

Interactive Physics Learning Innovation Using Solar System Scope to Understand Solar System Material

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Abstract

Physics learning is considered challenging because it involves abstract concepts that are difficult for students to understand, for example the material on the solar system. Interactive learning innovations use the Solar System Scope application as an effective learning medium in understanding the concept of the solar system. This study aims to describe the use of interactive web technology such as Solar System Scope as a learning medium for the solar system in class VI of Public Elementary School Suryodiningratan 3. The research approach uses qualitative descriptive with data collection techniques in the form of observation, interviews, and documentation. The results of the study showed that students were interested and found it easier to understand the material on the solar system. This innovation increases interest in learning, makes it easier to understand physics concepts, and encourages active student involvement in the learning process. The use of 3D visualization, interactive simulations, and exploration features allows students to learn the structure, motion, and characteristics of planets and the solar system in an interesting and amazing way. This innovation is expected to be an effective solution in supporting more modern and relevant physics learning.

Keywords: Innovation, Physics Learning, Solar System Scope

Abstrak

Pembelajaran fisika dianggap menantang karena melibatkan konsep abstrak yang sulit dipahami oleh siswa, misalnya materi sistem tata surya. Inovasi pembelajaran interaktif menggunakan aplikasi Solar System Scope sebagai media pembelajaran yang efektif dalam memahami konsep tata surya. Penelitian ini bertujuan untuk mendeskripsikan penggunaan teknologi web interaktif seperti Solar System Scope sebagai media pembelajaran sistem tata surya pada kelas VI SD N Suryodiningratan 3. Pendekatan penelitian menggunakan deskriptif kualitatif dengan teknik pengumpulan data berupa observasi, wawancara, dan dokumentasi. Hasil penelitian menunjukkan bahwa siswa tertarik dan lebih mudah memahami materi sistem tata surya. Inovasi ini meningkatkan minat belajar, mempermudah pemahaman konsep fisika, serta mendorong keterlibatan aktif siswa dalam proses belajar. Pemanfaatan visualisasi 3D, simulasi interaktif, dan fitur eksplorasi memungkinkan siswa untuk mempelajari struktur, gerak, serta karakteristik planet dan tata surya dengan cara yang menarik dan intuitif. Inovasi ini diharapkan dapat menjadi solusi efektif dalam mendukung pembelajaran fisika yang lebih modern dan relevan.

Kata kunci: Inovasi, Pembelajaran Fisika, Solar System Scope.

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INTRODUCTION

Physics learning is often considered difficult by students because the concepts are abstract and require deep understanding (Widyaningtyas et al., 2024). One of the challenging materials is the solar system, which includes planetary movements, Kepler's laws, and the concept of gravity. The challenge in understanding this material is often caused by the limitations of learning media that are only based on text or static images in textbooks. The development of digital technology opens up opportunities for innovation in learning, one of which is through the use of interactive applications. Solar System Scope is a simulation-based application that can display a three-dimensional model of the solar system in real-time. With interactive features that allow users to explore planets, see their orbits, and understand the concept of planetary motion visually, this application can improve students' learning experience and strengthen their understanding of the material. The use of technology in learning, especially in Physics subjects, can increase student engagement and clarify difficult-to-understand concepts. Therefore, the innovation of interactive Physics learning using Solar System Scope is expected to be an effective solution in improving students' understanding of the solar system and enriching teachers' teaching methods in the digital era.

The current digital era has a huge impact on human life and its impact cannot be underestimated, especially in the education sector in Indonesia. This means that educators need to give themselves the opportunity to apply learning strategies that are in accordance with current developments. (Ngongo et al., 2019). In addition to the use of technology in learning, collaboration skills between students are also needed. Activities involving educators and students should be designed through appropriate physics learning designs (Utami et al., 2021). Natural Sciences (IPA), especially physics, are the main subjects taught in elementary schools. Physics science learning in elementary schools is an important foundation for students' knowledge and interest in physics science (Hisbullah & Selvi, 2018). In physics science subjects, students learn various concepts and phenomena related to the natural environment. Students are challenged to understand natural concepts and phenomena in various ways. For example, through observation, internships, measurements, analysis, and others (Rahmawati, 2018).

After conducting observations and interviews at Public Elementary School Suryodiningratan 3, it was found that educators still use conventional learning models by only referring to student books, doing assignments and lectures, which cause students to have difficulty and be less motivated to learn the material on the planets in the solar system. In this digital era, the use of educational technology is a solution to overcome these challenges. According to Law Number 20 of 2003 concerning the National Education System, the learning process is interactive, fun, challenging and stimulating, motivating students to participate actively, encouraging spontaneity, creativity and development, depending on the talents, interests, skills, physical and psychological development of students. Learning is a conscious effort by individuals to change their behavior through practice or experience that includes cognitive, emotional, and psychomotor aspects in order to achieve certain goals (Siregar & Widyaningrum, 2015).

One innovation that can be implemented is the use of interactive web technology such as Solar System Scope in learning about the solar system. The integration of web technology such as Solar System Scope in learning is in line with the curriculum that focuses on technology and the development of 21st century skills. The use of this application not only helps students understand astronomical concepts but also introduces them to the use of technology as a learning tool. This is very relevant in the context of modern education, where digital literacy is one of the main competencies that students must have (Zalzabila & Hasyim, 2024). Thus, the use of Solar System Scope in learning in elementary schools can provide a richer and more meaningful learning experience. Through an interactive and visual approach, students can more easily understand and appreciate the beauty and complexity of the solar system.

METHODS

The study was conducted at Public Elementary School Suryodiningratan 3, located at Jl. Suryodiningratan No. 840, Suryodiningratan, Mantrijeron, Yogyakarta City, Special Region of Yogyakarta, during September to November 2023. The location was selected based on its attractiveness, uniqueness, and suitability to the research topic. The study population included all students of Public Elementary School 3 Suryodiningratan, with a sample of 25 grade 6 students.

The method applied in this study is a qualitative descriptive approach to describe the problems and focus of the study. Qualitative descriptive methods involve steps in social research to obtain descriptive data in the form of words and pictures. According to (Laurens, 2023), qualitative descriptive analysis includes steps to analyze, describe, and summarize conditions and situations reflected in various data. To support the implementation of the study, several tools were used such as stationery, cellphones, laptops, projectors, LCDs, speakers, and tripods. The data collection techniques applied include interviews. Interviews were conducted with one 6th grade homeroom teacher and four 6th grade students, using instruments that had been prepared in advance. The interview instrument consists of four questions. The second is observation. Observations are carried out during the interactive media-based learning process on the solar system material to obtain data or information from the objects observed. The third is documentation. Documentation is carried out by collecting data in the form of notes during the interview process and learning with the Solar System Scope web learning media.

Data analysis techniques include three stages, namely data reduction, data presentation, and drawing conclusions. Data reduction is done by summarizing and focusing on important aspects and eliminating irrelevant ones. Data presentation is done by displaying data in an easy-to-understand form such as tables, graphs, and narrative descriptions. Drawing conclusions is done by drawing conclusions and verifying the data that has been analyzed.

RESULTS AND DISCUSSION

RESULTS

This research was conducted at Public Elementary School Suryodiningratan 3 located at Jl. Letjen Suprpto No.84, Pringgokusuman, Gedong Tengen, Yogyakarta City, Special Region of Yogyakarta in May-June 2024. The selection of the location was based on considerations of attractiveness, uniqueness, and suitability to the chosen topic. With a population of all students of Public Elementary School Suryodiningratan 3 and a sample of 25 students of grade VI of Public Elementary School Suryodiningratan 3. In implementing the research, the material chosen was the solar system with the use of interactive web technology such as Solar System Scope which aims to help students understand the material and of course attract attention. Solar System Scope is a website that can display a model of the solar system in real time with accurate object positions. In it there is various information related to celestial objects outside the solar system and can be explored by its users. Through this Solar System Scope, users will be made to feel closer than the farthest reaches of the solar system and users can also see various models of the solar system, the night sky, and others. So, users will get direct experience.

Phase I (Getting started), data was obtained that students were ready to receive lessons from the teacher. The teacher first explained the material about the solar system using interactive web technology such as Solar System Scope and the students were very enthusiastic.

Phase II (A Phase in project), The data obtained showed that students in groups of 4-5 people who were randomly selected participated in learning activities by listening to the teacher's presentation related to the solar system material using interactive web technology such as Solar System Scope and singing the song Names of the Planets. Students worked on project assignments in the form of making a simple solar system model.

Phase III (Concluding a project), data obtained that students use various tools to make miniatures and use applications to explore the solar system that can be accessed via QR Code provided by the teacher. Students work on the questions on the student worksheet in groups then present the results of their work in front of the class and other groups provide responses, make conclusions with the guidance of researchers and also reflect on the learning that has been done.

The research data obtained from the learning cycle carried out are as follows:

1. Student Learning Experience Data with Web Solar System Scope

Table 1. Students' Learning Experience with Web Solar System Scope

Learning Experience	Many students	Percentage
Exciting	1	25%
Like	3	75%
Not both	0	0%
Total	4	100%

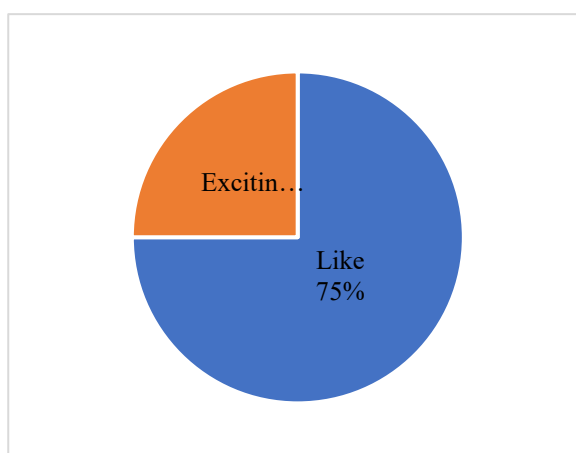


Figure 1. Students' Learning Experience with Web Solar System Scope

2. Data on students' interest in the Solar System Scope Web

Table 2. Interest in the Solar System Scope Web

Learning Experience	Many students	Percentage
Interested	4	100%
Not interested	0	0%
Total	4	100%

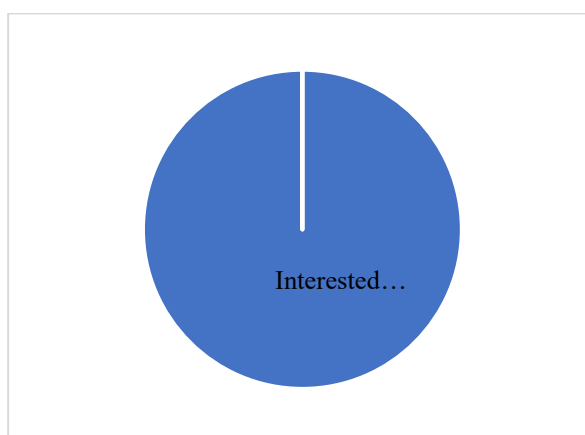


Figure 2. Interest in the Solar System Scope Web

3. Data on the Benefits of Using the Web Solar System Scope Perceived by Students

Table 3. Benefits of Using the Web Solar System Scope Perceived by Students

Learning Experience	Many students	Percentage
Help	1	75%
Very helpful	3	25%
Not helpful	0	0%
Total	4	100%

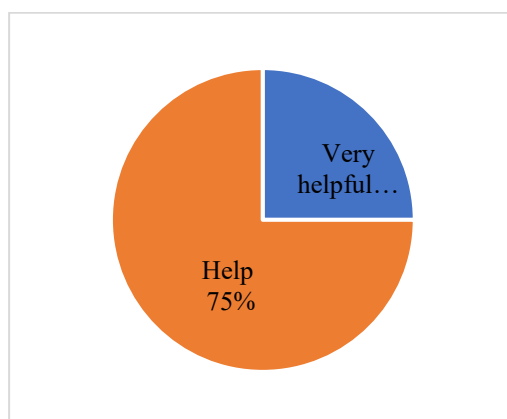


Figure 3. Benefits of Using the Web Solar System Scope Perceived by Students

4. Learning Obstacle Data Using the Solar System Scope Web

Table 4. Constraints on Learning Using the Solar System Scope Web

Learning Experience	Many students	Percentage
Need teacher help	1	25%
No obstacles	3	75%
Total	4	100%

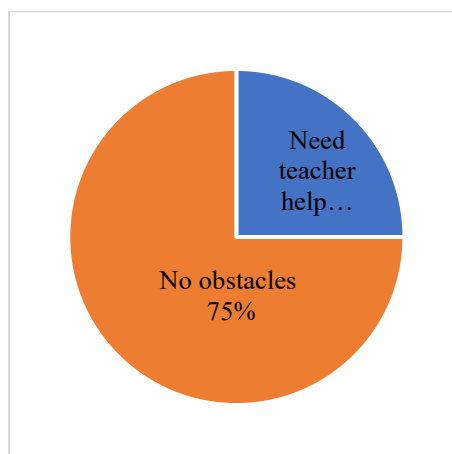


Figure 4. Constraints on Learning Using the Solar System Scope Web

DISCUSSION

The implementation of learning applied in class VI of Public Elementary School Suryodiningratan 3 is carried out solar system learning using interactive web technology such as Solar System Scope which is based on previously prepared learning steps.

a. Phase I Getting started

At this stage, the researcher begins learning by preparing the class, taking student attendance, and

conditioning the class. The researcher will then convey the material to be studied, the objectives of the learning to be carried out and apperception to stimulate students' curiosity about the material to be studied. In the core activity, learning is carried out by first explaining the material about the solar system using interactive web technology such as Solar System Scope.

b. Phase II A Phase in project

At this stage, the student group consisting of 4-5 people. Then the students listen to the teacher's presentation related to the solar system material using interactive web technology such as Solar System Scope, then the educator invites students to sing the song Names of the Planets. The teacher gives students a project assignment to make a simple model of the solar system. At this stage, students use interactive web technology to study the solar system material which will be used as basic knowledge in making miniature solar systems in groups. The integration of interactive web technology takes place when students learn about the solar system material. In this activity, students will learn about the solar system material which includes the names of planets, characteristics of planets, shapes of planets, and the arrangement of planets in the solar system. In studying this material, participants not only read through books but there are also learning videos and songs about the solar system to make it easier for students to understand the material.

c. Phase III: Concluding a project

At this stage, students integrate interactive web technology when students use various tools to make miniatures and use applications to explore the solar system which can be accessed via the QR Code provided by the researcher. A QR Code is a two-dimensional image that represents data, especially text data (Adna & Dewi, 2019). The QR Code can be scanned to access the learning website about the solar system, so that students can better understand the material being studied. Then students distribute student worksheets, which then students will work on the questions contained in the student worksheets in groups. After the solar system miniature is finished, students can present their work in front of the class and other groups provide responses. Furthermore, the closing of the learning process, students make conclusions with the guidance of researchers and also reflect on the learning that has been carried out.

Based on the data in Table 1 and Figure 1, it shows that 75% of students feel happy when using Web Solar System Scope. This shows that the majority of students feel motivated and enthusiastic in the learning process. Interesting visualizations, realistic animations, and interactive features provided make it easier for students to understand the material compared to just through textbooks. In addition, 25% of students feel excited when using this media. The use of Web Solar System Scope provides students with the opportunity to explore the solar system virtually, such as seeing planets up close, understanding orbits, and observing the movement of celestial objects directly. This interactivity makes learning feel more alive and enjoyable. This is in line with the opinion of (Sari et al., 2019) and (Zalzabila & Hasyim, 2024) who stated that one of the tools that can support the needs of solar system material is Solar System Scope, which is an application that displays a solar system model that can be explored by its users so that learning is more lively and enjoyable. The solar system scope web uses rich visualizations and high interactivity to help learners explore and understand the structure and dynamics of the solar system. By providing visual representations of abstract concepts such as planetary rotation and revolution, the app facilitates a more immersive and intuitive learning experience (Tuanakotta & Hasyim, 2024).

Based on the data in Table 2 and Figure 2, it shows that 100% of students are interested in using this media in learning. This shows that the Web Solar System Scope is able to attract students' interest because it provides a different and innovative learning experience. This interest also has the potential to increase students' learning motivation in understanding science materials. This is in line with the statement that the use of web-based simulators as learning media can make it easier for teachers to deliver learning materials more interestingly so that it can increase student interest and understanding (Fauzi et al., 2023; Sarip, 2024).

Table 3 and Figure 3 show that 25% of students who stated that Solar System Scope was very helpful, thought that the visualizations presented were very interactive and detailed. Realistic 3D

animations make it easier for students to understand the positions of planets, orbits, and interactions between celestial bodies. This feature allows students to explore the solar system directly, as if they were doing a real simulation. Meanwhile, 75% of students who stated that this website was helpful expressed that using this website provided a more concrete picture than conventional learning. With an attractive graphic display, students can understand the basic concepts of the solar system without getting bored. However, some students felt that the use of this website needed to be accompanied by a teacher's explanation so that the understanding obtained was more optimal. This is in line with the results of research conducted by (Khatimah et al., 2023) which also showed that the use of Solar System Scope learning media is effective in improving students' understanding of solar system material, as mentioned by (Aridya & Shofiyah, 2023).

Learning using the Solar System Scope website provides an interactive experience for students in understanding the solar system. However, based on the results of observations, data obtained according to Table 4 and Figure 4 show that as many as 25% of students need teacher assistance due to a lack of understanding of technology, unstable internet connections, and minimal digital literacy. Students who experience these obstacles have difficulty understanding web navigation and features independently. On the other hand, 75% of students do not experience obstacles, which shows that the majority of students are able to use this website independently. This proves that digital-based learning media is effective in improving student understanding. To overcome existing obstacles, it is recommended to provide digital literacy training, web usage guides, and additional assistance for students who need it. This is in line with the opinion of (Khatimah et al., 2023) which states that students will easily understand learning about solar system material because through the use of the solar system scope web application which contains various features that support learning.

CONCLUSION

This study shows that the implementation of interactive learning using web technology such as Solar System Scope in Public Elementary School Suryodiningratan 3 can improve students' understanding of the solar system. Learning steps involving the initial phase, the phase in the project, and the closing of the project provide opportunities for students to actively learn and apply their knowledge in making a miniature solar system. The integration of interactive web technology has also proven effective in increasing students' interest and involvement in learning, as seen from their participation in singing the songs of the names of the planets and making simple models of the solar system. A learning approach that utilizes interactive web technology such as Solar System Scope can be an interesting and effective alternative in improving students' understanding and interest in solar system material at the elementary school level.

Improve the effectiveness of learning by considering the following: continue to utilize interactive technology such as Solar System Scope, vary learning activities, add additional educational content, involve communities and astronomy experts, and conduct regular evaluations. With these steps, learning at Public Elementary School Suryodiningratan 3 can be more effective and interesting for students.

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