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Development of Interactive Multimedia Based on Appy Pie to Improve Learning Outcomes of Elementary School Students

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Abstract: This research aims to develop, test the feasibility and effectiveness of interactive multimedia based on Appy Pie to improve the cognitive learning outcomes of students in grade V of SD Negeri Kemijen 02, Semarang City. This type of research is development research (R&D) using the ADDIE model. The subjects of the study were 27 students in grade V of SD Negeri Kemijen 02. Data collection techniques include non-test and test. The data analysis technique uses normality test, homogeneity test, t-test, and N-Gain test. The results showed that the Appy Pie-based interactive multimedia development included covers, instructions for use, concept maps, learning competencies, materials, videos, discussion pages, AI chatbots, and evaluations. The feasibility results of media experts are 97.91% "very feasible", material experts are 89.28% "very feasible". The effectiveness of multimedia is proven through the t-test which shows a significance value of 0.000 (<0.05) with an N-gain value of 0.68 in the medium category. This study concludes that Appy pie-based interactive multimedia has been successfully developed with a very feasible and effective category to improve the learning outcomes of IPAS for grade V students of SD Negeri Kemijen 02 Semarang City.

Keywords: ADDIE model; Appy pie; Interactive multimedia; Learning outcomes

Introduction

The development of science and technology contributes significantly to education, especially through the use of technology in the development of learning media (Rahayu et al., 2023). Learning media is a physical means used to convey learning messages, which is expected to make it easier for teachers (Wulandari et al., 2023). Learning media is a physical means used to convey learning messages, which is expected to make it easier for teachers to achieve learning objectives (Kristanto, 2016). Learning media has a crucial role in optimizing the learning process and overcoming the potential for boredom during teacher and student interactions (Mulyanto & Mustadi, 2023).

The use of learning media can attract the attention of elementary school students, so that the messages delivered by educators to be effectively conveyed and improving learning outcomes (Ansori, 2024). There is a close relationship between learning media, learning materials, and curriculum. The curriculum, as a set of plans and arrangements, is the foundation for the preparation of learning materials and the selection of the right learning media. The curriculum helps set goals, content, and learning methods to achieve national education goals, including the development of student's potential and the formation of character in accordance with national values (Ahmad et al., 2023). Through the implementation of national education standards in the curriculum, education in Indonesia can have a clear direction and goals and encourage learning that is more effective and relevant to the times.

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used to convey learning messages, which is expected to make it easier for teachers to achieve learning goals (Kristanto, 2016). Learning media has a crucial role in optimizing the learning process and overcoming the potential for boredom during teacher and student interactions (Mulyanto & Mustadi, 2023). There is a close relationship between learning media, learning materials, and curriculum. The curriculum, as a set of plans and arrangements, is the foundation in the preparation of learning materials and the selection of the right learning media. The curriculum helps set goals, content, and learning methods to achieve national education goals, including the development of students' potential and the formation of character by national values (Ahmad et al., 2023). Through the implementation of national education standards in the curriculum, education in Indonesia can have a clear direction and goals and encourage learning that is more effective and relevant to the times.

The development and transformation in curriculum development in Indonesia aims to improve the quality of education. One of the important policies is the implementation of the independent curriculum, in accordance with the Decree of the Minister of Education and Culture Number 262/M/2022, which was implemented in the 2022/2023 school year. In this curriculum, there is a change in the name of the Natural Sciences and Social Sciences lesson to IPAS (Berlian et al., 2022). The implementation of IPAS in the Merdeka curriculum is based on the idea that elementary school students learn better through concrete experiences. By integrating Natural Sciences (IPA) and Social Sciences (IPS), it is hoped that students will be able to manage the natural and social environment as a unified whole (Dewi & Setyasto, 2024). IPAS learning is applied to grade 1, 2, 4, 5 and 6 with the division of phases: Phase A (grade I – II), Phase B (grade III – IV), and Phase C (grade V – VI). IPAS studies living and inanimate objects in the universe and their interactions, including humans as social creatures who interact with their environment (Masrifah & Setyasto, 2024). IPAS subjects are expected to equip the younger generation to answer future challenges, foster curiosity about the phenomena around them, help understand how the universe works, and interact with human social life on earth. This understanding is the basis for identifying problems that may be faced in the future.

Essential concepts of IPAS as a combination of Natural and Social Sciences that contribute to the creation of a sustainable environment (Inayati & Setyasto, 2024). IPAS is the main subject in the Indonesian education system, including at the elementary and junior high school levels, which aims to instill basic concepts to solve problems in society. However, challenges in teaching IPAS with a science approach include cognitive problems and students' confidence in IPAS materials, which sometimes hinder the willingness to learn and the effectiveness of time use (Suhelayanti et al., 2023). Therefore, IPAS learning needs to be structured in concrete stages, understanding basic and abstract concepts so that students can master the concepts comprehensively. The use of interactive multimedia in IPAS learning in elementary school has great potential to increase the effectiveness and efficiency of the learning process.

The use of technology such as interactive multimedia, simulation, and educational software can help students understand scientific concepts in a more engaging and interactive way (Fitrawati, 2019). This is supported by Rukmawati et al. (2023) highlighting that the application of appropriate learning media has a significant impact on students' learning achievement, increasing their motivation. It is again proven by Anggiani et al. (2023) where learning with multimedia can increase motivation, stimulate thinking, and achieve the goal of completeness. The use of multimedia in learning IPAS can improve higher-level thinking skills, science skills, and mastery of basic concepts and principles of IPAS in a fun way (Rizqi et al., 2024). The use of learning media must also be considered by teachers because it is an important means to achieve learning goals (Muhtar et al., 2020). Various learning media are very important to help students understand abstract concepts. Factors such as the role of teachers, student participation, quality of learning materials, and media variety play a significant role in achieving the desired learning goals.

Based on the results of pre-research through observation and interviews conducted from April 22 to April 30 2024 with grade V teachers at SD Negeri Kemijen 02, Semarang City, it shows that learning media is still limited to package books, whiteboards, and pictures, as well as the ineffective use of digital-based media. The use of projectors and mobile phones in digital learning is still not optimal. This condition limits the development of digital media that can be integrated thoroughly and become a suitable alternative to be applied in grade V. This is supported by learning methods that tend to be teacher-centered, causing students to be less active. The development of mobile phone-based digital learning media carried out by teachers does not create obstacles related to school facilities, so that students can learn from the material provided through digital media more flexibly at home.

The process of learning material on environmental problems is not mature, because students have difficulty understanding complex concepts such as deforestation, marine damage, waste management (3R), and environmental pollution, with the presentation of unfamiliar scientific terms. This is supported by the

learning results of IPAS students in class V at SD Negeri Kemijen 02 showing that 59% of the 27 students have not reached the KKTP set at 70. This condition has the potential to have a negative impact on the achievement of overall learning goals. To overcome these problems, researchers developed appy pie-based interactive multimedia in the IPAS subject of environmental problems.

Interactive multimedia is a combination of media, text, images, videos, and animations that are made into one in a computer (Maesaroh & Mulyadiprana, 2020). The use of multimedia as a tool that can complement the learning process so that it can contribute to students to enjoy learning and can improve student learning outcomes (Wahyudi et al., 2023). The use of multimedia provides convenience for learners to access learning anywhere, enables independent learning, and facilitates learners in understanding concepts within the learning materials (Megalina et al., 2023). One of the platforms that can be developed for interactive multimedia is Appy pie. Appypie is a popular internet platform thet allows the creation of mobile apps without in-depth knowledge in programming, which was launched in 2013 by Abinav Ghirdar in Noida, India (Chusni et al., 2018).

Appy pie's platform supports a wide range of operating systems, such as Android, iOS, Windows Phone, Blackberry, and HTML, making it easy for users to create and publish apps through app stores such as Google Play and iTunes (Chusni et al., 2018). The main advantage of Appypie is its simplicity of use with a "no-code" model, allowing anyone to create apps quickly and easily. Features such as drag-and-drop, data integration, social media, user analytics, and push notifications to make app development more efficient and functional (Appypie.com).

Appy Pie offers a variety of features, including animated and three-dimensional features, that can be used to create interactive learning media that appeals to learners. Appy Pie's software is very flexible and can be used to create multimedia learning media. With the features available in Appy Pie, teachers can create dynamic and engaging learning content. This learning media can be implemented in the classroom as an alternative choice of learning media, considering that the resulting application can be downloaded through the Play Store. Multimedia developed using Appy Pie can include images, audio, video, and games that contain learning materials. The addition of a backsound can provide additional attraction for students.

This research is supported by relevant previous research, providing a basis and further understanding related to the use of Appy Pie in the context of education. The research "Development of Android-Based Interactive Learning Media through Appy pie Software to Improve Student Learning Outcomes on the Sub-theme of Ecosystem Balance for Class V SD/MI" by Manggala et al. (2023) concluded that Appy Pie Software is effective as a learning medium. The value of media practitioners was 95%, material practitioners averaged 84.67%, student responses averaged 90.25%, and teacher responses of 96% showed the effectiveness of the media. The students' learning outcomes showed an n-gain of 0.701. Another study, "Development of Appy Pie Android Mobile Learning Application Based on Creative Thinking Skills in Elementary Schools" by (Auliyah & Sari, 2021), found that the validation of material experts was 88.50%, media experts 89.84%, and teacher assessment 87.50%. The trial on students resulted in a percentage of learning media quality of 79.25%, with a feasible category. Research by Latifa et al. (2020), entitled "Development of Android-Based Appy Pie Learning Media on Mathematics in Elementary School," concluded that the validation score of media experts was 91.11%, the validation score of material experts was 98.33%, and the response of students was 91.11%, indicating the categories of "very feasible" and "very good."

The novelty of research can be found in materials and the application of technology. The material discussed focused on environmental problems around polluted schools, relevant for students who still have a minimal understanding of the dangers of environmental pollution. The study integrates applications connected to Quizizz, using artificial intelligence (AI) to help teachers access students' grades and answers, as well as AI GPT that allows for more adaptive learning interactions. In addition, the practitioner score in the media test in this study reached 97, higher than the previous study, and included a test to improve student learning outcomes through n-gain, which was not present in previous studies. This research makes a significant contribution to the development of more effective and adaptive technology-based learning media in the digital era.

Based on the above presentation, the researcher wants to develop interactive multimedia based on Appy Pie to improve student learning outcomes on environmental problems at SD Negeri Kemijen 02, East Semarang District, Semarang City.

Method

This research includes Research and Development (R&D), which refers to an instructional design approach that involves the stages of needs analysis, content design, development, implementation, and evaluation to ensure interactive multimedia learning media, with quantitative methods (Li & Cheong, 2023). Development research is a process to develop educational products

and validate them through expert evaluation, aiming to produce new product discoveries as well as the improvement of existing products (Mahya & Setiawan, 2024). According to Sugiyono (2010), Research and Development (R&D) is a research method that aims to test, develop, and create certain products. Research (R&D) first involves research and will continue with development. This process involves several steps, starting from the analysis of findings or previous research related to the product to be developed, followed by product development, testing, and revision to correct the shortcomings contained in the resulting product.

The model development step is carried out on a cyclical basis (R&D). The cycle includes the findings of the product to be developed, developing products based on the findings of the submission both scientifically and operationally in the field, and revising to correct the shortcomings found in the field trial stage (Rustamana et al., 2024). The ADDIE model is applied in Research and Development, because it is a continuous and continuous evaluative process in each phase, as has been proven in each phase (Suratnu, 2023). In addition, an evaluation process is also carried out on the articulation between phases to determine the degree of consistency and coherence between each. The ADDIE development model has 5 stages depicted in Figure 1.

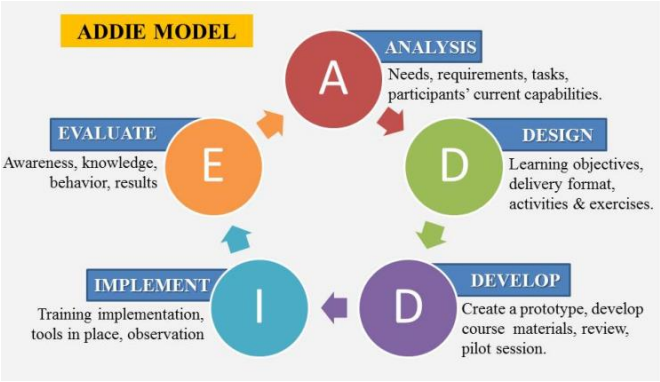

Figure 1. ADDIE Development Stages (Fatimah & Rohani, 2022)

The development of ADDIE consists of several stages. The initial stage of analysis involves analyzing problems, student characteristics, teaching materials, and teachers' needs for learning media. This stage was carried out through observation, interviews, and documentation at SD Negeri Kemijen 02. The results show that there are obstacles in the use of digital media that cause students to have difficulty understanding the concept of environmental problems, such as the unfamiliar concept of 3R. Therefore, the development of interactive multimedia with concrete examples is needed. The design phase uses the Canva platform, based on interviews and teacher needs questionnaires for interactive multimedia for the learning process in grade V. Design includes cover pages, user guides, learning components, concept maps, YouTube video integration, materials, class discussion pages, Kahoot and Quizizz quizzes, tools, and developer profiles. In the development stage, an interactive multimedia product based on Appy Pie was developed to be operated on Android and iOS, then validated by expert lecturers and teachers. The implementation stage involved 27 students in class V to measure the effectiveness of the product through pretest and posttest. Finally, the evaluation stage aims to assess the effectiveness of interactive multimedia in improving learning outcomes through pretest, posttest, and student and teacher responses.

The data collection instruments of this research use tests (pretest and posttest) and non-tests (interviews, observations, questionnaires, and documentation). The data analysis techniques used include product feasibility analysis through the validation of material and media experts (Fauzi et al., 2024). The use of validation by experts or validators aims to obtain evaluations and opinions from experts regarding the crucial aspects of the developed devices or products, assessing their suitability for use, using a Likert scale ranging from 1 to 4 (Masaguni et al., 2023). In addition, a dichotomy scale is used to determine the responses of teachers and students to the use of interactive multimedia products during the learning process.

The next analysis is the analysis of product effectiveness by analyzing pretest and posttest data which begins with a normality test using SPSS (Shapiro-Wilk) and a homogeneity test, then continues with the Paired Samples Test (t-test) and N-Gain test to measure the increase in score from pretest to posttest.

Result and Discussion

Interactive multimedia is developed using Appy Pie software, through the stages of analysis, design, and development. Appy pie-Based Interactive Multimedia Development Design.

Analysis Stage

An interview with Any Wahyuningtyas, S.Pd., a grade V teacher at SD Negeri Kemijen 02, revealed several aspects that need to be evaluated: the limitation of digital media in learning, a teacher-centered approach to learning, a lack of sustainable development in the development of digital media that can be integrated comprehensively in grade V, low understanding of students about environmental problems that threaten life, and low learning outcomes of IPAS subjects in class V.

Researchers' observations at SD Negeri Kemijen 02 Semarang City show that the school has facilities to support the learning process, such as computers and LCDs, and allows students to bring mobile phones to school. Based on the available facilities, it can be concluded that Appy Pie-based interactive learning media can be applied to improve student's IPAS learning outcomes. The purpose of using this media is to improve the learning outcomes of IPAS through the presentation of effective and interesting interactive multimedia. Therefore, it was decided to develop interactive multimedia that can improve the learning outcomes of students in IPAS subjects by using appy pie-based software.

Design and Development Phase

After determining solutions to overcome existing problems, the next research stage was designed by making an interactive multimedia design on IPAS subjects, material on environmental problems that threaten life with essential competencies of the independent curriculum for grade V of SD Negeri Kemijen 02. The requirements for creating learning materials for the Apply Pie application include: ease of use, attractive design, operability, and relevance to needs. The presentation of this learning media is designed in several pages with an aesthetic layout to attract students' attention and increase their interest in learning. This format includes a variety of components, including an opening page designed to attract students' attention with an attractive and creative display, so that students become more interested and do not feel bored during the learning process. The app's homepage will appear when the app is opened with layers containing user guide information, learning components, material concept maps, videos, learning materials, student books, class discussions, quizzes, tools, AI chatbots, and developer profiles created with the help of Canva. The Appy pie design plan is shown in Figure 2.

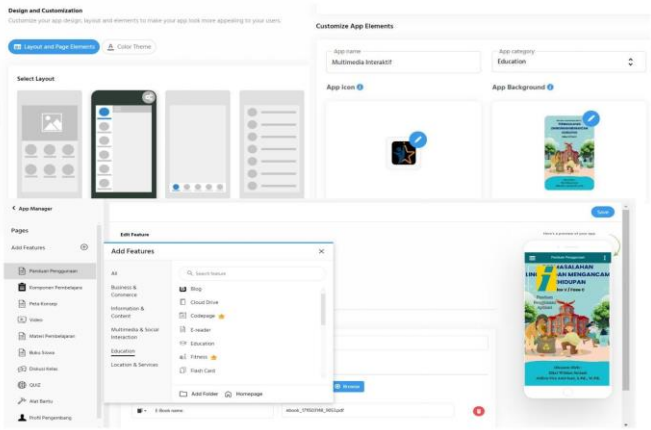

Figure 2. Design layout, features, and icon elements and application opening page

Figure 3. Home page, app usage guide, learning condep map

Figure 4. Learning components, learning materials, videos

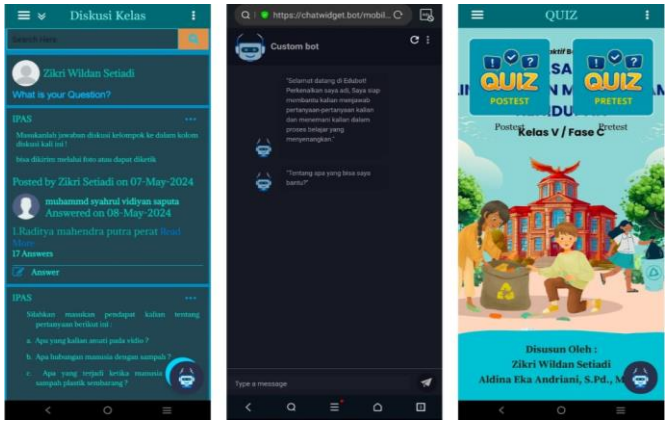

Figure 5. Discussion page views, AI chatbots, and quizzes

The development stage is a stage where interactive multimedia is developed so that it can be operated with Android and iOS for grade V students. At this development stage, each feature component is added and integrated with all learning tools such as learning materials, YouTube, Quizziz, Kahoot, and Open AI GPT. The results of Appy pie-based interactive multimedia development are shown in Figures 3 – 5.

Implementation and Evaluation Stage

The implementation stage was carried out by trial in a small group consisting of 6 students in grade V, held

on May 2 and 3, 2024. At this stage, students are given an understanding of the use of interactive multimedia after carrying out the pretest. After that, students operate Appy Pie-based interactive multimedia and complete evaluations on the quiz menu during learning activities. The small group trial showed excellent post-test results without requiring revision, so that it could be continued to the effectiveness test in a large group consisting of 21 class V students.

The last stage is evaluation. This evaluation aims to determine the effectiveness of Appy Pie-based interactive multimedia. To collect data, a response questionnaire was given to all students and teachers of class V. The questionnaire consisted of 15 questions, in which respondents were asked to give a mark (√) on the appropriate choice.

Appy pie-based interactive multimedia feasibility

The feasibility of the developed product will be determined based on the evaluation results from material and media validators, supported by feedback from students and teachers (Balqis & Andriani, 2024). Expert validation is carried out by PGSD lecturers at Semarang State University, with the aim of obtaining assessments and input on improvements related to the products developed. Aspects of assessment by material experts include material suitability, learning steps, and learning assessment. At this stage, interactive multimedia received suggestions from material experts, including adjustments to the grid of questions and questions based on the realm of cognitive aspects, adjustments to syntax and material taught in the media, and summarization of conclusions.

Aspects of assessment by media experts include the display and visual communication of learning media, the design of learning media, the benefits of learning media, and software aspects. The validation results from media and material experts are presented in Table 1.

Table 1. Validate the Feasibility of Interactive Multimedia

Validators	Category Indicators	Percentage	Eligibility criteria
Material Expert	Display and visual communication of learning media Learning media design Benefits of learning media Soft serve	89.28	Highly Worthy
Media Members	Material suitability Steps of learning Valuation	97.91	Highly Worthy

Based on the results of the validators in Table 1. The development of appy pie-based interactive multimedia can be said to be feasible to be implemented in grade V students of SD Negeri Kemijen 02.

Furthermore, to find out the response of students and teachers of grade V after using interactive multimedia for the learning process in learning environmental problems can be seen through a questionnaire of the responses of students and teachers to the use of interactive multimedia based on appy pie. (Suryawan & Permana, 2020) also revealed that seeing feasible and effective media in the learning process can be seen from direct feedback from users "teachers and students" with table 2.

Table 2. Results of the Questionnaire of Student and Teacher Responses

Validators	Percentage	Eligibility criteria
Class V Teacher	100	Highly Worthy
Learners	98.02	Highly Worthy

Based on Table 3, regarding the results of the responses, students and teachers of class V showed responses with the criteria of "very feasible". This is also strengthened by the findings of previous research by (Latifa et al., 2020) also stated that the use of appy pie in developing multimedia for the learning process is "very good" used in learning. Explained again by (Yuliyantika et al., 2023), the development of appy pie learning media by integrating android received a positive response to the responses of teachers and students.

The Effectiveness of Interactive Multimedia to Improve Student Learning Outcomes

Evaluation by experts showed that the learning media was tested on a sample of grade V students at SD Negeri Kemijen 02 through testing on all students. The main purpose of this test is to evaluate the suitability and feasibility of the developed learning media. The assessment was carried out by measuring learning outcomes using Appy Pie interactive multimedia before and after learning IPAS. In addition, a response questionnaire was given to teachers to find out their responses regarding the use of this interactive multimedia. The teacher's response score showed that 100% agreed that Appy Pie-based interactive multimedia was able to improve student learning outcomes.

Data analysis was carried out using a t-paired sample test to evaluate changes in IPAS learning outcomes. Before the main analysis, a normality test was carried out to assess whether the data was normally distributed. Decision based on significance value: if the significance value < 0.05, the data is not normally distributed; If the significance value > 0.05, the data is

normally distributed (Haryono et al., 2023). The results of this normality test are summarized in table 3.

Table 3. Table of Data Normality Test Results

Tests of Normality			
			Shapiro-Wilk
	Statistics	Df	Sig.
Pretest Scores	0.96	27	0.35
Posttest Values	0.95	27	0.24

Based on the results of the analysis in Table 3, the data shows a normal distribution because the significance value > 0.05. Furthermore, a homogeneity test was carried out to determine the uniformity of the variance of pretest and posttest values. The decision in the homogeneity test is based on the significance value: if the significance value > 0.05, the data is considered homogeneous; If the significance value < 0.05, the data is considered non-homogeneous (Haryono et al., 2023).

Table 4. Table of Data Homogeneity Test Results

Tests of Homogeneity of Variances				
Pretest - Posttest	Levene Statistics	DF1	DF2	Sig.
	1.71	6	9	0.22

The table data above shows a homogeneity significance value of 0.225 > 0.05, which indicates that the variance of pretest and posttest values is homogeneous. After the homogeneous data is known, the Paired Sample Test is carried out. The decision making of this t-test is based on the significance value (2-tailed): if the significance value < 0.05, there is a significant difference in the average IPAS learning outcomes of grade V students between the pretest and posttest scores; if the significance value > 0.05, there was no significant difference in the average IPAS learning outcomes of grade V students between the pretest and posttest scores. The results of the analysis of the Paired Sample Test are shown in Table 5.

The data in the Table 5 shows a significance value (2-tailed) of 0.000 < 0.05, so it can be concluded that there is a significant difference between the pretest and posttest with the use of interactive multimedia. In addition, this is also proven through the test of the average increase (N-gain) by comparing the increase in pretest and posttest results calculated using the analysis of the n-gain index in Table 6.

Table 5. Table of Results of Paired Test Samples

Paired Samples Test			
Pretest Grades – Posttest Grades	t-statistic	Degrees of freedom	Sig. (2-tailed)
	10.99	26	0.000

Table 6. N-Gain test results

Difference	Average	N-Gain	Category
Pretest	49.96	0.68	Keep
Posttest	82.74		

Based on the results of the N-gain test obtained is 0.68, which is in the range of $0.3 \leq g \leq 0.7$, indicating a moderate category or there is an increase in students' learning outcomes from pretest and posttest. This is supported by (Manggala et al., 2023) shaking their research showing that the use of learning media development with the Appy Pie platform is feasible and can be used to improve learning outcomes. In line with (Mandayati et al., 2022) revealed that media development with the Appy pie platform is effective in improving student learning outcomes.

The feasibility test shows that interactive multimedia is very effective when applied in the learning process, with very positive responses from both students and teachers. However, an N-Gain in the moderate category can occur due to several factors. The first factor is the readiness of students to use technology-based learning media, as not all students have the same skills in operating technological devices. The second factor is the different learning styles of students; some students easily understand visually, while others understand auditorily. The third factor is the varying levels of students' knowledge at the beginning of the learning process, where some students have a high or low level of initial understanding. The fourth factor is the conditions of the learning environment that support technology, such as the internet connection used by students, which is often unstable, resulting in less optimal use of interactive multimedia.

Learning readiness has a significant influence on the use of technology in the learning process (Dewi & Hasmirati, 2022). This is in line with previous research by Ramadhani et al. (2024) which explained that students' learning readiness must be prepared by sharing and need to pay attention to students' learning styles. Students' learning styles are very important in the learning process, a learning process that is in accordance with the student's learning style will increase students' understanding of the material provided (Derici & Susanti, 2023). Utami et al. (2020) revealed that the delivery of material to students will be hampered and less effective when internet access is slow. Also supported by Hafiuluddin et al. (2023) the main obstacle in the use of digital-based media is a slow internet connection that will affect the effectiveness of learning, but the effectiveness of learning is not only influenced by the network but can also be influenced by motivation, and the level of understanding of students. A low level of initial understanding of students will affect their level of understanding of critical thinking, so that students'

initial understanding ability affects students' understanding of learning materials (Awaluddin et al., 2024).

Conclusion

The conclusion of this study indicates that the interactive multimedia development design based on Appy pie with cover components, instructions for use, concept maps, learning competencies, materials, videos, discussion pages, AI chatbots and evaluations is feasible to use as evidenced by the feasibility test and validation of media and material experts who get a total percentage of scores from media experts of 97.91% and material experts of 89.28%. The effectiveness of interactive multimedia based on appy pie in learning IPAS was declared effective based on the results of the pretest and posttest scores which the pretest and posttest scores which experienced a significant increase as shown by the significance of the paired sample test of 0.000 < 0.05 with an n-gain value of 0.68, that the development of interactive multimedia based on appy pie was successfully developed to improve the learning outcomes of IPAS in the material of environmental problems of grade V elementary school students Negeri Kemijen 02 Semarang City.

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