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Development of Interactive Learning Media Using Animation and Educational Games of Solar System Materials Class VII

Afaf 'Izzatunnafsi[1], Muhammad Luqman Hakim Abbas[1]*
Sayyid Ali Rahmatullah State Islamic University
Jl. Mayor Sujadi No.46 Tulungagung, East Java 66221, Indonesia
e-mail: afafizzatunnafsi123@gmail.com, mluqman.abbas@uinsatu.co.id

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Abstract: This study addressed the low student performance on abstract Solar System topics, a problem exacerbated by the limitations of conventional teaching media. A needs analysis revealed that 77.8% of students had difficulty with the topic, while 97.1% were more engaged by interactive media like animations and educational games. This research aimed to (1) develop an interactive PowerPoint-based learning medium that integrates animations and educational games; (2) evaluate its feasibility; (3) assess its practicality; and (4) measure its effectiveness in improving student learning outcomes. The study employed a Research and Development (R&D) method using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model. The subjects were 72 students from classes VII A and VII C at SMPN 1 Sumbergempol. The results show that the developed medium was successfully implemented through all ADDIE stages. It was deemed valid by a material expert with a skor 85.83% and "quite valid" by a media expert with a skor 76.56%, and was rated as practical with a score of 86.52%. The medium was also effective in improving student learning outcomes, with the experimental class achieving an 80% mastery rate, significantly higher than the control class's 54%. Further statistical tests (Asymp. Sig. = 0.032; effect size = 0.568) confirmed a significant improvement. In conclusion, this interactive PowerPoint-based learning medium is effective in enhancing student performance and outcomes on the Solar System topic.

Keywords: Interactive Media; PowerPoint; Animation

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Introduction

Education is the main foundation in the development of quality Human Resources (HR), especially in facing the challenges of the Industrial Revolution Era 4.0. This era demands the mastery of critical thinking skills, creativity, technology, and digital literacy. The rapid development of information technology encourages educators to optimize their use to increase the effectiveness of the learning process, especially in delivering abstract material such as physics, which requires real visualization so that it is easy for students to understand.

Physics as part of Natural Sciences (IPA) at the junior high school (SMP) level is often considered difficult because many of the concepts are abstract. One of the materials that is considered challenging is learning about the solar system, which includes an explanation of

the solar system, the rotational and rotational movements of the earth and the moon, and how it affects life on earth. In phase D, students must be able to understand and visualize the relative position of the Earth-Moon-Sun, the Solar System, the structure of the Earth's layers to explain the natural phenomena that occur (Hardanie, 2021). However, although learning technology has developed rapidly, its use in science learning in schools still faces challenges, especially due to limited resources and traditional learning media use habits. The results of observations and interviews with teachers at SMPN 1 Sumbergempol show that the learning process still uses static text and image media that is less attractive to students. In fact, the majority of students actually show a high interest in digital media, animation, and educational games.

Students' difficulties in understanding the solar system material are a common problem that has been identified in various studies on learning media development. Some of the research conducted by Firmansyah et al., 2021 dan Nadzif et al., 2022, shows that the development of interactive media based on animation and educational games can be an effective solution. This is also supported by the data from the survey results of the analysis of the needs of grade VII students at SMPN 1 Sumbergempol. Where, 61.1% of students found it difficult to study science in general, and 77.8% of them specifically stated difficulties in understanding the material of the Solar System. This difficulty has a significant impact, not only affecting students' understanding of a single topic, but also hindering mastery of broader scientific concepts, such as gravity, motion of objects, and even astronomy at a higher level. Therefore, it is necessary to have the ability to visualize students who are supportive, by using adequate and innovative learning media according to the needs of their students to overcome this difficulty (Abbas, 2019; Reski et al., 2022).

The use of visual and interactive media in physics learning, especially in solar system materials, is now increasingly innovative and sophisticated with the presence of technologies such as Virtual Reality (VR) or augmented reality (AR). However, these media often require expensive equipment and costs and are difficult to access. For example, in the study Wika Prasetya, (2022) showed that the use of Adobe Flash-based interactive media for solar system topics was indeed successful in improving students' academic achievement. However, the implementation of this media requires a large installation space, making it less efficient for everyday use in the classroom. Departing from these challenges, this study emphasizes that learning media should be easy to use, easy access, and familiar to students. This is intended for students to be able to learn independently while getting a more meaningful learning experience. As a solution, the use of PowerPoint media was chosen as the main medium, because this platform is relatively practical, easy to develop, and has often been used by teachers in teaching. With its animation and interactivity features, PowerPoint is proven to significantly improve student understanding (Daulay et al., 2024). In addition, the ability of powerpoint to integrate images, videos, audio, and animations makes learning more interesting not monotonous, and is able to increase students' attention and understanding of the material taught (Dahniar, 2022; Hasanah, 2020). This approach is not just an improvement of existing learning media, but a new approach that uniquely combines elements of visualization, fun through games, quizzes and interactivity that are tailored to students' characteristics to help overcome abstract concepts (Afriliana & Diyana, 2024). Therefore, the purpose of this article is to develop an interactive PowerPoint-based learning media that is equipped with animations and educational games for Solar System materials, as well as to test its validity, practicality, and effectiveness in improving the learning outcomes of junior high school students.

Method

This research uses the research and development (R&D) method. The development model of this research uses the ADDIE model which consists of 5 stages (analysis, design, development, implementation, and evaluation) (Lee & Owens, 2014). In the Analysis stage, the researcher identified the needs of users and formulated product specifications through several steps, namely studying the learning outcomes of the Solar System material, collecting supporting references, interviewing science teachers to understand the learning conditions in the classroom, and distributing questionnaires to 36 students of grade VII A to find out their interest and expectations for learning media that is interactive, fun, and easy to understand.

The Design Stage includes the preparation of an animation-based learning media framework and educational games, including material systematics, evaluation design, and the creation of flowcharts and storyboards. The researcher also prepares materials, questions, navigation buttons, and selects supporting elements such as music and visual displays.

In the Development stage, the media is digitally created using PowerPoint with animations, educational games, interesting backgrounds, and sound effects. The resulting products are then revised and validated by experts, namely a lecturer who is a material expert, a lecturer who is a media expert, and a science teacher. The assessment criteria in the validation instrument include aspects of the feasibility of content, language, presentation, accessibility and media display, as follows:

Table 1. Material Expert Validator Questionnaire Grid

Yes	Aspects	Statement
1.	Material	Suitability of the material with the Learning objectives
		Suitability of the material with Learning Outcomes (CP)
		Completeness of the material presented
		Giving examples in clarifying the material
		The concept of delivering material is right
		The delivery of the material has been ordered/collapsed
		Compatibility with student development
		The questions presented are relevant to the material
2.	Language Use	The language used is according to the student's level of understanding
		Language in the delivery of material is easy to understand
		The sentences displayed in the media are clear and easy to understand
3.	Benefits of Media in Learning	Media can make it easier for students to understand Lessons
		Media can be used for independent learning
		The media used provides a learning experience for students
		Media can increase students' motivation to learn

Table 2. Media Expert Validator Questionnaire Grid

No.	Aspects	Statement
1.	Presentation Design	Font type accuracy
		Compatibility between voices
		Precise sound effects with displayed animations
		Sound suitability to conditions
		game
		Clear question size and answers
		Clear color contrast
		Clear coloring
		Good image quality

		Font color accuracy Font size accuracy
2.	Use of Interactions	Availability and Ease of use of navigation Consistency of button usage Availability of Instructions Keinteraktifan Attractiveness
3.	Accessibility	Feature Performance Function Effectiveness and Efficiency Ease of use Security Ease of remembering
4.	Reuse	Ease of use in different learners/student backgrounds Ease of use in different learning backgrounds

Table 3. Practicality Questionnaire Grid

No.	Aspects	Indicator
1.	Media display	The visual appearance caused by the colors and layout of this learning media is interesting Animation and material harmony Font sizes and types in easy-to-read learning media Sound/audio can make students more enthusiastic
2.	Material	The material presented has been sequenced/sequenced The material presented in the learning media is relevant to the school book
3.	Ease of use	The use of Navigation and instructions can make operation easier
4.	Media benefits	This interactive learning media of animation and educational games is practical to use This medium can be used repeatedly This interactive learning media of animation and educational games can make it easier for me to understand the material This media can help me learn independently

The Implementation Phase was carried out through a limited trial to teachers and 30 students of class VIII A who had received solar system material using the Simple Random Sampling *technique*, which was chosen because this method required random sampling without considering groups or strata in the population (Sugiyono, 2017). The trial used the Experimental Design approach with the Posttest Only Control Group Design pattern, which involved the experimental group and the control group. Samples were randomly selected, treatment was given only in the experimental class, and the measurement of results was carried out after the treatment (Anol Bhattacherjee., n.d.). Meanwhile, the Evaluation stage collects performance data and feedback to assess the effectiveness and improvement of the media. At the validation stage, this development section uses an assessment instrument containing a number of questions to assess the extent to which the developed media can be categorized as feasible. Measuring tool using *the linkert scale* (Budiaji, 2018) as follows:

Table 4. Scoring Guidelines

Category	Score
Very Feasible	4
Feasible	3
Less Feasible	2
Very Less Feasible	1

Table 5. Interpretation Criteria

Percentage	Criteria	Description
85% - 100%	Valid	Suitable for use without revision
70% - 84%	Quite Valid	Suitable for use with minor repairs
55% - 69%	Less Valid	Needs revision
< 55%	Not Valid	Total revision

Results and Discussion

The development of this research product is in the form of interactive learning media using animation and educational games that utilize various software, such as Ms. PowerPoint 365, Freepik, shuttersstock and Pixybay to create a more interactive and interesting learning experience. Using ADDIE's development methods, namely Analyse, Design, Development, Implementation, and Evaluation. With the goal of more interesting and effective media in supporting student understanding.

Stages of Analysis

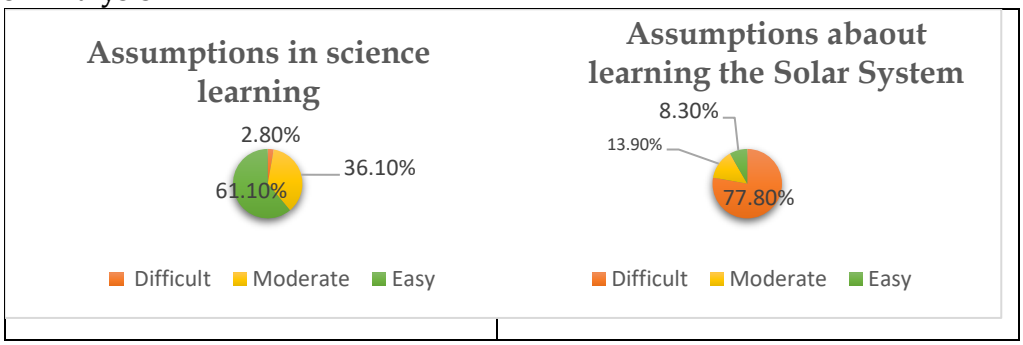

Figure 1. Summary of Student Answers Related to Science Learning and Solar System Materials

Figure **1** shows students' responses regarding the difficulties of learning science and Solar System materials. Where as many as 61.10% of respondents considered that science learning subjects were classically difficult, while 77.80% stated that the solar system material was quite challenging. Some of the reasons given are the many theoretical concepts, calculations and abstract properties of the Solar System that cannot be observed directly because they are in space. This shows that on average there are still students who have difficulty understanding the material as a whole. This data is also in line with Rini Caswita's research which shows that the average student understanding is only 50%(Rini, 2023).

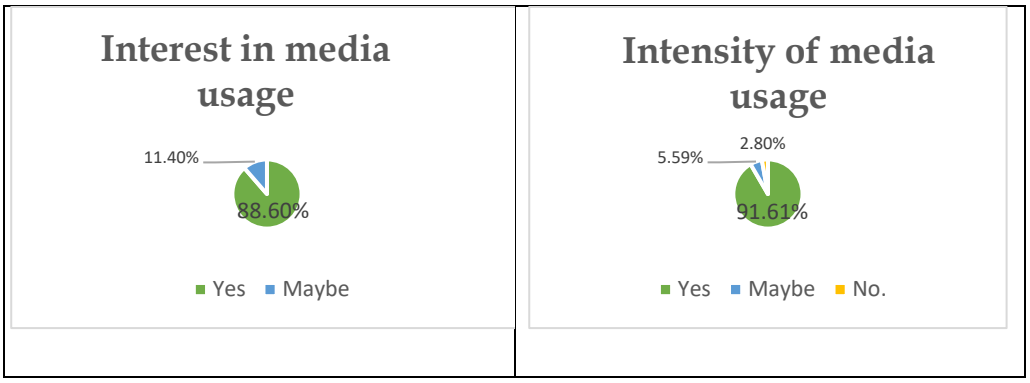

Figure 2. Summary of Students' Answers Related to the Use of Science Learning Media, Especially Solar System Materials

Figure 2 shows that students' interest in the use of media in science learning is very high, as evidenced by 91.7% of respondents expressing interest in using it. At the intensity of use of learning media around 88.6%, it means that it is often used, but its effectiveness is still limited. This is because the use of PowerPoint media by teachers is considered less interesting and not interactive. Students complain that the static presentation often fails to support students' understanding optimally because it tends to be less interesting. This condition shows that there is a gap between students' high interest in media and the quality of available learning media. These findings are in line with Arista Widya's research which emphasizes that students need visual and interactive approaches to improve their understanding. Therefore, visual media that is able to present abstract concepts in a concrete way, such as in solar system materials, is indispensable to create more effective and interesting learning for students (Arista Widya, 2024).

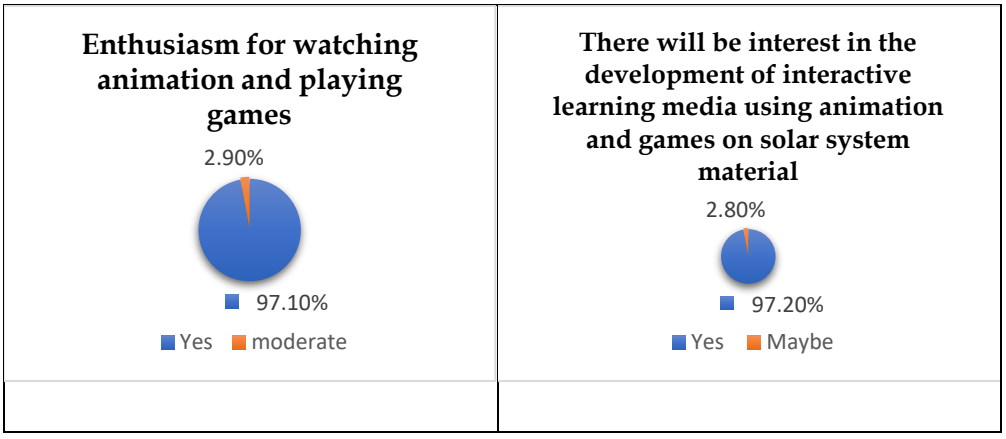

Figure 3. Summary of students' answers about their penchant for watching animation and playing games and their opinions on the development of interactive media

In **Figure 3**, students show a very high interest in entertainment-based media, with 97.10% of students liking watching animations and playing games in their free time. They find these activities fun and entertaining. This is in line with the findings of the study (Faryanti, 2016) which states that students' expressions and habits when using learning media can be an indicator of their learning motivation.

Based on this analysis, the development of interactive learning media that combines animation and educational games is a relevant solution to increase student involvement in science learning, especially solar system materials. This solution is also supported by **Figure 3**

about the interest in the development of animation-based interactive media and educational games for these materials by 97.20%, students agree. Thus, more interesting and technology-based learning media is expected to reduce students' learning load and improve their understanding of abstract concepts**.**

Design Stage

Media development begins with the creation of storyboards as a guide to material flow, display, and media interactivity. Refers to multimedia theory (Mayer, 2009), The media is designed with a combination of text, images, audio, animation, and educational games to help students understand abstract Solar System material. Interactive elements such as buttons, navigation, and quizzes are added to increase engagement, while animations and morph transitions are used to visually explain concepts (Winanti, 2024). This planning aims to create learning that is engaging, interactive, and in accordance with the needs of students.

The selection of graphic displays in this learning media is guided by the principles of coherence and signaling. This means that we ensure color and shape alignment, as well as the use of visual markers to direct students' attention to key information (Mayer & Fiorella, 2014). The visuals designed not only take into account aesthetic value, but also serve to clarify abstract concepts, such as the Solar System. This approach is supported by research (Rahayu et al., 2024), which states that Mayer's principle in multimedia can affect the way cognitive works. This principle utilizes two information channels, visual and auditory, which work in a balanced manner to facilitate understanding and reduce the cognitive load on students. This media, developed in the form of interactive PowerPoint slides, also features navigation buttons, which make it easy for users to move to the desired learning page efficiently.

Figure 4. Media display

Development Stage

The stage that carries out a validation test process by media experts, materials and teachers before being applied to students. This aims to ensure quality and suitability with learning needs. The following are the results of media validation:

Table 6. Media Validation Results

No	Validator	Precentage	Category
1.	Media expert 1	77,08%	Quite valid
2.	Media expert 2	76,06%	Quite valid
Average percentage of Validator scores		76,56%	Quite Valid (Worth using with improvement)

The results of the learning media validation showed an average score of 76.56% (category "Quite Valid") from the two validators, with scores of 77.08% and 76.06%, respectively. This indicates that this media is suitable for use after several improvements. Overall, the media was rated positively based on four main aspects: visual display quality, level of interactivity, ease of accessibility, and reuse potential (Nesbit et al., 2009). Its aesthetic visual design, supported by the use of relevant colors and animations, is considered to be able to increase the attractiveness and understanding of students. The interactivity aspect is also satisfying, thanks to the educational game features and intuitive navigation that encourage active student engagement. In terms of accessibility, this PowerPoint-based media is easily accessible without additional installation, making it flexible for teachers and students to use.

Nonetheless, validators provide some qualitative input. Validator 1 highlights some of the necessary fixes, such as fixing bugs, navigation inconsistencies, clarity of game instructions, and large file sizes. In addition, it is recommended to replace the background music with a quieter one so as not to disturb the students' concentration. These improvements, especially related to interactivity and accessibility, are critical to optimizing the learning experience.

Table 7. Material Validation Results

No	Validator	Percentage	Category
1.	Media expert 1	88,33%	Valid
2.	Media expert 2	83,33%	Quite valid
Average percentage of Validator scores		85,83%	Valid

The results of the material validation showed very satisfactory results. Two subject matter experts gave validation scores of 88.33% and 83.33%, so that the average score reached 85.83%. This figure indicates that this learning medium is valid and suitable for use without revision. By loading all indicators If viewed from each indicator, the validation results show strong performance. The suitability of the content with learning outcomes received high appreciation because the material was in line with the direction and objectives of the curriculum. The accuracy and breadth of the content received good scores because it contained the core of the subject matter of the Solar System in depth but still in accordance with the cognitive level of junior high school students. The combination of validation results from media and material aspects shows that the developed learning media products are effective for use in the learning process.

In addition, to measure students' responses to the developed media, the researcher distributed the questionnaire to 30 students of class VIII A who had studied solar system material. This trial was carried out by sharing interactive learning media using animations and

educational games to students so that they could try using them. The results of the product test are as follows:

Table 8. Trial Results

Total score	1142
Maximum total score	1320
Precentage	86,52%
	(Very Interesting/very easy to use)

So the results of the questionnaire and practicality test showed an average score of 86.52%. This figure is classified as very attractive and easy to use by students. Thus, this learning medium is classified as practical and feasible to be applied in larger-scale trials (F. Suri, 2019).

Implementation Stage

The application of interactive learning media in the classroom, involving experimental classes using animation-based media and educational games, as well as control classes with conventional methods. The main purpose of the implementation is to compare student learning outcomes in both groups and identify students' responses to each learning method used. The results showed that the learning completeness in the experimental class reached 80% (good category), while the control class was only 54% (good category), this shows that interactive learning media effectively improves learning outcomes. To corroborate these findings, statistical analysis used the Mann-Whitney U test because the data were abnormal, but homogeneous, resulting in a significance value of 0.032 (< 0.05), which showed a significant difference between the two classes. This advantage is inseparable from the characteristics of interactive learning media that combine visual animation to clarify abstract concepts, as well as educational quizzes and games that encourage active student engagement. It also allows students to learn independently and get hands-on feedback, so their understanding improves across the board. The effect size value of 0.568 is in the medium category, which indicates the positive influence of interactive learning media on learning outcomes (AlWahaibi et al., 2020). These findings are in line with research conducted by (Wahyuni, 2021) that the use of ICT-based interactive learning media has a positive impact on improving student learning outcomes. This can be seen from the increase in the average student score from 75 (during the pre-test) to 88 (after the post-test). The effectiveness of the media is also strengthened through the results of excellent validation tests with indicators of material aspects of 75% (feasible), linguistic aspects of 93% (very feasible), media aspects with a percentage of 82% (very feasible) and assessment of educational practitioners with an average of 93%.

Conclusion

This study shows that the use of PowerPoint-based interactive learning media combined with animations and educational games has proven to be valid and effective in improving student learning outcomes on Solar System materials. The validation results from material experts with an average score of 85.83% in the valid category and media experts obtained a score of 76.56% with a fairly valid category, as well as a very positive student response with an average percentage of 86.52% in the category was very interesting, confirming that this media is suitable for use in learning. The effectiveness of the media was also seen from the significant differences between the experimental class (80% completeness) and the control class (54% completeness), with the Mann-Whitney U test result of 0.032 (< 0.05) and an effect size of 0.568 (medium category). These findings imply that the integration of interactive and game-based media is able to increase students' engagement and conceptual understanding in science learning. Further research is suggested to optimize the use of visual

elements to maintain the quality and performance of media, as well as to expand the application of this media to other science topics or different levels of education.

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