Interactive Multimedia Learning: An Instructional Technology Innovation to Improve Elementary School Students' Understanding

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Abstract
This research aimed to 1) develop interactive multimedia learning to improve elementary school students' understanding of The Solar System materials, 2) reveal the feasibility of the developed interactive multimedia learning, 3) reveal the effectiveness of the developed interactive multimedia learning in improving elementary school students' understanding in The Solar System materials. This research and development consisted of planning, design, and development phases. The product test consisted of the product's feasibility tests were alpha test and beta test, and the product's effectiveness test. The data were collected through interviews, questionnaires, rating scales, and tests. The data were analyzed through qualitative descriptive and quantitative techniques. The product of this research is an interactive multimedia learning application for Solar System materials in elementary school. The developed is proved to be highly feasible to improve students' understanding of Solar System materials in terms of media aspects, material aspects, teacher and students' responses. The developed interactive multimedia learning also has a high level of effectiveness in improving students' understanding, gain score of 0.722.

Keywords: Interactive Multimedia Learning, Elementary School Students, Students Understanding, Solar System Materials

Introduction

Natural Science in elementary school is a subject related to natural knowledge and a process of discovery, so it is not just concepts, facts, and principles. Science learning is learning based on the principles and processes that can foster students' scientific attitudes toward science (Luthfi et al., 2023). Several kinds of material can be studied in science learning, including solar system material. The solar system is one of the materials in natural science contained in the elementary school curriculum (Nugraha & Hidayat, 2019). The solar system is an arrangement of celestial bodies with the sun as its center and the planets, meteoroids, comets, and asteroids that orbit around the sun, and all objects are bound by their gravity (Nuqisari & Sudarmilah, 2019). These objects are the known planets with elliptical orbits, dwarf planets with elliptical orbits, natural satellites, and millions of celestial bodies (meteors, asteroids, and comets) that have been identified (Maura Widyaningsih & Wulandari, 2019). The solar system consists of the sun, planets, satellites, comets, meteors, and asteroids, just one of millions of stars in a group known as galaxies. In this universe, there are thousands of galaxies with enormous distances, each large in size (Ripansyah et al., 2021).

This solar system material is one of the materials that can be considered quite challenging to learn without the help of learning media or supporting materials. However, many students have difficulty understanding and memorizing material about the solar system because each planet possesses many different characteristics. This happens because of the limited learning media provided by the teacher when doing practicum. Many of the solar system learning methods applied today are still manual. In contrast, solar system material is challenging to find in everyday life, so students find it difficult to imagine the existence of planets in the solar system being studied (Nuqisari & Sudarmilah, 2019). In addition, students also find it difficult to distinguish between one planet and another in accordance with the characteristics of each planet.

Many students forgot the material that was taught, both easy and difficult. In addition, students also did not look active in group discussions, and only a few students looked active. The causes of low learning outcomes and student activeness on the solar system materials are many factors, namely the teachers' methods and students' thinking abilities (Safii, 2020). The method used by the teacher is too monotonous, namely only by lecturing. In addition, the teaching aids used are less attractive. This caused students to be less enthusiastic in receiving lessons. Meanwhile, when viewed in terms of student potential, the average student is less active and lazy in science lessons on the solar system material.

From the observations of science learning activities, it is known that in the learning process at SDN Paron 1 in learning science material about the solar system, teachers still use learning methods that have not varied. Teachers have not used a teaching aid or learning media to carry out the classroom learning process. The interaction between teachers and students is still limited to questions and answers because the learning is still teacher-centered and centered on the teaching materials provided by the school and the government. Science learning still tends to be teacher-centered, which does not give more space for students to play an active role. This causes students to be less active in the learning process, and answers from interviews show that students are quickly bored with the learning activities. From the exposure to these observations, it is known that many students still do not explore the material or understand solar system material, especially in science subjects.

Furthermore, interviews with teachers revealed that Natural Sciences is a detailed and complex subject, so it is included in the topics considered difficult by students. The pre-survey results showed that 80% of students stated that science is a complex subject. The results of students' science scores are also reasonably low. About 50% of 6th-grade elementary school students have cognitive knowledge scores below the minimum score criteria 70 for science lessons.

The learning media used in learning science at elementary schools are textbooks from the government and sometimes student worksheets. According to the teacher, the textbook media is insufficient to help students learn and understand solar system material. Learning solar system material also requires a teacher as a guide to understand the complexity of solar system material, even though students only meet with teachers at school. Therefore, students find it challenging to learn solar system material independently if they only rely on textbooks and teacher explanations at school. Thus, according to the teacher, there is a need for other media that reduces students' difficulty in understanding the content of science lessons and can be used independently by students and accompanied by repeated exercises.

Based on the problems expressed, it is necessary to improve the performance of all elements of education that play an active role in the teaching and learning process. Therefore, in an age of increasingly advanced technological developments such as today, in overcoming the problems faced, especially in solar system material, it would be nice if the existing technological developments could be utilized by producing various types of innovations that are interesting and fun, as well as interactive, to make students more active, happier, more interested and more highly motivated in learning, which of course is expected to support and have a positive impact on the learning process carried out (Khatimah et al., 2023).

The needs analysis (pre-survey) results also showed that 85% of students agreed to add other media in learning science, namely interactive multimedia learning. As many as 88% of students agree that there is science learning with multimedia learning on complex solar system material. Therefore, science lesson materials can be packaged in an interactive and exciting multimedia application and user-friendly so that material that is considered difficult will be easier to understand. Through multimedia, students learn faster and have a more robust retention rate.

Based on the background of the problems that have been presented, this study aimed to (1) produce appropriate learning multimedia products to improve student understanding of solar system material in elementary schools, (2) determine the feasibility of learning multimedia to improve student understanding in solar system material in elementary schools (3) determine the effectiveness of learning multimedia to improve student understanding in solar system material in elementary schools.

Conclusion

Result and Discussion

The Planning

The subject matter for this interactive multimedia learning is the solar system. Interactive multimedia learning is developed with PowerPoint. The interactive multimedia learning

developed has an attractive appearance and technical media, facilitates independent student learning, and provides exercises that can be done repeatedly.

The Design

Developing initial content based on the results in the planning stage, making material scripts, multimedia learning flowcharts of solar system material, and storyboards.

The Development

Text, image, audio, and video content are prepared. All components that have been designed are combined and made into a screen display using PowerPoint. An example of the title page of the developed interactive multimedia learning can be seen in Figure 1.

Figure 1. Title Page of Multimedia Learning Solar System Material

Alpha Test Results and Revisions

The media expert conducted a product feasibility assessment. Media assessment focuses on interactive multimedia learning aspects, namely parts of program introduction, information presentation, developer identity, assistance, student control, and interactivity. The evaluation results from the media expert on each element can be seen in Table 1.

Table 1. Media Assessment Results Average of Each Aspect

No.	Assessment Aspect	Score	Criteria
1	Program Introduction	3.75	very feasible
2	Information Presentation	3.59	very feasible
3	Developer Identity	4	very feasible
4	Provision of Assistance	4	very feasible
5	Student Control	3.61	very feasible
6	Interactivity	3.5	very feasible
	Mean		3.65
	Media Quality Criteria by Media Expert	very feasible	

Based on Table 1, the overall results of the Media Expert assessment obtained an average evaluation of 3.65 with the results of the Highly Appropriate criteria. The acquisition of this value indicates that the science interactive multimedia learning as a support for learning solar system material developed has met the requirements for good multimedia according to the specified assessment aspects and is suitable use for learning by making improvements according to suggestions and comments from media expert.

The improvements and suggestions given by the media expert include the following: placing the next and back buttons close together to facilitate student navigation control, adding an answer key at the end of the question in the evaluation menu, renaming the evaluation menu options to test menu options, and deleting the response to each test item and only providing feedback on the final test assessment.

Material expert assessment is focused on learning aspects and material aspects. The results of the material expert assessment can be seen in Table 2.

Table 2. Material Expert Assessment Results

No	Assessment Aspect	Score
Instructional		
1	Appropriateness of objectives, materials, exercises, and evaluation	4
2	Clarity of target users	4
3	Appropriateness of material delivery strategy	4
4	The attractiveness of the material content	4
Material		
5	Clarity and conciseness of material content	4
6	Correctness and depth of material content	3.5
7	Clarity of examples and accuracy of multimedia elements	3.7
8	Language suitability	4
9	Accuracy of emphasizing important points	4
10	Clarity and suitability of exercise questions and evaluation questions	3.75
Mean		3.84
Multimedia Quality Criteria By Material Expert		Very feasible

Table 2 shows the average assessment given by the material expert is 3.84 on a scale of 4, with the results of the Very Feasible criteria. The acquisition of this value indicates that the interactive multimedia learning developed in terms of learning and material is suitable for use for learning by making improvements according to the suggestions of the material expert. The improvements and suggestions given by the material experts include the following modification of video supporting material directly at the point of discussion, simplification of questions on exercises by the competence of 6^{th}-grade elementary school students as target users, and made according to work instructions.

Then the teacher assessment results can be seen in Table 3.

Table 3. Teacher Assessment Results

No	Assessment Aspect	Score
1	Suitability of objectives with learning indicators	4
2	Suitability of material with essential competencies	4
3	Suitability of exercises and evaluations with the material	4
4	Correctness of material content	4
5	The suitability of the delivery strategy with the characteristics of the material	3
6	The ability to learn multimedia to motivate students	4
7	The ability to learn multimedia to involve students	4
8	Students can understand the presentation of the material	4
9	Appropriateness of using multimedia components	4
10	Accuracy of writing	3
11	The ability of multimedia to increase student understanding	4
12	Learning multimedia helps students learn independently	4
13	The appearance of this multimedia is attractive and suitable for target	4
14	Multimedia already contains navigation that is easy for students	4
15	The accuracy of the instructions for exercises and evaluation question	4
Mean		3.87
Multimedia Quality Criteria by Teacher		very feasible

Based on Table 3, the average result of the teacher's assessment is 3.87 on a scale of 4 with the results of the Very Feasible criteria. This value shows that the teacher responds positively to interactive multimedia learning, which is suitable for learning. The teacher's comments after using science interactive multimedia learning as a support for learning solar system material are that learning science solar system material using learning multimedia helps students master the material studied. Students do not feel bored and are more excited about learning science.

Beta Test Results

In the beta test, this interactive multimedia learning assessment was carried out from the students' responses. Students gave responses regarding the presentation of learning multimedia information and usage. The results of the response or assessment by students can be seen in Table 4.

Table 4. Average Student Assessment Results

No	Assessment Aspect	Mean	Criteria
1.	Ease of multimedia access	4	Very Feasible
2.	Image quality	3.83	Very Feasible
3.	Video quality	4	Very Feasible
4.	Ease of language	3.67	Very Feasible
5.	Attractiveness of display	4	Very Feasible
6.	Readability of letters	3.50	Very Feasible
7.	Color harmony	3.67	Very Feasible
8.	Sound quality	3.83	Very Feasible
9.	Ease of practice and evaluation question	3.5	Very Feasible
10.	Ease of understanding the solar system materials	4	Very Feasible
Mean		3.8	Very Feasible
Multimedia Quality Criteria by Students		Very Feasible	

Based on Table 4, the average of the assessment results from students is 3.8 on a scale of 4 with the results of the Very Feasible criteria. This value shows that students respond well to interactive multimedia learning, which is suitable for use in learning. Students' comments after using science interactive multimedia learning as a support for learning solar system material are that learning science using multimedia is very interesting, the multimedia developed is also attractive, learning the solar system materials is not monotonous, students understand more about solar system material, especially accompanied by exercises that can be done repeatedly.

Effectiveness Test Results

The effectiveness test phase lasted for three face-to-face learning sessions. The first meeting began by giving an initial test (pretest) to determine the initial cognitive abilities of students regarding solar system material. After the pretest was conducted, students were invited to the computer laboratory room to take part in learning using interactive multimedia learning. This process lasted until the third meeting, when the end of the lesson was given a final test (posttest) to determine students' abilities after participating in learning with multimedia. In both stages of the test, students were given 20 questions with different cognitive levels. The statistical calculation results of the average pretest and post-test scores can be seen in Table 5.

Table 5. Mean Score of Pretest and Posttest

	N	Minimum	Maximum	Mean
PRE	20	40.00	80.00	53.25
POST	20	75.00	100.00	87.00

Table 5 shows that the mean pretest score is 53.25, with a lowest score of 40.00 and a highest score of 80.00. The mean posttest score is 87.00, with a lowest score of 75.00 and a highest score of 100.00. Meanwhile, the frequency distribution of pretest and posttest scores can be seen in Figure 2 and Figure 3.

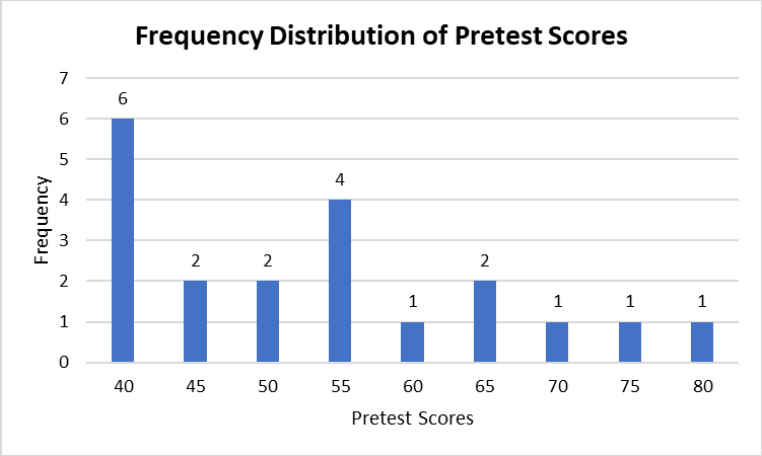

Figure 2. Frequency Distribution of Pretest Scores

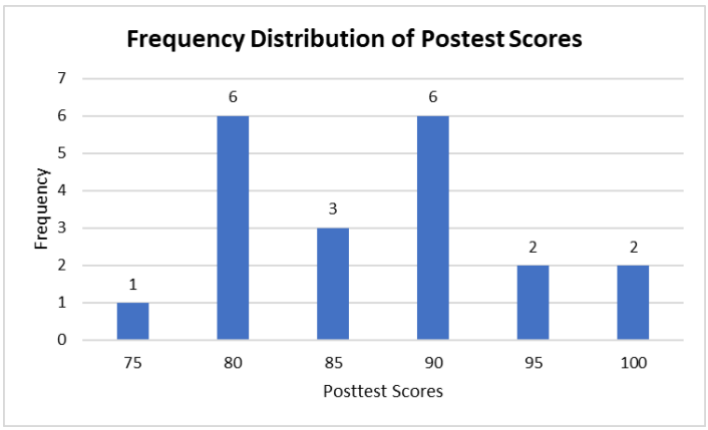

Figure 3. Frequency Distribution of Posttest Scores

In this study, a significance analysis was also carried out using the Paired Sample t-test statistical test. The results of the significance analysis are shown in Table 6.

Table 6. Pretest and Posttest Correlation

		N	Correlation	Sig.
Pair 1	PRE & POST	20	0.784	0.000

In Table 6, a significance value smaller than the significance level (p-value <0.05) is obtained, p-value = 0.00, which means that there is a significant difference between before and after using interactive multimedia learning.

The last stage of the effectiveness test data analysis is to test the effectiveness level of interactive multimedia learning products. Referring to students' average cognitive learning outcomes before and after using interactive multimedia learning, the calculation of effectiveness using the Normalised Gain formula is as follows.

$$g = \frac{Posttest\ Score - Pretest\ Score}{Highest\ Score - Pretest\ Score}$$

$$g = \frac{87.00 - 53.25}{100{,}00 - 53.25}$$

$$g = \frac{33.75}{46.75}$$

$$g = 0.722$$

The N. Gain result obtained 0.722, which is included in the "High" criteria (g> 0.7). The N. Gain shows that there is an increase in students' cognitive learning outcomes scores before using interactive multimedia learning and after using interactive multimedia learning. This indicates that developed science interactive multimedia learning products as support for learning solar system material are highly effective in improving student understanding of solar system material.

Conclusions

The results of this development research were in the form of science interactive multimedia learning applications to support learning solar system material in elementary schools. Interactive multimedia learning facilitates student learning on solar system material independently, compiles using inductive learning methods, involves students in learning with high enough interactivity, contains mechanical exercises accompanied by correct and incorrect answer warnings, and has an attractive appearance and technical media and by the characteristics of grade vi elementary school students. This interactive multimedia learning development model consists of three stages: planning, design, and development, accompanied by attributes always present in each stage, namely standards, ongoing evaluation, and project management.

This interactive multimedia learning product is "Very Feasible" to be used in learning solar system science material for 6th-grade elementary school students based on a review of the assessment results of media aspects, material aspects, teacher responses, and students. The average results of the feasibility assessment obtained by interactive multimedia learning on a scale of 4, from the media aspect of 3.65, from the material aspect of 3.84, teacher response of 3.87, and student responses of 3.80. This interactive multimedia learning was proven effective in improving students' understanding of solar system science material. It was confirmed by an increase in the average achievement of students' cognitive learning outcomes after learning that there was a significant difference in cognitive learning outcomes before and after using multimedia and a "High" level of effectiveness, with a gain value of 0.722.

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References

Alessi, S. M., & Trollip, S. R. (2001). Multimedia for learning, methods and development. Allyn and Bacon-A Pearson Education Company.

Babiker, M. E. A. (2015). For effective use of multimedia in education, teachers must develop their own educational multimedia applications. Turkish Online Journal of Educational Technology, 14(4), 62–68.

Khatimah, I. A. K., Fatkhom, F., Atika, N., & Taowatto, S. (2023). EFEKTIFTAS MEDIA SOLAR SYSTEM SCOPE DALAM MENINGKATKAN PEMAHAMAN SISWA TERHADAP MATERI TATA SURYA. SEJ (School Education Journal), 13(1), 73–82. https://jurnal.unimed.ac.id/2012/index.php/

Knörzer, L., Brünken, R., & Park, B. (2016). Emotions and multimedia learning: the moderating role of learner characteristics. Journal of Computer Assisted Learning, 32(6), 618–631. https://doi.org/10.1111/jcal.12158

Krismadinata, Kurnia, U. I., Mulya, R., & Verawardina, U. (2022). The Interactive Multimedia Learning for Power Electronics Course. International Journal of Online and Biomedical Engineering, 18(7), 44–56. https://doi.org/10.3991/ijoe.v18i07.30029

LEOW, F.-T., & NEO, M. (2014). Interactive Multimedia Learning: Innovating Classroom Education in a Malaysian University. Turkish Online Journal of Educational Technology, 13(2), 99–110.

Luthfi, R. A., Sahari, S., & Wenda, D. D. N. (2023). Pengembangan Media Visual Tentara (Tentang Tata Surya) Pada Pembelajaran Ilmu Pengetahuan Alam Sd Kelas Vi Materi Tata Surya. Jurnal Pendidikan Dasar Flobamorata, 4(1), 444–449. https://doi.org/10.51494/jpdf.v4i1.818

Magana, A. J. (2014). Learning strategies and multimedia techniques for scaffolding size and scale cognition. Computers and Education, 72, 367–377. https://doi.org/10.1016/j.compedu.2013.11.012

Maura Widyaningsih, & Wulandari, W. (2019). EDUKASI TATA SURYA MENGGUNAKAN TEKNOLOGI AUGMENTED REALITY Maura. Jurnal Sains Komputer Dan Teknologi Informasi, 2(1), 29–39.

Mayer, R. (2009). Multimedia learning 2nd Edition. Cambridge University Press.

Nazir, J., Rizvi, A. H., & Pujeri, R. V. (2012). Skill development in Multimedia Based Learning Environment in Higher Education: An Operational Model. International Journal of Information and Communication Technology Research, 2(11), 820–828. http://www.esjournals.org

Nuqisari, R., & Sudarmilah, E. (2019). Pembuatan Game Edukasi Tata Surya dengan Construct 2 berbasis Android. Emitor: Jurnal Teknik Elektro, 19(2), 86–92. https://doi.org/10.23917/emitor.v19i2.7987

Nugraha, B. S., & Hidayat, I. (2019). Implementasi Media Pembelajaran Interaktif " Sistem Tata Surya " untuk Kelas VI Sekolah Dasar. INFOS Journal, 1(3), 1–6. https://ojs.amikom.ac.id/index.php/INFOSJournal/article/view/2336

Ozdemir, T. Y., Ozan Boydak, M., & Aydogan, I. (2013). Educational Process: International Journal. Educational Process: International Journal, 2(1–2), 47–58. https://www.ceeol.com/search/article-detail?id=663740

Ripansyah, I., Astuti, I. F., & Widagdo, P. P. (2021). Pemanfaatan Augmented Reality Sebagai Media Pembelajaran Pengenalan Sistem Tata Surya Untuk Siswa SD Dengan Metode Marker Based Tracking. Informatika Mulawarman : Jurnal Ilmiah Ilmu Komputer, 16(2), 88. https://doi.org/10.30872/jim.v16i2.4174

Rolfe, V. E., & Gray, D. (2011). Are Multimedia Resources Effective in Life Science Education? A Meta-Analysis. Bioscience Education, 18(1), 1–14. https://doi.org/10.3108/beej.18.5

Rozie, F., & Siswoyo, A. A. (2020). Pegebangan Media Pembelajaran IPA Interaktif Tata Surya di SDN Banyuajuh. Jurnal Ilmiah Rekayasa, 8(2), 129–136.

Safii, A. (2020). Peningkatan Hasil Dan Keaktifan Siswa Kelas Vi Materi Planet Dalam Tata Surya Melalui Partner Card. Refleksi Edukatika : Jurnal Ilmiah Kependidikan, 10(2), 172–177. https://doi.org/10.24176/re.v10i2.4444

Wei, P. C., He, F., & Huang, S. (2018). Effects of instructional multimedia integrated situational approach on students' learning achievement. Eurasia Journal of Mathematics, Science and Technology Education, 14(7), 3321–3327. https://doi.org/10.29333/ejmste/91244

Xu, X. (2017). Study on effective using of multimedia teaching system and enhancing teaching effect. International Journal of Emerging Technologies in Learning, 12(6), 187–195. https://doi.org/10.3991/ijet.v12i06.7093

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