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EFFECTIVENESS OF INTERACTIVE POWERPOINT MEDIA INTEGRATED WITH AUGMENTED REALITY IN IMPROVING STUDENT LEARNING OUTCOMES ON THE SOLAR SYSTEM TOPIC

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Abstract

Conventional learning methods that lack interactivity often make it difficult for students to understand concepts, resulting in low learning outcomes. This study aims to determine the feasibility and effectiveness of interactive PowerPoint learning media integrated with Augmented Reality (AR) in improving students' learning outcomes on the topic of the solar system. The research design used is a one-group pretest-posttest design. Media feasibility was assessed through expert validation by design, material, and media experts, as well as a small group trial. The validation results showed that the media was highly feasible, with an average feasibility score of 98% from the three experts, along with positive responses from the small group trial. The effectiveness of the media was analyzed using normality tests, homogeneity tests, paired sample t-tests, and N-Gain calculations. The t-test results showed a significant value of 0.000 < 0.05, indicating a significant difference between pre-test and post-test scores. The average N-Gain score of 0.60 or 60.21% falls into the moderate and fairly effective category. Therefore, the media is considered highly feasible and fairly effective for use in science learning at the junior high school level.

Keywords: Learning Media, Interactive PowerPoint, Augmented Reality, Learning Outcomes

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INTRODUCTION

Rapid technological advances have had a major impact on various aspects of human life, including in the field of education (Munti & Syaifuddin, 2020). Technology plays an important role in supporting teachers and students in the learning process. Currently, the learning process in schools has involved the use of technology as the main component in teaching and learning activities. One important aspect of the use of this technology is the use of appropriate learning media (Fadhilah et al., 2021). Learning media is an important component in supporting the success of the teaching and learning process. Learning media aims to explain difficult concepts, facilitate interaction between students and teachers, and improve understanding of the material (Wulandari et al., 2023).

The rapid development of technology has also encouraged the creation of more innovative and effective learning media. Therefore, the selection of learning media used must be able to attract the interest of students so that they are more enthusiastic in following the learning process. In addition, the media must be interactive and allow students to participate actively, either through discussions, simulations, or independent exploration of the material (Jovanović & Chiong, 2013).

Based on the results of observations conducted in class VII at SMPN 1 Kota Kediri, the learning process there is still dominated by the use of conventional media, such as textbooks and literacy books from the school library. Although teachers occasionally use PowerPoint presentations to explain the material, this method has not completely replaced the conventional approach commonly used in teaching. The use of existing PowerPoint is still simple, namely only displaying text in the form of points or paragraphs, with a plain slide display and minimal visualization. This causes student involvement in the learning process to be limited, due to the lack of interactive elements and interesting visual stimuli.

In the digital era, mobile phones have become a tool that greatly supports the learning process in schools. With features such as access to digital materials, learning applications, and fast communication, mobile phones can improve the effectiveness of student learning. The use of this technology allows students to access various learning resources, take interactive classes, and understand the material in a more interesting way (Hidayat & Khotimah, 2019). However, in practice, the use of mobile phones is often not optimal. Instead of being used to support learning, many students actually use them for less productive things, such as playing games, accessing social media, or doing activities unrelated to the subject matter. This reduces students' concentration during learning and has an impact on their learning outcomes.

Learning outcomes are the abilities that a person has after undergoing a learning process, which includes changes in knowledge, understanding, attitudes, and skills so that they become better than before (Purwanto, 2002). Learning outcomes are one indicator of the learning process. Learning outcomes also act as one of the signs or indicators of the success of the learning process. In other words, behavioral changes that occur in students after participating in learning activities are evidence of these learning outcomes (Anni, 2004).

In this study, the author will focus on testing the cognitive assessment aspect only in determining student learning outcomes. According to Potter, MK, & Kustra, E. in Lestari & Irawati (2020), cognitive learning outcomes are the level of student mastery of the subject matter, including the knowledge or theory learned. This involves students' intellectual abilities, such as remembering facts, understanding patterns, procedures, and concepts, and developing their thinking skills. Students cognitive learning outcomes include six indicators based on Anderson (1999) revised Blomm's taxonomy, namely: 1) remembering, 2) understanding, 3) applying, 4) analyzing, 5) evaluating, 6) creating. Cognitive learning outcomes are measured in order to obtain accurate information about aspects of ability in the cognitive domain.

In this study, class VII K was selected as a sample, based on the results of the needs analysis showing that students are at a crucial stage of development in understanding abstract basic concepts, one of which is the solar system material. The researcher assumes that students' low understanding due to conventional learning methods and excessive use of mobile phones has an impact on the decline in learning outcomes of class VII K students. Based on the daily test score data for ecology material, it is known that the average score of class VII K students is 68.52, which is still below the Minimum Mastery Criteria (MMC), namely 75. This condition indicates a need for more effective and interactive learning methods.

Based on the needs analysis that has been done, to overcome the problems faced in learning the solar system material, the researcher decided to develop interactive PowerPoint learning media integrated with Augmented Reality (AR) for grade VII students. Interactive PowerPoint is a form of presentation media development that not only

displays static text or images, but is also equipped with animations, dynamic transitions, and visual elements that allow students to interact more actively with the material (Alfi et al., 2022). Furthermore, Augmented Reality (AR) is a technology that combines virtual objects in the form of images, sounds, or animations into the real world interactively (Tresnawati et al., 2019). This media is designed to create a more interesting, enjoyable learning experience and facilitate meaningful learning.

Based on the book *PowerPoint for Teachers* by Finkelstein & Samsonov (2007), PowerPoint is an effective presentation tool to support the learning process, as it can present material visually, in a structured and engaging manner. One of the advantages of PowerPoint is its ability to integrate text, images, audio, and animations, which can stimulate various learning styles and enhance both the appeal and understanding of the material. PowerPoint also enables teachers to organize lessons systematically and in a way that is easy for students to follow. In line with this, a study conducted by Dewi & Manuaba (2021) on the development of curriculum-based interactive PowerPoint media showed that this medium can improve student engagement in learning and help them understand the material more easily due to its systematic visual and interactive elements. In addition, research conducted by Setiawan (2021), the learning completion using augmented reality media obtained an average score of 86.1%, which shows a very good increase in student learning outcomes. This finding indicates that the combination of interactive visualization from PowerPoint media and augmented reality elements as learning media is very effective in improving student learning outcomes.

Based on the description in the background, the researcher will conduct a study aimed at improving student learning outcomes in the solar system material through the use of interactive PowerPoint learning media integrated with Augmented Reality (AR). Guided by the problems that have been described, the formulation of the problem in this study is: "How feasible and effective is the use of interactive PowerPoint media integrated with Augmented Reality for teaching the solar system topic to class VII students at SMPN 1 Kota Kediri?". The purpose of this study was to determine the feasibility and effectiveness of interactive PowerPoint learning media integrated with Augmented Reality on the learning outcomes of class VII students at SMPN 1 Kota Kediri.

METHOD

Research Design

The research design used in this study is one group pretest-posttest design (Table 1), which is a quasi-experimental design involving one group of subjects who are given a pretest before treatment and a posttest after treatment. This design aims to determine changes in student learning outcomes after using the developed learning media, by comparing pretest and posttest scores in the same group (Sugiyono, 2008).

Table 1. Trial design

O_1	X	O_2

Note: O_1 = Pretest; X= Treatment; O_2 = Posttest

Research Objectives

The targets in this study consist of subjects, time, and location of the study. The subjects of the study consisted of one class, namely class VII K of SMPN 1 Kota Kediri with a total of 31 students, consisting of 16 female students and 15 male students. This class was the main subject in testing the effectiveness of the learning media. In addition, five students from class VII J were used in a small group trial to assess the feasibility of the media from the user's perspective. The media validation subjects involved one lecturer as a design expert validator, one lecturer and one science teacher as material expert and media expert validators. This study was conducted in May 2025, which is the even semester of the 2024/2025 academic year, at SMPN 1 Kota Kediri.

Data Collection Techniques

Data collection techniques in this study included observation, expert validation, a media feasibility trial questionnaire, and pre- and post-tests. Observations were conducted at the initial stage to obtain an overview of learning conditions, student needs, and the challenges teachers face in teaching the solar system.

Expert validation was conducted using a questionnaire designed to assess the media from various aspects. The media expert validation assessed two aspects: ease of accessibility and visual quality of the content. The design expert validation assessed aspects including the interactive PowerPoint design and media integration and visualization through the Assemblr Edu application. The material expert validation assessed aspects including the material's suitability to the curriculum and student understanding.

Meanwhile, the media feasibility trial questionnaire completed by students in the small group trial consisted of three assessment aspects:

ease of access, suitability to the material, and student response to the media. Each assessment aspect, in both the expert validation and the student trial questionnaire, consisted of five indicators assessed using a Likert scale. The following guidelines for assessing feasibility using a Likert scale are shown in Table 2.

Table 2. Likert scale

Score	Information
5	Very Good
4	Good
3	Enough
2	Not Enough
1	Very Less

(Suharsimi & Arikunto, 2006)

The pre-test and post-test instruments consisted of 20 multiple-choice questions covering cognitive levels C1 to C4, with five questions representing each level. Each question carries a maximum score of 5 points. Although the pre-test and post-test were structured based on the same indicators, the questions used were different to avoid repetition or memorization effects.

Data Analysis Techniques

Media feasibility data were obtained from the validation results of design experts, material experts, and media experts, as well as from small group trial questionnaires by students. Each expert and student provided an assessment of the media using a Likert scale instrument . The assessment results were analyzed quantitatively by calculating the percentage of feasibility from each validator and student responses. The feasibility category was determined based on the percentage score interpretation criteria.

Effectiveness data were obtained from the results of pre-test and post-test tests given to students before and after using learning media. Data analysis was carried out statistically using the normality test (Shapiro-Wilk) to ensure that the data was normally distributed, as well as the homogeneity test to test the similarity of variance between data. After the test assumptions were met, a paired sample t-test was conducted to determine significant differences between the pre-test and post-test scores. In addition, the N-Gain calculation was used to determine the extent of the increase in student learning outcomes, which were categorized based on the effectiveness classification according to Hake in (Raharjo, 2019).

RESULTS AND DISCUSSION

The feasibility of a learning media is an important aspect that must be analyzed before the media is used in the learning process widely. Media is said to be feasible if it has gone through a validation process by experts and received a positive response from target users (Sadiman, 2021). In this study, the feasibility of AR-integrated interactive PowerPoint media was assessed through four main sources, namely design expert validation, material expert validation, media expert validation, and small group trial results. The recapitulation results of the feasibility test are presented in Table 3.

Table 3. Recapitulation results of feasibility test

Subject	Percentage Score
V_1	98%
V_2	98%
V_3	98%
V_4	98%
Average score	**98%**

Note: V_1 = Design Validator; V_2 = Material Validator; V_3 = Media Validator; V_4 = Small Group

The scores obtained from the validation questionnaire and media feasibility trials were then converted into five feasibility category scales in Table 4.

Table 4. Feasibility criteria

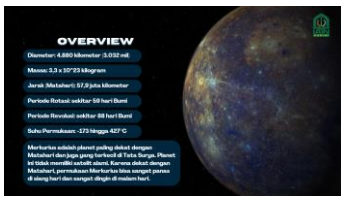
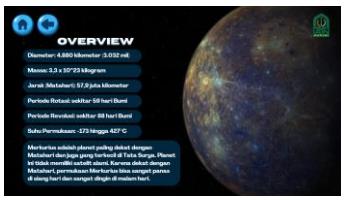
Score in percent (%)	Feasibility categories
< 21 %	Not Feasible
21 – 40 %	Less Feasible
41 – 60 %	Fairly Feasible
61 – 80 %	Feasible
81 – 100 %	Very Feasible

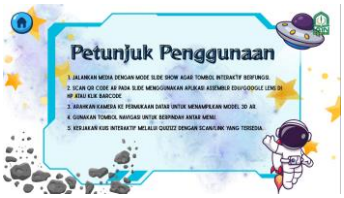
(Suharsimi & Arikunto, 2006)

Based on Table 4, the results of the four subjects showed an average feasibility score of 98%, which is included in the “very feasible” category. This high level of feasibility indicates that the media meets the criteria of attractive visuals, content that is in accordance with the Merdeka Curriculum, ease of access and effective use of AR technology. These four subjects support each other in forming media that is not only technically and theoretically feasible, but also practically used in the field.

As a follow-up to the validation process, researchers revised the media based on suggestions and input from the validators. These revisions included improving the visual appearance, refining the content, and optimizing AR media integration to make it more accessible and usable by students. Table 5 below shows a comparison of the media before and after revision by experts. The changes aimed to improve the overall quality of the media, making it more engaging, interactive, and tailored to classroom learning need.

Table 5. Media revision

Number	Revised section	Before	After
1	Added navigation buttons throughout the Powerpoint slides with a hyperlink system.	  	  
2	Added audio in the form of planetary narration on each initial page of planetary material.		
3	Added hyperlinks to all Augmented Reality QR codes.		
4	Added audio and elements to the true/false quiz menu.	 	 

Number	Revised section	Before	After
5	Added navigation buttons on the user manual page.		

Based on table 6, this learning media development integrates AR features to support the visualization of abstract concepts in the solar system, specifically the sub-material of the sun and the eight planets. The AR design was carried out using the Assemblr Edu application, which provides various features for creating 3D objects and adding interactive elements to them.

Table 6. AR design development

Content	Description	Screen display
AR design development	In developing the Augmented Reality (AR) feature in this learning media, researchers utilized the Assemblr Edu platform as a tool for creating 3D content. For the planet models, researchers sourced directly from Assemblr Edu's 3D library, selecting 3D objects that could move to make the display more engaging and interactive.	
	Each planet model features audio and text pop-ups that students can click on. When activated, the pop-ups display explanatory narration about the planet and its characteristics, providing a more immersive and engaging learning experience.	
	Once the design process is complete, the resulting 3D model is exported as a QR code, which is then inserted into a PowerPoint slide. Students can scan this QR code using their devices to directly access the AR content.	

In theory, appropriate media has a close relationship with improving student learning outcomes. According to the cognitive and constructivist theoretical framework put forward by Maskun and Rachmedita (2018) in the book *Teori Belajar dan Pembelajaran*, well-designed media can help students build understanding through visual representation, active involvement, and systematic delivery of material. Attractive visual design can increase attention, appropriate material content helps form correct schemata, and interactive features encourage independent exploration of concepts. All of these ultimately strengthen the process of internalizing knowledge and contribute directly to improving learning outcomes.

This is supported by findings in small group trials, where students stated that the media was interesting, easy to use, and helped them understand the material. This positive response shows that the media is not only liked, but also has a direct impact on learning effectiveness (Andika et al., 2022). This finding is reinforced by previous studies, such as those conducted by

Thahir and Kamaruddin (2021), which concluded that AR-based learning media can significantly improve student learning outcomes compared to conventional methods. In the study, the experimental class using AR media achieved a learning completion rate of 86.1%, while the control class using conventional learning methods only achieved 47.2%.

Compared to Thahir and Kamaruddin's research, the media in this study not only emphasizes the visual aspect of AR but also integrates it in a PowerPoint format that is more familiar to teachers, thus expanding the possibility of implementation in schools. In addition, the consistently high validation results from all aspects and the positive responses of students in this study strengthen the conclusion that this media is able to support the improvement of learning outcomes theoretically and practically.

The effectiveness of learning media is an important indicator in assessing the success of a product in helping to improve student learning outcomes. According to Rachmawati et al., (2025) effective learning media can facilitate students to understand the material better and improve learning outcomes. In this study, the effectiveness of AR-integrated interactive PowerPoint media was analyzed through several stages of statistical tests, namely normality test, homogeneity test, paired sample t-test , and N-Gain test.

The normality test was conducted as an initial stage to ensure that the data was normally distributed, so that parametric analysis techniques could be used. Based on the results of the test using Shapiro-Wilk on the pre-test and post-test data of class VII K, the significance values were 0.215 and 0.064, respectively. Because both values are greater than 0.05, it can be concluded that the data is normally distributed.

Next, a homogeneity test was conducted to determine whether the pre-test and post-test data variants were homogeneous. The test results showed a significance value of 0.051 greater than 0.05, which means that the data variants are homogeneous or balanced. This confirms that the data meets the requirements for parametric statistical tests.

Table 7. Pretest-posttest results

Grade VII K Value	N	Mean	Min	Max
Pretest	31	63.45	55.00	72.00
Posttest	31	85.03	75.00	97.00

Note: N= Number of students

Based on Table 7, descriptive statistical analysis shows the pretest and posttest test results scores. The pretest score got a minimum score of 55.00 and a maximum of 72.00, with an average score of 63.45. While the posttest score got a minimum score of 75.00 and a maximum score of 97.00 with an average of 85.03. The results of this data indicate that after the treatment was given, there was a significant increase in learning outcomes.

To strengthen the assumption of the pre-test and post-test results, a paired sample t-test was conducted to determine whether there was a significant difference between the pre-test and post-test scores. Based on the results of the t-test, a significance value (Sig. 2-tailed) of 0.000 was obtained, which is smaller than 0.05. In accordance with the basic guidelines for making paired sample t-test decisions, H_0 is rejected and H_a is accepted (Sugiyono, 2008).

Therefore, the results of the analysis indicate that there is a statistically significant difference between the pre-test and post-test scores. This finding suggests that the learning intervention provided through the AR-integrated interactive PowerPoint media has a substantial impact on improving students cognitive performance. The increase in learning outcomes also illustrates that students experienced better comprehension after the treatment was given, as compared to their initial understanding measured through the pre-test.

Furthermore, this conclusion is supported by the graphical illustration presented in Figure 1, which clearly shows a consistent upward trend in the distribution of students' scores from pre-test to post-test. The visible improvement reinforces the interpretation that the media developed does not merely offer visual enhancement but also contributes meaningfully to students' conceptual understanding and engagement during the learning process.

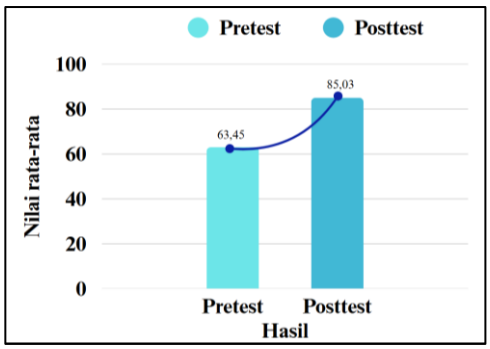


Figure 1. Graph of increase in pretest-posttest scores

In theory, these results indicate that the media has met the basic principles in both

behavioristic and cognitive theories, namely changes in behavior or knowledge as a result of learning. Effective media will affect students attention, retention, and transfer ability in understanding concepts, all of which correlate with increased learning outcomes (Maskun & Rachmedita, 2018).

As a complement to the effectiveness analysis, N-Gain calculations are also carried out. N-Gain aims to evaluate the effectiveness of a method or treatment in research with a one group pre-test post-test design (Sugiyono, 2008). The N-Gain test process involves calculating the difference between the pre-test and post-test values, which is called the gain score. By analyzing this gain score, we can assess the extent to which a method or treatment is considered effective or not in achieving the research objectives.

The categorization of N-Gain value acquisition can be determined based on the N-Gain score or the N-Gain value in the form of a percentage (%). The division of N-Gain value acquisition categories can be seen in Table 8.

Table 8. Gain score categorization

N-Gain Value	Category
$g > 0.7$	High
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

Adapted from (Meltzer, 2002)

Meanwhile, the division of N-gain acquisition categories in the form of percentages (%) can refer to Table 9.

Table 9. Categorization of N-gain percentage

Percentage (%)	Category
< 40	Ineffective
40 – 55	Less Effective
56 – 75	Fairly Effective
> 76	Effective

Adapted from (Hake, 2002)

The N-Gain value describes how big the difference is between the pre-test and post-test scores produced by students, as well as how effective a learning medium is in improving students' understanding of the material. The higher the N-Gain score, the greater the increase in learning outcomes achieved (Raharjo, 2019). The results of the N gain test in this study can be seen in table 10.

Table 10. N-gain test output

Results	N	Mean
Gain Score	31	0.60
Gain Percentage	31	60.21

Note: N= Number of students

Based on the Table 9 output results, the average N-Gain score was obtained at 0.60 and the average N-Gain in percentage form was 60.21%. Based on the interpretation of the N-Gain index, the N-Gain value of 0.60 is included in the medium category, while in percentage form, the value of 60.21% is in the fairly effective category.

Although statistically there is a significant increase, the effectiveness of this media is only in the medium and fairly effective category. This can be caused by several field factors. Based on observations during the post-test, it was found that many students worked in groups or waited for friends to answer, so that the evaluation process did not fully reflect individual understanding as a whole. The discussion activity did reflect collaboration, but in the context of measuring individual learning outcomes, this became a bias that could reduce the effectiveness value quantitatively. Thus, although the media has been well designed, factors of student learning discipline and discussion culture also affect the results.

This study can also be compared with previous research by Nurkumala et al., (2024), who developed interactive pop-up book media for learning the solar system. In their study, the effectiveness of the media was in the high category with an N-Gain value of 70.30%. This difference in results can be caused by variations in the number of samples, the level of student readiness, and class management during the evaluation. However, in general, both studies show that the integration of AR technology in learning media can have a positive impact on learning outcomes.

One of the main advantages of interactive PowerPoint learning media integrated with augmented reality is its ability to present a more dynamic, interesting, and easy-to-understand learning experience for students. Interactive PowerPoint allows for the delivery of more varied materials through animation, moving visuals, and gradual presentation of information, so it is not boring like conventional slides (Barabas et al., 2024). When integrated with augmented reality technology, students learning experiences are further enhanced because they not only see the material through the screen, but can also interact directly with 3D models of solar system objects through mobile devices. The combination of these two media helps students understand abstract concepts more concretely and visually, such as seeing the shape and order of the planets directly. In addition, this media encourages active and independent learning because it can be accessed anytime and anywhere, and utilizes devices that are familiar to students such as mobile phones, so

it can increase their motivation and involvement in learning.

The implications of the results of this study indicate that AR-integrated interactive PowerPoint media can be a solution to the problems that have been explained in the background, namely the lack of contextual and visual learning media that can increase student engagement and understanding of the solar system material. This study is in line with the research of Laili et al., (2023) who developed Android-based media on the solar system material which concluded that, with the presence of planetary visualizations and interactive features that are close to real experiences, students can more easily understand abstract concepts. In addition, this media can also support the implementation of the Independent Curriculum which encourages active and meaningful learning. Although there are still limitations in the implementation of individual evaluations, this media still makes a positive contribution to improving learning outcomes, and is worthy of being developed and applied in science learning at the junior high school level.

CONCLUSION AND SUGGESTIONS

Conclusion

Based on the results of the research that has been conducted, it can be concluded that the interactive PowerPoint learning media integrated with Augmented Reality (AR) on the solar system material is declared feasible and quite effective for use in science learning in junior high schools. The feasibility of the media is proven through the validation results of design experts, material experts, and media experts with an average score of 98%, and is supported by positive responses from small group trials. The effectiveness of the media is shown through the results of the paired sample t-test which shows a significant difference between the pre-test and post-test scores, and the N-Gain score of 0.60 or 60.21% which is in the moderate and quite effective category. Thus, this media is able to improve student learning outcomes and can be used as an alternative to innovative technology-based learning media in class VII of junior high schools.

Suggestion

Suggestions based on this research, so that interactive PowerPoint learning media integrated with Augmented Reality (AR) can be used by teachers as an alternative innovative learning media in delivering solar system material to make it more interesting and easier for students to understand. The use of this media can also support the technology-based learning process in accordance with the Independent Curriculum. For further research, it is recommended that the media be developed with a wider scope of material and tested on larger samples and various school levels so that the results obtained are more general. In addition, stricter supervision is needed during the implementation of the post-test to minimize the influence of discussions between students that can affect the objectivity of learning outcomes.

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