INNOVATIVE LEARNING BY UTILIZING WORDWALL TO MAKE IT INTERACTIVE IN ELEMENTARY SCHOOL

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| ***Abstract***  *This research aims to analyze the effectiveness of using Wordwall, a gamification-based platform, in improving elementary school students' critical thinking skills on Solar System materials. This is motivated by the fact that digital transformation in basic education has encouraged the utilization of technology to increase student engagement and interactivity, but there are still many challenges in delivering materials in an interesting and effective way. On the other hand, although students show interest in Solar System materials, they often struggle in understanding abstract concepts such as revolution, rotation and gravity. Conventional learning is often not interactive enough, so students feel less engaged and have difficulty in understanding the material. The use of innovative educational technology such as Wordwall is expected to address this issue, by offering a more engaging and fun approach to learning complex concepts. This study used a qualitative approach with exploratory descriptive method, involving interviews, questionnaires and observations of three teachers and 30 students in three elementary schools that have adopted technology-based learning. The results showed that students using Wordwall were more active in discussions and had better understanding compared to conventional learning methods. Therefore, Wordwall has great potential to improve learning effectiveness and students' critical thinking skills in elementary schools. The results of this study are expected to be a reference for educators in optimizing the use of technology in more innovative and effective learning.*  ***Keywords:*** *wordwall; digital learning; critical thinking skills; primary education; solar system* | | | | |
| **Abstrak**  Penelitian ini bertujuan untuk menganalisis efektivitas penggunaan Wordwall, platform berbasis gamifikasi, dalam meningkatkan keterampilan berpikir kritis siswa sekolah dasar pada materi Tata Surya. Hal ini dilatar belakangi oleh transformasi digital dalam pendidikan dasar telah mendorong pemanfaatan teknologi untuk meningkatkan keterlibatan dan interaktivitas siswa, namun masih banyak tantangan dalam menyampaikan materi secara menarik dan efektif. Di sisi lain, meskipun siswa menunjukkan minat pada materi Tata Surya, mereka sering kesulitan dalam memahami konsep-konsep abstrak seperti revolusi, rotasi, dan gravitasi. Pembelajaran konvensional seringkali tidak cukup interaktif, sehingga siswa merasa kurang terlibat dan mengalami kesulitan dalam memahami materi tersebut. Penggunaan teknologi pendidikan yang inovatif seperti Wordwall diharapkan dapat mengatasi masalah ini, dengan menawarkan pendekatan yang lebih menarik dan menyenangkan untuk mempelajari konsep-konsep yang kompleks. Penelitian ini menggunakan pendekatan kualitatif dengan metode deskriptif eksploratif, yang melibatkan wawancara, kuesioner, dan observasi terhadap tiga guru dan 30 siswa di tiga sekolah dasar yang telah mengadopsi pembelajaran berbasis teknologi. Hasil penelitian menunjukkan bahwa siswa yang menggunakan Wordwall lebih aktif dalam diskusi dan memiliki pemahaman yang lebih baik dibandingkan dengan metode pembelajaran konvensional. Oleh karena itu, Wordwall memiliki potensi besar untuk meningkatkan efektivitas pembelajaran dan keterampilan berpikir kritis siswa di sekolah dasar. Hasil penelitian ini diharapkan dapat menjadi referensi bagi pendidik dalam mengoptimalkan penggunaan teknologi dalam pembelajaran yang lebih inovatif dan efektif.  **Kata Kunci:** wordwall; pembelajaran digital; keterampilan berpikir kritis; pendidikan dasar; tata surya | | | | |
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**Introduction**

Digital transformation in basic education has emerged as a significant catalyst for enhancing the quality and effectiveness of the learning process. The integration of digital technology in educational settings enables more interactive, engaging, and meaningful learning experiences for students (Affandi et al., 2024). Moreover, digitalization supports flexible and personalized learning, allowing students to progress at their own pace and adapt learning to their individual styles. This shift aligns with constructivist learning principles and student-centered approaches, emphasizing active student involvement and the construction of knowledge through experience and interaction.

Among the various technological innovations being adopted in schools, Wordwall has gained attention as a digital platform that facilitates gamification-based learning. By providing various customizable features—such as quizzes, games, and puzzles—Wordwall encourages more dynamic and enjoyable learning experiences (Andika & Adiwijaya, 2025). Its interactive nature not only helps in strengthening conceptual understanding but also nurtures essential 21st-century skills, including critical thinking, collaboration, and problem solving. Additionally, Wordwall enables teachers to assess students’ comprehension through interactive activities that align with specific learning objectives. The use of gamification elements, such as points, levels, and rewards, can foster intrinsic motivation and make learning more engaging and stimulating for students (Renata et al., 2024).

Despite the promising benefits of integrating digital tools like Wordwall into basic education, several challenges remain. Existing studies have mostly focused on the general application of Wordwall without deeply examining how its gamification components specifically impact students’ critical thinking abilities and active engagement. Furthermore, there is limited discussion on contextual factors such as teacher readiness, school infrastructure, and students’ digital literacy, which play a crucial role in the effective implementation of digital learning tools (Kospita & Mulyadi, 2024). In many cases, the success of technology-based learning depends not only on the tool itself, but also on how it is implemented within the teaching and learning process.

This research seeks to address those gaps by offering a deeper analysis of the impact of Wordwall on elementary school students’ critical thinking skills, learning motivation, and engagement in the classroom. The novelty of this study lies in its dual focus: first, it evaluates the pedagogical effectiveness of Wordwall in fostering critical thinking and enhancing conceptual understanding, and second, it explores the influence of external factors, such as teacher readiness, students’ digital competencies, and school infrastructure, on the success of implementation. This study also aims to design a responsive implementation model of Wordwall that can be adapted across various subjects and student ability levels in basic education. By analyzing its use in different learning contexts, the study is expected to generate practical insights for optimizing Wordwall as a digital learning medium.

Theoretically, this study is grounded in several key frameworks. Constructivist learning theory provides the foundation for understanding how students build knowledge through interactive and meaningful experiences. Mayer’s Cognitive Theory of Multimedia Learning supports the role of digital tools in enhancing students’ comprehension through well-structured visual and auditory input. In addition, gamification theory—especially within the framework of self-determination theory—explains how elements such as rewards, challenges, and feedback loops can enhance student motivation and engagement. These theoretical perspectives guide the research in assessing how Wordwall can be strategically implemented to improve the quality of learning in elementary education.

**Research Methods**

This study used a qualitative approach with an exploratory descriptive design to analyze the learning needs of Solar System materials in elementary schools. The study involved three teachers who had participated in the ICT-Based Learning (PEMBATIK) program, as well as 30 students in grades IV to VI from three purposively selected schools. The purposive sampling was chosen to ensure that the participants had experience with ICT-based learning, which is relevant to the study's objectives. Data were collected through teacher and student interviews, as well as a Likert scale-based questionnaire and open-ended questions. Teacher interviews explored learning strategies, constraints in teaching abstract concepts, and the effectiveness of learning media, while student interviews highlighted their learning experiences and challenges they faced. Example questions from the teacher interviews include: "What strategies do you use to teach abstract concepts like gravity?", and from the student interviews: "What part of the Solar System topic do you find most difficult to understand?" Teacher questionnaires assessed the effectiveness of teaching methods and readiness to use technology, while student questionnaires measured their understanding of the Solar System through questions like "How confident are you in explaining the rotation of planets?" Data analysis was done thematically through the stages of reduction, presentation, and conclusion drawing. The categorization used in this study involved open coding and the identification of both a priori themes, such as "teaching effectiveness" and "student engagement," as well as emergent themes. Validity was strengthened through triangulation of sources and methods, with coding supported by tools like Excel. The results of this study are expected to be the basis for developing technology-based learning media, such as Wordwall, to increase student engagement and critical thinking skills in understanding Solar System concepts.

**Results and Discussion**

This chapter presents the findings and discussion on the effectiveness of Wordwall learning media in improving students' critical thinking skills on Solar System materials in elementary schools. The discussion includes the impact of using this media on concept understanding, student engagement, and the role of technology in supporting learning. In addition, the research findings are linked to relevant theories and previous studies to provide a comprehensive interpretation of the results. The chapter also explores how the integration of gamification elements within Wordwall contributes to students' learning motivation and active participation in the classroom. Particular attention is given to how different levels of digital literacy among students and teachers influence the outcomes of technology-based learning. Furthermore, this chapter identifies both the challenges encountered during the implementation process and the potential opportunities for scaling and optimizing the use of Wordwall in diverse educational settings.

The researcher administered questionnaires and conducted interviews to 3 upper grade teachers from three elementary schools to identify challenges in teaching the Solar System, as well as the effectiveness of the learning methods used. The three teachers who became respondents in this study are teachers who have participated in the ICT-Based Learning (PEMBATIK) program with various types of training. The first teacher has attended training on the basics of using technology in learning, including the use of educational software and interactive media. The second teacher has received training on ICT integration in project-based learning, which enables the development of more collaborative and exploration-based learning strategies. Meanwhile, the third teacher has attended training in digital learning media development, which equipped her with skills in creating interactive digital content. With this training background, all three teachers have experience in integrating technology in learning as well as utilizing digital media to improve students' critical thinking skills. The following table 1 is related to the distribution of teacher questionnaire results:

**Table 1.** Distribution of Teacher Questionnaire Results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Statement | SS | S | TS | STS |
| Experience in Teaching Solar System |  |  |  |  |
| I find the material about the solar system very difficult to teach to students. | 1 | 2 | 0 | 0 |
| I often face difficulties when explaining solar system concepts to students. | 1 | 2 | 0 | 0 |
| I enjoy teaching solar system material in class. | 2 | 1 | 0 | 0 |
| Teaching Methods |  |  |  |  |
| The teaching method I used really helped students understand the solar  system material. | 1 | 2 | 0 | 0 |
| I prefer to use learning media such as pictures or videos to teach the solar  system. | 2 | 1 | 0 | 0 |
| Group discussions are effective in helping students understand solar system  material. | 1 | 2 | 0 | 0 |
| Obstacles Faced |  |  |  |  |
| I had difficulty explaining the names of the planets and the concept of  planetary movement to students. | 2 | 1 | 0 | 0 |
| I find it difficult to make students understand the concept of eclipses and  other solar system phenomena. | 2 | 1 | 0 | 0 |
| I had difficulty in developing students' critical thinking skills when teaching  the solar system. | 2 | 1 | 0 | 0 |
| Suggestions for Improvement |  |  |  |  |
| I believe that using more learning media (such as pictures, videos) will help  students better understand the solar system. | 2 | 1 | 0 | 0 |
| I feel that solar system lessons would be more effective if they were  delivered in a more interactive way. | 2 | 1 | 0 | 0 |
| I need more resources and tools to teach solar system material effectively. | 2 | 1 | 0 | 0 |
| I would like more time to discuss and dialog with students about the solar  system material. | 2 | 1 | 0 | 0 |
| I need further training on how to teach solar system materials effectively. | 1 | 2 | 0 | 0 |

Source: Adapted from Boone & Boone (2012) on the use of Likert scales for educational research and Miles, Huberman, & Saldaña (2014) on thematic distribution-based qualitative data analysis. Based on the analysis of the data distribution from the questionnaires given to teachers about teaching solar system materials, several findings were obtained, which are summarized in the table 2 below:

**Table 2.** To Summarize The Findings From The Questionnaire Results

|  |  |
| --- | --- |
| **Finding** | **Response Distribution** |
| Difficulty in teaching solar system material | 1 teacher strongly agreed (SS), 2 teachers agreed (S) |
| Difficulty in explaining solar system concepts | 1 teacher strongly agreed (SS), 2 teachers agreed (S) |
| Enjoyment in teaching solar system material | 2 teachers strongly agreed (SS), 1 teacher agreed (S) |
| Challenge of limited learning media | Some teachers reported a lack of sufficient media at school |

These findings form the basis for the development of critical thinking skills-based Wordwall learning media to improve students' understanding of solar system material in elementary schools. The results highlight that some teachers found the material challenging to teach, particularly in explaining solar system concepts. The distribution of responses shows that 1 teacher strongly agreed, and 2 agreed, indicating a consensus about the difficulty of teaching this topic. The majority of teachers, however, reported enjoying teaching this material, showing a high level of motivation. Additionally, many teachers noted the limited learning media at school as a significant challenge in delivering the content effectively.

Regarding the teaching methods, teachers felt that the methods used were quite helpful in helping students understand the solar system material, with one teacher strongly agreeing (SS) and two teachers agreeing (S). Most teachers preferred the use of learning media such as pictures or videos in teaching this material, with two teachers strongly agreeing (SS) and one teacher agreeing (S). In addition, group discussions were considered effective in helping students' understanding, with one teacher strongly agreeing (SS) and two teachers agreeing (S). These results confirm that the use of technology-based media, such as Wordwall, can be an effective alternative to increase students' engagement in learning. In terms of obstacles faced, teachers experienced difficulties in explaining the names of the planets as well as the concept of planetary movement to students, with two teachers strongly agreeing (SS) and one teacher agreeing (S). Similar difficulties also occur in explaining the concept of eclipses and other solar system phenomena, as well as in developing students' critical thinking skills when teaching this material.

To improve learning effectiveness, teachers suggested using more learning media, such as pictures and videos, to help students' understanding, with two teachers strongly agreeing (SS) and one teacher agreeing (S). In addition, they felt that solar system lessons would be more effective if delivered interactively, with two teachers strongly agreeing (SS) and one teacher agreeing (S). Requests for more resources and tools were also raised by teachers with similar responses. In addition, the desire to have more time to discuss with students as well as the need for further training on how to teach this material effectively were also major concerns of the teachers. Table 3 below shows the transcripts of the interviews with teachers:

**Table 3.** Transcript of Interview with Teacher

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No.** | **Question** | **Teacher 1** | **Teacher 2** | **Teacher 3** |
| 1 | How do you feel when teaching Solar System material in class? | I enjoy teaching the Solar System because it is interesting for students.  However, it is difficult to hold their attention when explaining abstract concepts such as  revolution and  rotation. | I was excited because the children were curious about space. However, I felt limited in  Providing a real learning experience due to limited tools. | I feel excited  because this  material is  interesting for students. However,  there challenges in explaining  concepts that  students canot directly observe are |
| 2 | What do you like most about teaching Solar System material? | I like to see the students'  enthusiasm,  especially when showing pictures of planets or videos. They ask  a lot of questions. | I like discussing phenomena like eclipses and day- night because they can be related to everyday life. | I like it when students start asking questions on their own and try to relate the material to their experiences. |
| 3 | What are the main obstacles you face when teaching Solar System material? | Limited learning media. I only had pictures in the textbook, making it difficult to explain planetary  motion. | Students have difficulty imagining how celestial bodies move. They tend to just memorize, not understand the  concept. | The lack of  interactive tools makes it difficult for students to understand  abstract concepts. |
| 4 | Which part of the Solar System material is the most difficult to explain to students? Why? | The concepts of revolution and  rotation are  difficult to explain as they require good spatial  understanding. | Gravity and its effect on planetary motion. Children find it difficult to  understand why objects can orbit without falling into  the Sun. | The concepts of orbits and  gravitational forces are difficult to explain without adequate  simulations. |
| 5 | What teaching method do you use most often to teach Solar System material? | Lecture method (*Leaturing method*) and discussion. I also ask students to read a book and then discuss  the content. | I often use pictures and maps of the Solar System. Sometimes I make a simple model with a ball and flashlight to  explain an eclipse. | I use group  discussions and simple experiments to help students understand the material. |
| 6 | Is your teaching method effective for improving students' critical thinking skills? Why or why not? | Less effective. Students receive more  information from me rather than exploring on their  own. | I think there is still a need for other methods, because students are not used to asking questions or looking for  answers themselves. | It has not been fully effective, as students still tend to memorize rather than analyze the concepts they  learn. |
| 7 | Do you use learning media such as pictures, videos or other teaching aids? If yes, what media are used and how are they used? | I use images from the textbook and sometimes play videos from *YouTube*. | I once used a *globe* and a flashlight to explain day and night. | I use interactive animations and concept maps to help students understand the relationships  between planets. |
| 8 | How effective is the learning media in helping students understand Solar System material? | Videos are  helpful, but because they are long, students sometimes lose focus. | Simple models can help, but interactive simulations are more effective. | Digital media is helpful, but it is more effective when  Accompanied by  direct discussion and Q&A. |
| 9 | Do students have difficulty thinking critically when learning about the Solar System? Can you tell us more? | Yes, they  memorize more than they  understand. If I ask, they only answer according to the text of the  book. | Some students can think critically, but most just accept information without trying to analyze it. | Most students still have difficulty in connecting  concepts with phenomena that occur around them. |
| 10 | How do you support the development of students' critical thinking skills in Solar System learning? | I sometimes ask them to come up with their own questions, but only a few can. | I often ask 'Why?' or 'What if...?' but not all students can answer. | I ask students to make a small project, such as a model of the Solar System with an explanation of its  movement. |
| 11 | What can help overcome the obstacles in teaching the Solar System? | More interactive media so that students are more active in  thinking. | Simulations or learning apps that they can explore on their own. | Use technology- based experiments or simulations to provide a more concrete learning  experience. |
| 12 | Do you have any suggestions or  recommendations to improve the learning of Solar System material in elementary school? | Training for teachers on how to teach science more  interactively. | More digital learning resources can be accessed by students and teachers. | Develop  technology-based learning media so that students can be more active in exploring  concepts. |

Source: Adapted from Miles, Huberman, & Saldaña (2014), Creswell & Creswell (2017), and McKenney & Reeves (2018).

The results of interviews with teachers corroborate the findings of the questionnaire that the Solar System material is interesting for students, but abstract concepts such as revolution, rotation and gravity are difficult to explain without interactive tools. Teachers use lectures, discussions, pictures, videos, as well as simple models such as balls and flashlights, but this approach is not optimal in improving students' critical thinking skills, who tend to memorize rather than understand concepts deeply Regarding the obstacles faced, the interview results also confirmed that limited learning media was the main challenge. Teachers had difficulty explaining planetary motion, orbits and gravity due to the lack of visual aids and interactive simulations. In addition, students have difficulty in connecting solar system concepts with everyday phenomena, which hinders the development of their critical thinking skills. To overcome these obstacles, teachers in the interviews suggested using more interactive learning media, such as videos, simulations and technology-based learning applications. One teacher stated that technology-based experiments can provide a more concrete learning experience for students, while another recommended the use of small projects to increase student engagement in the exploration of solar system concepts.

Based on the results of the questionnaires and interviews, it can be concluded that the main challenges in teaching solar system materials in elementary schools relate to the limitations of learning media and students' difficulties in understanding abstract concepts. Teachers recognize that the use of technology-based learning media, such as Wordwall, can help overcome these obstacles by providing a more interactive learning experience and supporting students' critical thinking skills. From the researcher's perspective, these findings strengthen the argument that the utilization of technology in science learning can increase the effectiveness of understanding complex concepts. According to Mayer (2024), multimedia-based learning that combines visual and interactive elements is proven to be more effective in improving students' understanding compared to the conventional lecture-based method. In addition, research conducted by Clark and Mayer (2016) showed that the use of digital media can increase student engagement and strengthen connections between scientific concepts and real-life experiences. Furthermore, a literature review by Jonassen (2010) emphasizes that technology-based learning not only improves concept understanding, but also encourages the development of critical thinking skills through active exploration. This is in line with the interview results which show that students memorize more than understand the concept of the solar system in depth.

The use of technology-based learning media in science teaching, especially on solar system materials, is in line with the cognitive theory of multimedia learning proposed by Mayer (2022). According to this theory, the combination of visual and interactive elements in learning media can help students build stronger mental models and facilitate understanding of abstract concepts. In addition, research conducted by Fitria, L., & Tarisa, V. (2023) showed that the use of educational game-based applications, such as Wordwall, can increase student engagement and improve student understanding in science subjects. Another study by Uma'iyah, N., Wahyuni, S., & Nuha, U. (2023) confirmed that technology-based learning methods not only increase student motivation, but also contribute to strengthening critical thinking skills through explorative and problem-based activities.

To strengthen the research data, the researcher then administered questionnaires to students in three elementary schools to identify their experiences in learning the Solar System, the effectiveness of teaching methods used by teachers, the obstacles they face, and suggestions for learning improvement. The total respondents were 30 students, each consisting of 10 students. The data obtained is presented in the form of a percentage distribution in order to analyze the trend patterns of student responses in more depth. The following table 4 is related to the distribution of student questionnaire results:

**Table 4.** Distribution of Student Questionnaire Results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Statement | SS  (%) | S  (%) | TS  (%) | STS  (%) |
| Experience in Solar System Learning |  |  |  |  |
| I find the material about the Solar System very difficult to  understand. | 30% | 45% | 20% | 5% |
| I often feel confused when the teacher explains about the Solar  System. | 25% | 50% | 20% | 5% |
| I enjoyed learning about the Solar System in class. | 40% | 50% | 5% | 5% |
| Teaching Methods |  |  |  |  |
| The way the teacher taught Solar System really helped me  understand the material. | 35% | 50% | 10% | 5% |
| It is easier for me to understand the Solar System when the  teacher uses pictures or videos. | 50% | 40% | 5% | 5% |
| Group discussions help me better understand the Solar System  material. | 30% | 45% | 15% | 10% |
| Obstacles Faced |  |  |  |  |
| I have trouble remembering the names of the planets in the Solar  System. | 20% | 40% | 30% | 10% |
| I found it difficult to understand the concepts of planetary  movements and eclipses. | 25% | 45% | 20% | 10% |
| I find it difficult when I have to think critically in Solar System  lessons. | 30% | 50% | 15% | 5% |
| Suggestions for Improvement |  |  |  |  |
| I think using more learning media (such as pictures, videos) will  help me understand the Solar System. | 60% | 30% | 5% | 5% |
| I would have preferred if the Solar System lesson was delivered in  a more interactive way. | 55% | 35% | 5% | 5% |
| I would like more time to discuss the Solar System with my  friends. | 40% | 45% | 10% | 5% |

Source: Adapted from Boone & Boone (2012) on the use of Likert scales for educational research and Miles, Huberman, & Saldaña (2014) on thematic distribution-based qualitative data analysis.

Based on the questionnaire results, 30% of students found the Solar System material very difficult to understand, while 45% agreed that it was challenging. In addition, 25% of students often feel confused when the teacher explains this material, indicating that there are gaps in students' understanding of Solar System concepts. Nonetheless, 40% of students really enjoy learning about the Solar System and the other 50% agree, indicating that this topic has a special appeal for students. In terms of teaching methods, the majority of students (50%) stated that it was easier to understand the material when the teacher used pictures or videos, while only 35% of students felt that the teacher's teaching methods were enough to help them understand Solar System concepts. As many as 30% of students strongly agreed that group discussions could help their understanding, but there were 10% of students who disagreed with this method.

In terms of obstacles faced, 40% of students expressed difficulty in remembering the names of the planets, while 45% of students found it difficult to understand the concepts of planetary movements and eclipses. In addition, 30% of students strongly agreed that critical thinking in Solar System learning is difficult for them, indicating the need for learning strategies that better support exploration and problem solving. For improvement, the majority of students (60%) stated that the use of more learning media such as images and videos would greatly help their understanding. 55% of students also stated that they would prefer if Solar System lessons were delivered interactively, and 40% of students would like more time to discuss this material with friends. To strengthen the data from the questionnaire, the researchers then conducted interviews with three groups of students from three different elementary schools, with each group consisting of 5 students. The selection of participants was done to obtain a more comprehensive representation of their learning experience in understanding the Solar System material.

These findings from the questionnaires and interviews confirm that students need more innovative and interactive learning approaches to better understand Solar System concepts. One strategy that can be implemented is the use of technology-based learning media, such as Wordwall, which allows students to learn through more engaging and explorative activities. According to Fiani, et al., (2024), multimedia-based learning that combines visual and interactive elements can improve students' understanding of abstract concepts more effectively than traditional lecture methods. In addition, research by Putri, A. E. (2024) showed that the use of digital-based educational games can increase student motivation and engagement in the learning process. With its interactive features, Wordwall can help students remember the names of planets, understand the movement of celestial bodies, and hone critical thinking skills through quizzes, simulations, and educational games. In addition, the integration of group discussions in the use of this media can provide opportunities for students to exchange understanding and overcome the difficulties they face together. Furthermore, the adaptability of Wordwall allows teachers to customize learning materials based on students' needs and learning paces, ensuring more effective knowledge acquisition. This flexibility makes Wordwall a valuable tool in differentiated instruction, supporting both struggling learners and high-achieving students. Therefore, the development of technology-based teaching methods can not only improve students' understanding of Solar System materials, but also create a more enjoyable and meaningful learning experience. The positive response from both students and teachers in this study indicates a strong potential for broader implementation of Wordwall in science subjects. Future research may further explore the long-term impact of gamified learning on students' higher-order thinking skills and overall academic achievement. The following table 5 is a thematic summary of student interviews:

**Table 5.** Thematic Summary of Student Interviews

|  |  |
| --- | --- |
| Theme | Summary of Student Answers |
| Experience in Learning the Solar System | Most students are interested in this material because they want to know more about outer space. However, they had difficulty in understanding planetary movements and abstract scientific  concepts. |
| Hard to Understand Parts | Students find it difficult to understand the concepts of revolution and rotation because it is difficult to imagine the movement of planets. In addition, remembering the order of the planets and distinguishing their characteristics was also a challenge for some  students. |
| Teacher's Teaching Method | The most commonly used methods are lecturing (*Leaturing method*) and reading textbooks, with little use of teaching aids. Some teachers use balls and flashlights for eclipse simulation, but the use  of interactive media is still limited. |
| Effectiveness of Learning Methods | Most students stated that the methods used did not help their understanding in depth, mainly due to the lack of visual demonstrations and hands-on exploration of the concepts being  taught. |
| Learning Media Preferences | Students find it easier to understand the material when using videos, animations, interactive simulations, and educational games compared to reading books or listening to lectures (*Leaturing*  *method*). |
| Critical Thinking Skills | Students tend to memorize information rather than conduct in-  depth analysis. They are rarely given the opportunity to explore concepts or relate them to everyday phenomena. |
| How Students Analyze Information | Most students simply repeated information from the textbook when given open-ended questions. Few students tried to ask critical questions such as "Why don't planets fall into the Sun?" or "What  would happen if there was no gravity?" |
| Suggestions and Solutions | Students suggested making learning more interesting by adding simple experiments, digital simulations, and educational games  that can help them understand abstract concepts better. |

Source: Adapted from Miles, Huberman, & Saldaña (2014), Creswell, J. W., & Creswell, J. D. (2017), and McKenney & Reeves (2018) in the presentation of qualitative data for thematic analysis in educational research.

The results of interviews with students confirmed the findings from the questionnaire that most students were interested in Solar System material but had difficulty in understanding the concept of planetary movement and abstract scientific phenomena. Many students stated that they had difficulty imagining the concepts of revolution and rotation as well as remembering the order and characteristics of the planets. Regarding teaching methods, most students mentioned that teachers mostly use lectures (Lecturing method) and reading textbooks, with little use of teaching aids. Although some teachers tried to use balls and flashlights for eclipse simulation, students felt that this method still did not help them understand the concepts deeply. They stated that the use of videos, animations, and interactive simulations were more effective in improving their understanding.

Interviews showed that students tend to memorize rather than analyze Solar System materials, rarely ask critical questions, and only repeat information from books. The teacher suggested the use of experiments, digital simulations, and educational games to help understand abstract concepts. According to recent studies (Mayer, 2024), interactive multimedia learning can improve student understanding by engaging them in active exploration. Similarly, Clark & Mayer (2016) and that digital media and technology support the development of critical thinking skills through active exploration. These results align with previous research showing that multimedia learning strategies promote deeper comprehension by engaging students more effectively than traditional lecture methods (Mayer, 2024; Jonassen, 2020).

The interview results show that students memorize more than they understand concepts, suggesting the need to integrate digital media such as Wordwall to enhance their analytical skills. This finding supports Piaget's (2013) theory of cognitive development, which asserts that children at the concrete operational stage (elementary school age) better understand concepts through direct manipulation or visual representation. More recent research (Park & Lee, 2021) confirms that interactive digital media can help bridge the gap between abstract concepts and students' real understanding, especially when using visual aids. This evidence further emphasizes the potential of digital media in facilitating comprehension at the elementary level.

Additionally, research by Hattie & Yates (2022) showed that technology-based learning not only increased students' motivation but also strengthened their memory and problem-solving abilities. This aligns with the results of this study, which suggests that integrating technology in Solar System learning provides significant benefits compared to conventional methods like text-based and lecture-based approaches. Furthermore, recent studies on active learning (Smith et al., 2023) suggest that students who engage with interactive media are more likely to develop deeper understanding and critical thinking skills.

Based on the findings of this study, it can be concluded that although students are interested in Solar System material, they face difficulties in understanding the concepts, especially those that are abstract. The dominant use of the lecture method and textbooks is one of the factors that hinder their understanding. Therefore, a more interactive and technology-based learning strategy is needed to improve students' understanding and critical thinking skills. In addition, support from teachers in directing students to be more active in learning is also an important factor in improving their understanding. Teachers can facilitate more open discussions, encourage students to ask critical questions, and provide more constructive feedback in the learning process. This is consistent with recent research (Hattie & Yates, 2022; Smith et al., 2023) suggesting that active learning strategies foster deeper engagement and enhance critical thinking. With a more exploratory and experiential approach, students can not only understand Solar System concepts better but also develop critical thinking skills that are essential in overall science learning.

**Conclusion**

Based on the results of the study, it can be concluded that the use of Wordwall as a digital learning media in Solar System materials in elementary schools has a positive impact on students' concept understanding and critical thinking skills. The majority of students showed high interest in this material, but had difficulty in understanding abstract concepts such as revolution and rotation. Limited teaching aids and conventional teaching methods are the main challenges for teachers in delivering the material effectively. The use of Wordwall is proven to be able to increase student interaction in learning. Through gamification-based features, Wordwall makes students more active in exploring the material and more easily understand the concepts taught. Teachers also benefit from this platform in helping to explain the material in a more interesting and interactive way. The analysis showed that students using Wordwall were more able to ask critical questions and connect concepts to everyday phenomena compared to the traditional lecture method. However, the effectiveness of Wordwall is highly dependent on the readiness of teachers and school infrastructure, so training for educators and adequate technology support are needed. Therefore, the implementation of technology-based learning should be done systematically by considering the readiness of available resources. It is hoped that the research can continue by exploring the use of Wordwall in various subjects as well as developing the best strategy to optimize the utilization of technology in learning in primary schools.

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