Jurnal Pijar MIPA
https://jurnalfkip.unram.ac.id/index.php/JPM

ISSN 1907-1744 (Print)
ISSN 2460-1500 (Online)

Development of Prezi-Based Learning Media Assisted by Virtual Reality and Songs on Solar System Science Material

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Received: April 25, 2025. Accepted: May 9, 2025. Published: May 21, 2025

Abstract: Science learning in elementary schools often faces challenges in delivering abstract materials such as the solar system, especially due to the limited availability of interactive and interesting media. To overcome this, this study developed Prezi-based learning media assisted by virtual reality and songs as learning aids that are expected to improve students' understanding and learning experience. This study uses a development research method with the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The research stages include needs analysis, media design, product development, implementation in learning, and evaluation of the effectiveness of the media developed. Prezi media assisted by Virtual Reality and songs were tested through a series of validity and effectiveness tests to assess their quality in supporting learning. The results of expert validation showed that the media developed was categorized as very feasible, with a feasibility percentage reaching 92.85% from media experts and 93.75% from material experts. The validated media was then implemented in class 6 of SDN 6 Wulung with a population of 24 students. The results of the normality test showed a significance value above 0.05, which indicates that the data on all test results that had been carried out were normally distributed. There was an increase in learning scores as evidenced by the paired t-test value, which showed a value of 0.014 in small-scale classes and 0.000 in large-scale classes. In the N-Gain test conducted, the figure was 0.72, which is considered high in small-scale classes, and 0.69, which is considered moderate in large-scale classes. The use of Prezi and virtual reality technology combined with songs has been proven to be able to increase students' grades, interests, and involvement in learning. Thus, this media has the potential to be an innovative alternative in teaching science at the elementary school level. This study recommends further testing with a wider scope to ensure the sustainability and effectiveness of media use in various learning conditions.

Keywords: Learning Media; Prezi; Solar System; Song; Virtual Reality.

Introduction

Learning Natural and Social Sciences (IPAS) at the elementary school level plays an important role in building students' understanding of various natural phenomena, including the solar system. This material includes the concepts of planets, orbits, and interactions between celestial bodies that are often considered abstract by students, thus requiring a strong visual approach. However, teaching methods that still rely on lectures with minimal support for learning media are a challenge for teachers. Elementary school-aged children need concrete stimulation to understand abstract concepts more deeply [1]. In this case, the use of learning media can activate the brain's visual modality and help students process information more effectively [2].

Observation results at SDN 6 Wulung show that most teachers still use the lecture method without utilizing learning support technology. As a result, students tend to be passive and less involved in the learning process. This is in line with the findings of Sanjaya, Misdalina and Suryani [3], who identified the low utilization of learning media as one of the factors causing decreased motivation and involvement of students in learning. This lack of involvement has a direct impact on less than optimal learning outcomes, especially in complex materials such as the solar system. Therefore, interactive learning technology can be a solution to increase student motivation and understanding [4].

From the perspective of Piaget's constructivist theory [5], students learn more effectively when they are involved in activities that allow them to build understanding through direct experience. This theory supports the use of technology such as virtual reality (VR) in science learning because VR creates a more immersive learning experience. This technology allows students to explore abstract concepts, such as the solar system, through realistic three-dimensional simulations. Research by Hwang & Hu [6] shows that the integration of VR in learning can improve students' understanding of complex materials by presenting an in-depth and interactive learning experience. In addition, immersive technology such as VR can provide an interesting learning environment, increase motivation, and strengthen students' memory of the material being studied [7].

In addition to VR, Prezi-based media also has great potential in presenting material visually and in a structured manner. Prezi provides flexibility for teachers to design dynamic, interactive, and hierarchically organized presentations, so that students can more easily understand the relationships between concepts [8].

How to Cite:
M. N. Huda and P. Y. Sutikno, "Development of Prezi-Based Learning Media Assisted by Virtual Reality and Songs on Solar System Science Material", *J. Pijar.MIPA*, vol. 20, no. 3, pp. 474–481, May 2025. https://doi.org/10.29303/jpm.v20i3.8895

In addition to visualization, the use of educational songs also plays an important role in supporting students' memory. Music has the unique ability to facilitate rhythmic repetition of information, thus helping students remember key concepts in a fun and non-boring way. Makarima & Sutikno [9], found that the integration of music in learning has a positive impact on information retention, especially on material that requires memorization. Research conducted by Sari & Sutikno [10] found that the integration of songs into learning media showed a good impact on learning outcomes achieved by students.

Mayer's [11] multimedia cognitive theory states that learning is more effective when information is delivered through various forms, such as text, images, sound, and animation. In this context, the combination of Prezi with VR and songs is expected to optimize students' memory through the effects of repetition and melodic association. This is supported by Clark and Paivio's [12] dual coding theory, which states that information processed through verbal and visual channels simultaneously is easier to understand and remember.

Within the framework of the Independent Curriculum, this approach is very relevant because it emphasises exploration, collaboration, and problem-solving based on real contexts. The Project-Based Learning (PjBL) learning model promoted in the Independent Curriculum encourages students to learn through projects that stimulate their curiosity [13]. In addition, the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 37 of 2018 concerning Amendments to the Core Competencies and Basic Competencies of the 2013 Curriculum for Primary and Secondary Education, 2018 emphasizes the importance of utilizing technology in education to improve the quality of learning. Therefore, the development of Prezi-based learning media, assisted by virtual reality and songs, is in line with this principle because it combines technology, visualisation, and creativity to provide a more in-depth learning experience.

Empirically, various studies have shown that the use of VR in science learning can increase students' motivation, engagement, and conceptual understanding. For example, Dewi's research [14] found that the use of VR in science learning resulted in better conceptual understanding than traditional methods based on text and images. However, this study still uses a computer to run the VR application, making it less practical to implement in elementary school environments that have limited infrastructure. In addition, research by Aini et al. [15] and Hakim et al. [16] shows that simulation-based learning and VR have a significant positive effect on student learning outcomes. However, the obstacle faced in this study was the large number of textures used in the VR application, which made the device's performance heavy, thus affecting the quality of the graphics displayed.

Although various studies have proven the effectiveness of VR in learning, not many have combined elements of text, images, sound, and animation in an integrated manner. Therefore, this study seeks to perfect the development of learning applications that have been carried out previously by integrating Prezi, virtual reality, and songs in one more effective and innovative learning media. It is hoped that this media can improve students' understanding, involvement, and memory of the solar system material in grade 6 of SDN 6 Wulung.

Research Methods

This study uses the Research and Development (R&D) method with the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development model. This model was chosen because it provides a systematic framework for developing innovative and effective learning media [17].

The research stage begins with an analysis of the problems faced by students in science learning. Observations were carried out to find out how students understand the material and the obstacles they face. In addition, interviews with teachers were used to identify the need for more interactive and innovative learning media. The results of this analysis are the basis for designing Prezi-based learning media assisted by virtual reality (VR) and songs.

At the design stage, the structure of the material to be presented in the Prezi media is determined first, followed by the preparation of the VR application and the development of educational song lyrics that are in accordance with the solar system material. Project-Based Learning (PjBL)-based teaching modules are also prepared so that the media developed can be integrated into the learning process systematically.

After the design is determined, the development stage is carried out by building a solar system model using the Blender application, which is then entered into Unity to be developed into a VR application. The use of Google VR for Unity and Android SDK assets ensures that the application can be run on devices based on Android 9 and above. The educational songs that have been designed are developed using the Suno application, producing musical instruments that are interesting for students. To support the presentation of the material, Prezi is used to make interactive presentations.

The implementation of learning media is carried out in class 6 of SDN 6 Wulung by involving students in PjBL-based learning. During the learning process, students in groups explore the solar system virtually, discuss the material, and compile miniature solar system projects. The teacher acts as a facilitator who guides students in understanding the concepts presented in the media.

Evaluation of the effectiveness of the media is carried out through several techniques, including pretests and posttests to measure the increase in student understanding before and after using the learning media. In addition, questionnaires are given to students and teachers to assess their level of involvement and satisfaction with the media developed.

This research was conducted at SDN 6 Wulung, Blora Regency, Central Java, with a population of 6th-grade students. The sample selection used a total sampling technique. The population and sample used in this study consisted of 10 students in the small-scale test and 24 students in the large-scale test. The use of total sampling was chosen because the population is relatively small, allowing the entire population to be sampled without causing selection bias. In addition, grade 6 students are considered to have sufficient basic literacy skills to participate in learning with technology-based media such as Prezi and virtual reality, and are able to provide reflective assessments of their learning experiences.

Data analysis was carried out quantitatively and qualitatively. The results of the pretest and posttest were analyzed using the normality test, homogeneity test, paired t-test, and N-Gain test to see the significance of the increase in student understanding after using VR-based media. Data from the questionnaire were analyzed with a percentage of responses to determine the level of student acceptance of the media developed.

Table 1. N-Gain Value Criteria

N-Gain Value	Criteria
N-Gain ≥ 0.70	High
0.30 ≤ N-Gain < 0.70	Medium
N-Gain < 0.30	Low

[18]

Table 1 above shows the criteria for the N-Gain value, which will be used as a benchmark to determine how effective the media that has been developed and implemented is for students.

Results and Discussion

This study develops Prezi-based learning media assisted by virtual reality and songs on solar system science material using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development model. At the analysis stage, identification of problems that are obstacles to learning at SDN 6 Wulung was carried out. Based on the results of observations and interviews with grade 6 teachers, it was found that one of the main obstacles in science learning is the lack of use of innovative learning media. Teachers still tend to use lecture methods without the support of interactive technology that can help visualize concepts more concretely. In addition, the learning outcomes of students also tend to be less than optimal. The lack of interesting learning media causes low student involvement, which has implications for less than optimal learning outcomes [3]. In addition, the level of student information retention on the material is also relatively low, which indicates the need for a more effective and enjoyable learning approach.

Based on the results of the analysis, the design stage is carried out by designing various components of the learning media to be developed. The initial step in this stage is to compile a teaching module that integrates the Project-Based Learning (PjBL) learning model. This model was chosen because it emphasizes exploration and collaboration that is relevant to real life, in accordance with the principles of project-based learning in the Independent Curriculum [13]. In addition, learning materials are also designed using the Prezi application so that the presentation is more interactive and interesting for students. Prezi was chosen because of its ability to present information visually with a dynamic and intuitive structure [8].

In addition to developing Prezi-based materials, the design stage also includes designing educational song lyrics that aim to improve students' memory of the solar system material. This song is designed by considering pedagogical aspects to suit the cognitive level of students and is able to accommodate the needs of music-based learning. Furthermore, virtual reality (VR) media is also being designed using the Blender application. The solar system model in VR will be made as detailed as possible, including the sun, planets, natural satellites, and asteroid belts, so that students can explore the solar system more realistically and in depth.

At the development stage, various components of the learning media that have been designed begin to be made technically. The teaching modules that have been prepared are further developed to ensure optimal integration with the PjBL model. Learning materials in the Prezi application are made in the form of presentations consisting of interactive slides, so that students can understand the concept of the solar system through an attractive and easy-to-follow visual display.

Figure 1. Making Prezi Learning Media.

The designed song lyrics are then entered into the Suno application to get accompanying musical instruments, so that the song becomes more interesting and easier for students to remember. The use of songs in learning is based on research showing that music can increase information retention through rhythmic and enjoyable repetition mechanisms [19].

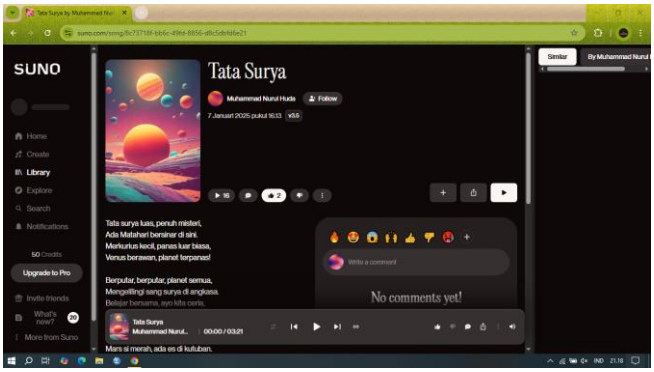

Figure 2. Song Creation On Suno App.

The lyrics of the song used are:

Tata surya luas, penuh misteri,
Ada Matahari bersinar di sini.
Merkurius kecil, panas luar biasa,
Venus berawan, planet terpanas!

Berputar, berputar, planet semua,
Mengelilingi sang surya di angkasa.
Belajar bersama, ayo kita ceria,
Planet-planet kita sungguh luar biasa!

Bumi tempat kita penuh kehidupan,

Mars si merah, ada es di kutuban.
Jupiter besar dengan badai besar,
Saturnus bercincin, indah bersinar.

Berputar, berputar, planet semua,
Mengelilingi sang surya di angkasa.
Belajar bersama, ayo kita ceria,
Planet-planet kita sungguh luar biasa!

Uranus biru, mengguling berputar,
Neptunus terjauh, anginnya menggempar.
Cahaya bintang temani malam gelap,
Tata surya kita, ilmu takkan lenyap!

Berputar, berputar, planet semua,
Mengelilingi sang surya di angkasa.
Belajar bersama, ayo kita ceria,
Planet-planet kita sungguh luar biasa!

To attract the attention of students, songs that have been accompanied by instruments from the Suno application are then downloaded and added with videos. The videos used are planet videos that are adjusted to the lyrics being sung. The video source itself comes from the Canva application's video stock, which is then combined into one.

The creation of the solar system model was done using the Blender application. In this process, each component of the solar system, such as the sun, planets, satellites, and asteroid belts, was designed with appropriate scale and proportions in mind for a more realistic learning experience.

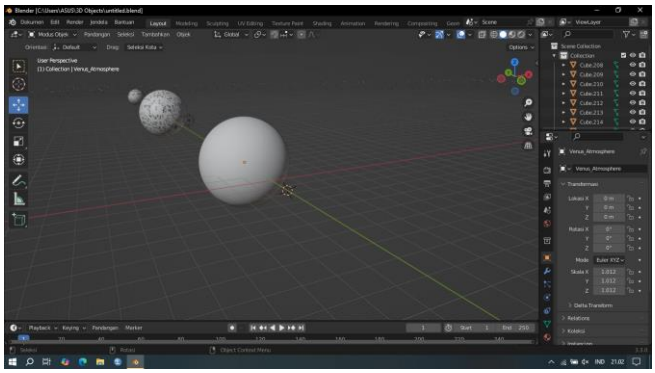

Figure 3. Creating a Solar System Planet Model in Blender Application.

The created model is then inserted into the Unity application to be integrated with interactive elements. In Unity, the solar system model is set so that its size is not too large, and the VR Look Walk script is added to allow users to walk in various directions by lowering their heads by 30 degrees, and when they want to turn in the desired direction, the user simply points their head in the desired direction. To prevent users from falling outside the boundaries of the simulation area, the Box Collider element is added as a boundary. In addition, Google VR for Unity assets and the Android SDK for Android 9 are used so that the application can be installed on Android devices version 9 and above.

Figure 4. Creating Virtual Reality Applications in Unity 2018 Applications.

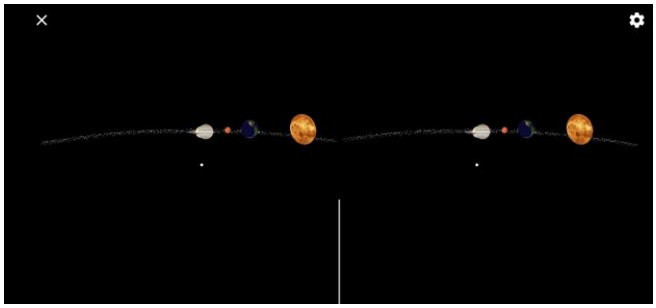

Figure 5. Virtual Reality Application View.

After the teaching module, Prezi material, songs, and virtual reality application of the solar system are completed, the next step is to validate the media and materials to experts. This validation is needed as an initial assessment before all components are implemented to students. In this assessment, the validator will decide whether all aspects can be used directly or require some revisions so that the modules and media developed are better and more appropriate. The results of the validation by media and material experts can be seen in the following table.

Table 2. Expert Validation Table

Validation Type	Percentage	Category
Media Validation	92.85%	Very Worthy
Material Validation	93.75%	Very Worthy

Based on the validation results, it can be seen that the development of Prezi-based learning media assisted by virtual reality and songs has a result above 76%, which means it is very feasible to use.

The learning media that have been developed are then implemented in learning activities in class 6 of SDN 6 Wulung. In this implementation stage, it is divided into 2 classes, namely a small-scale class with 10 students and a large-scale class of 24 students. Each class is carried out 2 times the learning process. In this stage, students are divided into several groups, where each group gets the opportunity to study the material using the media that has been developed. Learning begins with the delivery of material by the teacher through an interactive presentation using the Prezi application. Furthermore, students are asked to listen to and sing a song with a solar system theme that has been developed by the researcher. After that, students are given the opportunity to try the VR application that has been

installed on a smartphone and used together with the VR glasses that have been provided.

During the VR usage session, students take turns in their groups to explore the solar system by walking in various directions, seeing the planets more closely, and observing how the solar system works. Navigation in this application allows students to move right, left, front, and back by lowering their heads by 30 degrees, and change the direction of the camera by turning their bodies or heads in the desired direction.

After the VR exploration, students continued the activity by making a miniature solar system in groups. In this activity, students colored the solar system model that had been prepared by the teacher, so that they not only gained visual experience through technology, but also had the opportunity to construct their understanding through physical activities. As part of the project-based learning process, each group was then asked to present the results of the miniature solar system they had made in front of the class, which aimed to improve their understanding and communication skills.

Evaluation in this study was carried out by analyzing the effectiveness of the learning media developed through various assessment instruments. The main evaluation was carried out by comparing the results of the pretest and posttest of students to see if there was an increase in understanding after using Prezi, VR, and song-based learning media. The results of the pretest and posttest were analyzed using normality tests, homogeneity tests, paired t-tests, and N-Gain tests to see the significance of the increase in students' understanding after using the media. In addition, student response questionnaires were also used to measure the extent to which the developed learning media were able to increase student engagement and learning motivation.

Table 3. Average Value Table

Class	Value	N	Mean
Small Scale Class	Pretest	10	58
	Posttest	10	88
Large Scale Class	Pretest	24	52.9
	Posttest	24	84.79

Table 3 shows the results of the average pretest and posttest scores of small-scale classes and large-scale classes. In the small-scale class, the average pretest score is 58, and the average posttest score is 88. In the large-scale class, the average pretest score is 52.9, and the average posttest score is 84.79. Of course, this shows that there is an increase in scores in both small-scale and large-scale classes.

Table 4. Normality Test Table

Class	Test	Shapiro-Wilk		
		Statistic	df	Sig.
Small Scale Class	Pretest	.930	10	.447
	Posttest	.930	10	.445
Large Scale Class	Pretest	.924	24	.070
	Posttest	.933	24	.114

Table 4 shows the results of the normality test of the pretest and posttest values in the small-scale class and the large-scale class. From the results of the Shapiro-Wilk test using SPSS in Table 4, it is known that the significance values of the pretest and posttest in the small-scale class are 0.447 and 0.445. Meanwhile, the significance values in the pretest and posttest of the large-scale class are 0.070 and 0.114. This shows that the pretest and posttest values in both classes are normally distributed based on the decision-making criteria in the normality test, if the significance value is greater than 0.05, then the data is considered normally distributed [20]. Thus, the pretest and posttest results on both test scales can be further analyzed using parametric statistical tests.

Table 5. Homogeneity Test Table

Class	Type	Levene Statistic	Sig.
Small Scale Class	Based On Mean	2.855	.108
	Based On Median	1.714	.207
Large Scale Class	Based On Mean	2.101	.154
	Based On Median	1.556	.219

Table 5 shows the results of the homogeneity test on the pretest and posttest results in small-scale classes and large-scale classes. From the homogeneity test using SPSS, it is known that the significance value in the small-scale class is 0.108 and the significance value in the large-scale class is 0.154. This shows that the pretest and posttest values in both classes are homogeneous according to statistical theory. If the significance value is greater than 0.05, it can be concluded that the data variance is homogeneous, so the t-test can be performed to see significant differences between the two data groups [20].

Table 6. Paired Samples Correlations Test Table

Class	Test	N	Correlation	Sig.
Small Scale Class	Pretest & Posttest	10	.740	.014
Large Scale Class	Pretest & Posttest	24	.702	.000

Table 6 shows the results of the correlation test of the pretest and posttest values in small-scale classes and large-scale classes. From the table, it is known that the significance value of the pretest and posttest of the small-scale class is 0.014. While in the large-scale class, the significance value of the pretest and posttest is 0.000. This shows that the pretest and posttest values of each class have a relationship because the significance value is less than 0.05.

Table 7. Paired Samples Test Table

Class	Test	t	df	Sig. (2-Tailed)
Small Scale Class	Pretest & Posttest	-13.416	9	.000
Large Scale Class	Pretest & Posttest	-20.407	23	.000

Table 7 shows the results of the t-test of the pretest and posttest values of the small-scale class and the large-scale class. In both classes, the results of the t-test using SPSS showed a significant result (2-tailed) of 0.000. This shows that there is a significant difference between the pretest and posttest values in both classes. This is because if the significance value (2-tailed) is less than 0.05, then there is a significant difference between the two data groups [21].

Table 8. N-Gain Test Table

Class	N	Mean	Category	Effectiveness
Small Scale Class	10	.72	High	Quite Effective
Large Scale Class	24	.69	Medium	Quite Effective

Based on the N-Gain criteria [18], the N-Gain value in the range of $0.70 \leq g \leq 1.00$ is categorized as high, while the value in the range of $0.30 \leq g < 0.70$ is categorized as moderate. Meanwhile, the N-Gain effectiveness value in the range of 56% - 75% is categorized as quite effective. Table 8 shows the results of the N-Gain test using SPSS based on the pretest and posttest values of the small-scale class and the large-scale class. In the small-scale class, the average N-Gain value is 0.72 and is included in the high and quite effective category. Meanwhile, in the large-scale class, the N-Gain value is 0.69 and is included in the moderate and quite effective category.

Table 9. Media Response Questionnaire Results

Type	Class	N	Average Percentage Score
Student Questionnaire	Small Scale Class	10	87.32%
	Large Scale Class	24	91.96%
Teacher Questionnaire	Small Scale Class	1	96.66%
	Large Scale Class	1	91.66%
Average Amount: 91.9%			

Based on Table 9, it is known that the average percentage of the media response questionnaire reached 91.9%, so it can be said to be very good and in accordance with the needs of students and teachers. Students also feel happy and enthusiastic when the learning process takes place and enjoy their space journey.

This study attempts to complement the shortcomings of the research conducted by Adiwisastra [22], Darojat [23], Rahman [24], and Rahman Hakim [16] There are still shortcomings in these studies. Some of the shortcomings in previous studies include: learning materials that are still integrated into virtual reality applications so that they are less flexible for exploration, the use of virtual reality in the form of videos that limit student interaction, and the absence of audio features in the application that can help guide and explain the material briefly to students. In this study, researchers tried to separate the existing material into the Prezi application. This aims to ensure that students do not spend too long using virtual reality, which can cause eye fatigue and dizziness if they are not used to using virtual reality.

In addition, in these studies, there is no media to strengthen their memory of the material and visualizations they see in virtual reality applications, so that students have the potential to forget the material they have seen in learning. Therefore, in this study, researchers present songs that are in accordance with the solar system material to strengthen students' memory of the material.

The novelty of this research, in addition to integrating Prezi media, virtual reality, and songs, lies in the virtual reality application. A brief explanation of the planets is included in audio form and accompanied by music, so that students can focus more on exploring the planets in the solar system, not on reading long texts in the virtual reality application.

The results of the study showed that the use of Prezi-based learning media assisted by virtual reality and songs had a significant impact on students' understanding of the concept of the solar system. This increase in understanding was evidenced by the results of the pretest and posttest, which showed a significant change in value after students used this learning media.

The results of this study are also in line with previous studies, which showed that the use of virtual reality-assisted technology in learning can improve deeper learning experiences and improve understanding of complex concepts, especially in science [7]. In addition, the use of songs as an aid in learning has been shown to increase students' memory and involvement in understanding scientific concepts through fun repetition patterns, which is in line with research conducted by Fatmawati [25].

From the implementation aspect, the research method used refers to the ADDIE development model, which consists of the stages of analysis, design, development, implementation, and evaluation. At the implementation stage, students showed a very positive response to the use of this media, with many of them finding it easier to understand the solar system through interactive visualizations provided by VR technology. In addition, song-based learning activities help students remember information better because the material is presented in an attractive and easy-to-remember format. This learning model also supports exploration-based learning which is in line with Piaget's constructivism theory, where students learn through direct experience and active interaction with the material [5].

Overall, this study shows that Prezi-based learning media with the help of VR and songs has high effectiveness in improving students' understanding of the solar system. With expert validation results showing that this media is very feasible to use, as well as statistical test data that supports its effectiveness, this media can be an innovative alternative in learning science in elementary schools. The implication of this study is that the development of interactive technology-based learning media can be a solution in improving the quality of science learning, especially in understanding abstract concepts such as the solar system.

Conclusion

Based on the results of the research that has been conducted, it can be concluded that the development of Prezi media assisted by virtual reality and songs for solar system material in science learning provides a positive contribution to the values, learning experiences, and understanding of students. The test results show that this media is effective in improving students' skills in understanding and explaining the concept of the solar system and its elements in more depth. In addition, the use of virtual reality-based technology combined with songs has been proven to be able to increase the appeal of learning and strengthen student involvement in the learning process. Thus, this media has the potential to be an innovative alternative in science learning, especially in abstract material such as the solar system. However, further

research is needed to test its effectiveness on a wider scale and consider the sustainability aspect of its use in elementary school environments. Suggestions in this study focus on further development and application of research results in a broader context. First, this study can be expanded by involving larger and more diverse samples to increase the generalization of the findings. In addition, testing the effectiveness of song-based virtual reality media can be carried out over a longer period of time to see a deeper impact on students' understanding of the concept of the solar system. Second, the integration of technology in learning needs to be accompanied by training for teachers so that they can utilize this media optimally in the learning process. Furthermore, further research can explore the cognitive and affective aspects of students in more depth, for example by analyzing learning motivation or student engagement during media use. Finally, collaboration with educational technology developers can be considered to improve the features of virtual reality media so that they are more in line with learning needs in elementary schools.

Author's Contribution

This article is the result of a collaboration between Muhammad Nurul Huda as the first author and Putri Yanuarita Sutikno as the second author. The first author was responsible for media development, research implementation, data analysis, and manuscript preparation. Meanwhile, the second author contributed through media design and a critical review of the research findings.

Acknowledgements

The author extends sincere gratitude to the Primary School Teacher Education Program, Faculty of Education and Psychology, Universitas Negeri Semarang, for the academic support and opportunities provided. Deep appreciation is also expressed to Dr. Putri Yanuarita Sutikno, S.Pd., M.Sn., for her invaluable supervision, insightful guidance, and continuous encouragement throughout the research process. The author is profoundly thankful to their parents for their unwavering support and motivation. Special thanks are further addressed to the principal, teachers, and students of SDN 6 Wulung for their cooperation and permission, which enabled the successful implementation of this study.

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