qualitative and quantitative data. Qualitative data were obtained from the results of filling out questionnaires, observations, and interviews with grade IV teachers. Quantitative data were obtained from documentation of learning outcomes of students in grade IV and the results of tests before (pretest) and after (posttest) the product trial. Data analysis was carried out to determine the feasibility, practicality, and effectiveness of the product developed by the researcher. Data analysis of product validation results from expert validators of material and media using validation sheet instruments with a Likert scale was carried out to assess product feasibility. The percentage of product feasibility test results can be converted in line with those shown in Table 1.

Table 1. Expert Validation Assessment Criteria

Percentage (%)	Criteria
76-100	Very Eligible
51-75	Eligible
26-50	Quite Eligible
0-25	Less Eligible

To assess the practicality of the product, the researcher conducted data analysis on the results of filling out the teacher's response questionnaire using the Likert scale and the results of filling out the student response questionnaire using the Guttman scale. The percentage of product practicality data can be converted according to what is shown in Table 2.

Table 2. Product Practicality Assessment Criteria

Percentage (%)	Criteria
76-100	Very Positive
51-75	Positive
26-50	Negative
0-25	Very Negative

The effectiveness of the learning media developed by researchers was assessed by analyzing the results of the pretest and posttest of students during the learning process. This analysis was carried out through a series of tests, including normality tests, paired sample tests, and N-Gain using SPSS 25 software, which aims to show an increase in learning outcomes before and after learning.

$$N - Gain = \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score} \quad (1)$$

The N-Gain test results are categorized based on the criteria listed in Table 3.

Table 3. N-Gain Assessment Categories

Mark	Category
N-Gain ≥ 0.70	High
0.30 ≤ N-Gain < 0.70	Medium
N-Gain < 0.30	Low

Result and Discussion

Development of Interactive Learning Media Design Based on Android Designed with the Assistance of Smart Apps Creator

Interactive learning media based on Android designed with the assistance of Smart Apps Creator software was developed by following the Borg and Gall model development procedure. The first and second stages in media development are identification of potential and problems and data collection. At this stage,

researchers look for potential and problems in schools by collecting data through observation, interviews with grade IV teachers, distributing questionnaires, and documentation. Researchers found problems in the form of low student learning outcomes in the content of science subjects, especially in the material on the form of matter and its changes. This can be seen in the documentation data on student learning outcomes which shows that some students have not completed the KKM. Of the 36 students, only 14 students (41.67%) completed it, while 21 students (58.33%) have not completed the KKM.

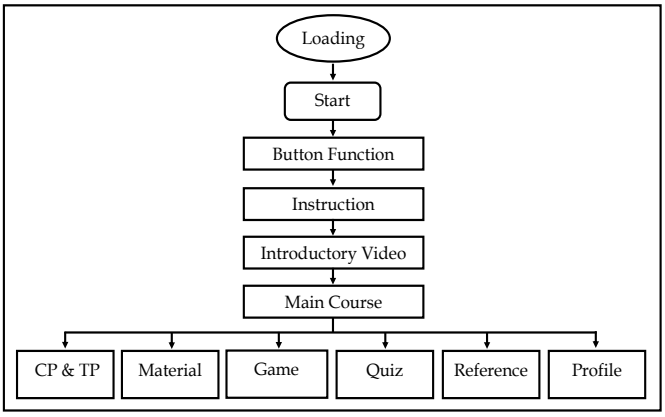


Figure 2. Flowchart of Interactive Learning Media

The combined results of interviews with grade IV teachers, observations, and filling out questionnaires show that: minimal use of technology as a learning medium; low student interest in learning; and low student learning outcomes. The results of the questionnaire showed that students already have Smartphones that can be used for the learning process at school. The third stage of media development, namely product design. The design of interactive learning media is designed using steps that include: preparation of materials; making Flowcharts and Storyboards; and realizing the Storyboard in a real product. Preparation of materials is carried out by analyzing Learning Achievements and creating Learning Objectives to be achieved, as well as compiling lesson materials, games, and evaluation questions that will be delivered through the media. Furthermore, researchers began to make Flowcharts, diagrams containing a description of the flow of interactive learning media programs (Kusumawati et al., 2021). The flowchart is shown in Figure 2.

The flowchart that has been created is then developed into a storyboard, in order to fully explain the appearance of the interactive learning media program (Afifah et al., 2021). The storyboard contains sketches of images containing icons and core texts on the media. The storyboard is contained in Figure 3 and Figure 4.

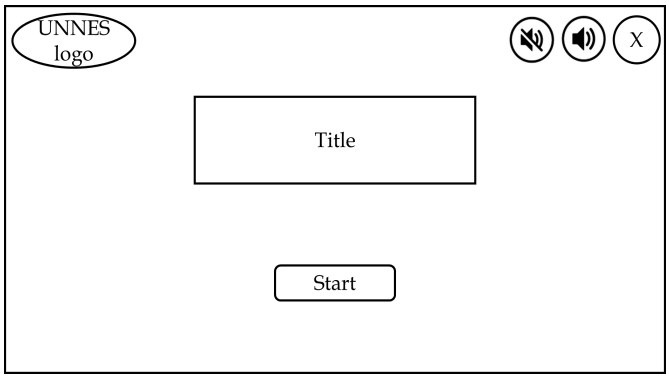


Figure 3. Start page storyboard

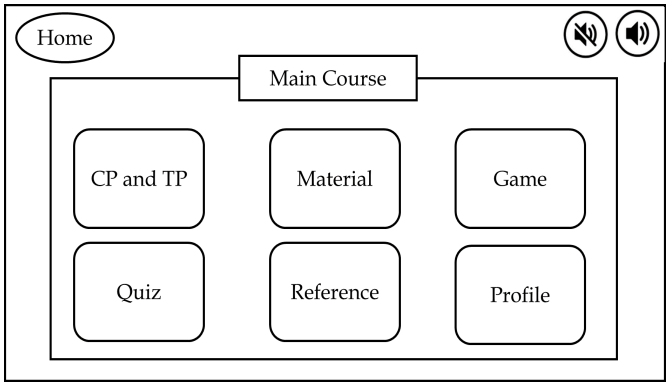


Figure 4. Main menu page storyboard

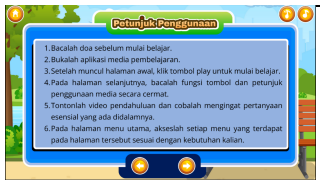
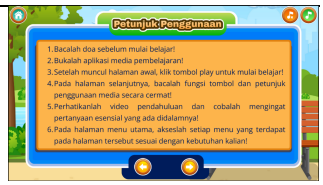
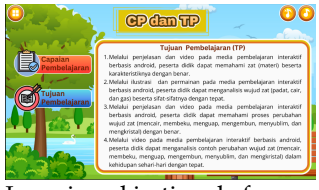
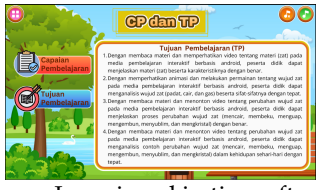
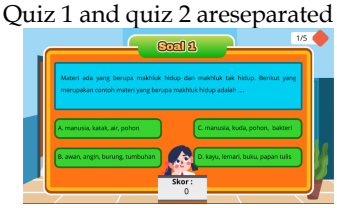
Figure 5. Start Page View

Figure 6. Main Menu Page View

The Storyboard design was then realized into a real product template using the Canva application. After that, interactive learning media was developed using the Smart Apps Creator software by editing the media template by adding text, image, audio, video, and animation elements as well as creating interactive game and quiz menus. The final result of editing learning media with Smart Apps Creator is a file in APK format, which can be run via a Smartphone with an Android system. The initial product design results can be seen in Figure 5 and Figure 6.

The fourth stage of media development is design validation. In this step, interactive learning media designed with the help of Smart Apps Creator software is assessed by expert validators, namely media experts and material experts. The design validation stage is carried out to assess the feasibility of the product design. This process is carried out by providing a validation questionnaire, where the validator is asked to check each aspect that is assessed. If there are aspects that are not yet appropriate, the media expert and material expert will provide input. The input is then used by the researcher to make revisions in the next stage. The fifth stage of media development is design revision. The researcher improves the design of the learning media according to the input provided by the material expert validator and media expert. The media expert provides several inputs, including: the background color in certain parts is more contrasting and the color of the navigation buttons is varied. Input from the material expert includes: learning objectives are adjusted to the material and quizzes between learning 1 and learning 2 are made separately. The results of the design revision are contained in Table 4.

Table 4. Design Revision Results from Media Experts and Material Experts

Before Revision	After Revision
Page start before revision	Page starts after revision
Button functions before revision	Button functions after revision
	
Instructions for use before revision	Instructions for use after revision
Main menu before revision	Main menu after revision
	
Learning objectives before revision	Learning objectives after revision
Quiz 1 and quiz 2 combined	
	Quiz 1 and quiz 2 areseparated
	
Quiz before revision	Quiz after revision

The sixth stage of media creation is product testing, in the form of direct application of interactive learning media to students. This stage was carried out on a small scale to 12 grade V students, who were selected through a purposive sampling method according to the cognitive level of students, namely high, medium, and low categories, each consisting of 4 students. In the small-scale trial, the researcher also gave a response questionnaire to teachers and students, consisting of 20 questions. The results of the teacher and student responses will be used as material to assess the practicality of the product being developed and as a consideration for large-scale trials. The seventh stage of media development is product revision.

The learning media developed by the researcher received a positive response and there were no comments from teachers and students in the small-scale trial so that no revision process was needed. From this, the interactive learning media based on Android developed with the help of Smart Apps Creator is worthy of being tested on a large scale. The eighth stage

of media development is a usage trial. This stage was carried out by testing the product on a large scale to 23 fourth-grade students at SDN Sumbaga 01. At this stage, students and teachers filled out a response questionnaire related to the learning media developed by the researcher. At the end, students worked on the pretest and posttest questions. This is in line with the research design used, namely the pre-experimental design with a one-group pretest-posttest model, students were given a pretest before being treated and a posttest after being treated. The pretest and posttest scores in the large-scale trial were used to assess the effectiveness of the product based on student learning outcomes.

Feasibility of Android-Based Interactive Learning Media Designed with the Assistance of Smart Apps Creator

Media testing by expert media validators and material experts through a validation process for Android-based interactive learning media was carried out to assess the feasibility aspect of the media. The results of the product validation are shown in Table 5.

Table 5. Results of Validation by Media Experts and Material Experts

Expert	Score	Total score	Percentage (%)	Criteria
Media	131	140	93.57	Very Eligible
Material	92	100	92	Very Eligible

Table 5 shows that the developed learning media product obtained a percentage score of 93.57% with very feasible criteria from media experts and a percentage score of 92% with very feasible criteria from material experts. The product was considered very feasible by media experts because it had met the aspects: learning; navigation; writing; language; visual and audio displays; interactivity, and programming. The product was considered very feasible by material experts because it had met the aspects: curriculum; material content; and language. These results show that the Android-based learning media developed using Smart Apps Creator software is feasible to be tested on users. This finding is in line with previous research which showed that the development of learning media using Smart Apps Creator obtained a score of 91% from media experts and 80% from material experts with very feasible criteria, so the product is feasible to be tested. Other research also shows that learning media assisted by Smart Apps Creator obtained a percentage score of 92% from media experts and 90% from material experts, which is included in the appropriate category (Ratnasari et al., 2024).

Practicality of Android-Based Interactive Learning Media Designed with the Assistance of Smart Apps Creator

Teachers and students also participated in providing an assessment of the Android-based interactive learning media designed with Smart Apps Creator. In small and large-scale trials, teachers and students filled out a response questionnaire related to the media developed. This was done to determine the practicality of the product. The results of teacher and student responses are contained in Table 6 and Table 7.

Table 6. Teacher and Student Responses in Small-Scale Trials

Respondent	Evaluation (%)	Criteria
Teacher	96.70	Very Positive
Students	99	Very Positive

Table 7. Teacher and Participant Responses in the Large-Scale Trial

Respondent	Evaluation (%)	Criteria
Teacher	93.30	Very Positive
Students	98.30	Very Positive

Table 7 and Table 8 show that the interactive learning media based on Android assisted by Smart Apps Creator received a very good response from students and teachers. In the small-scale trial, the learning media obtained a percentage score of 96.70% from teachers with very positive criteria and a percentage score of 99% from students with very positive criteria. In the large-scale trial, the learning media obtained a percentage score of 93.30% from teachers with a very positive section and a percentage score of 98.30% from students with very positive criteria. These results indicate that the interactive learning media based on Android designed by the researcher is very practical to use in the learning process and can be beneficial for both students and teachers. This finding is in line with previous research which revealed that the results of filling out the questionnaire of teacher and student responses to learning media using Smart Apps Creator obtained a percentage score above 75% with a very practical section indicating that the learning media is practical to use in the learning process in the classroom (Sholihah & Hidayati, 2023). Other research also shows that Android-based learning practices through Smart Apps Creator are able to optimize creativity, activity, learning outcomes, and student motivation (Suhartati, 2021). Meanwhile, research was conducted Puspitasari et al. (2022) revealed that the combination of animation and music in the Smart Apps Creator learning media makes the media feel interesting, fun, and not boring and is also able to make it easier for students to understand the material.

Effectiveness of Android-Based Interactive Learning Media Designed with the Assistance of Smart Apps Creator

The effectiveness of Android-based interactive learning media is assessed by comparing the pretest and posttest data during the learning process. The effectiveness of learning media testing is carried out

through several tests, namely normality tests, tests, and N-gain. The results of the normality test are presented in Table 8.

Table 8. Normality Test Results

Test Type	N	Mean	Sig	Category
Pretest	23	54.61	0.222	Normal
Posttest	23	85.13	0.204	Normal

Table 8 shows that the significance values in the pretest and posttest are respectively 0.222 and 0.204. This shows that both significance values are more than 0.05, so they fall into the normal category. The researcher then conducted a t-test (paired sample test) to prove whether there was a difference in the average of the pretest and posttest results or not. The results of the t-test are contained in Table 9.

Table 9. Results of the t-test (Paired Sample Test)

Test Type	N	Mean	Std. Deviation	Std. Error	Sig (2-tailed)
Pretest	23	54.61	14.61	3.05	0.000
Posttest	23	85.13	10.70	2.23	

Table 9 shows that the sig. (2-tailed) value is 0.000, which is less than 0.05. This indicates that there is a significant difference in student outcomes before and after using Android-based interactive learning media assisted by Smart Apps Creator. Finally, in order to determine the average increase in learning outcomes of grade IV students at SDN Sumbaga 01 on the material on the state of matter and its changes, an N-Gain test was conducted. The results of the N-Gain test are contained in Table 10.

Table 10 shows that in the large-scale trial, the average difference was 30.40 and the N-Gain results showed a figure of 0.71 with high criteria. This indicates an increase in the value of student results with a high category. This finding is in line with previous research which states that Smart Apps Creator-based learning media is effective in improving student learning outcomes, with N-gain included in the high category (Nurmila et al., 2023). In line with this, other studies have revealed that developing learning media with Smart Apps Creator is effective in improving student learning outcomes (Khoirudin et al., 2021; Sutrisni et al., 2022).

Table 10. N-Gain Test Results

Test Type	N	Mean	Different	N-Gain	Criteria
Pretest	23	57.17	30.40	0.71	High
Posttest	23	84.57			

Learning media is a tool used by teachers to convey messages to students, so that the messages conveyed can be understood more easily and learning objectives can be achieved (Marpanaji et al., 2018; Hadi et al., 2022). Learning media is one of the most important elements that can determine the success of learning activities (Febrina & Setiawan, 2024; Rahim et al., 2022). In today's digital era, various aspects of life have been affected by technological developments, including education. In learning, technological advances have driven the rapid development of learning media, especially in the form of technology-based media (Widyatama & Pratama, 2022; Williamson et al., 2020; Zamiri & Esmaeili, 2024). The use of technology as a learning medium can help teachers create active, interactive and interesting learning (Metasari & Amalia, 2024; Haleem et al., 2022).

Conclusion

Based on the research results, it is proven that the android-based interactive learning media developed using Smart Apps Creator software is able to improve students' learning outcomes in the content of the natural sciences subject matter of the state of matter and its changes. This can be seen from the results of the analysis of the pretest and posttest data of students which showed an increase with an average difference of 30.40 and an N gain value of 0.71 which is included in the high criteria. In addition, the results of the product validation assessment by expert validators obtained a score percentage of 93.57% and 92%, which are included in the very feasible category. Through the results of the distribution of response questionnaires, a very positive response was obtained from both students and teachers. This proves that the android-based interactive learning media created with the help of Smart Apps Creator is feasible, practical, and effective in improving students' learning outcomes in the material of the state of matter and its changes in the content of the natural sciences subject in grade IV of elementary school.

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Author Contributions

S. M. N. A contributed in conducting research, developing products, analyzing data, and writing articles. N. S as a supervisor in research activities until writing articles.

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Conflicts of Interest

The researcher declares that he has no conflict of interest.

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