



Development of Solar System Pop-Up Book Learning Media to Increase Student Learning Motivation in Class VI B of SDN Jatisari

Hendriek Farhan Saputra^{1*}, Bagas Kurnianto²

^{1,2} Universitas Negeri Semarang

E-mail Correspondence: hendriekfs927114@students.unnes.ac.id

ABSTRACT	ARTICLE INFO
<p><i>This research was conducted with the aim of developing a Pop-Up Book learning media about the Solar System for the lesson "Exploring the Universe", determining the suitability of the media, and assessing the increase in student motivation and learning outcomes after the media is applied in the classroom. The method used is Research and Development (R&D) based on the ADDIE model, which includes the stages of Analysis, Design, Development, Implementation, and Evaluation. The research was conducted at SD Negeri Jatisari with a sample of 9 students in a small group trial and 27 students in a large group trial. Data collection is carried out through observation, interviews, documentation, analysis, as well as pretest and posttest. Data analysis used quantitative descriptive techniques, validity and reliability tests, normality tests, paired sample t-tests, and N-Gain tests. The results showed that the Solar System Pop-Up Book media received a media expert validation score of 96% and a subject matter expert validation score of 89%, with an overall average of 92.5%, which is included in the "very acceptable" category. The results of the student questionnaire resulted in a score of 93%, teacher feedback of 97.3%, and student learning motivation of 93%, all of which fall into the "excellent" category. Meanwhile, the results of the N-Gain test showed an average of 0.6884 in small-scale trials and 0.6593 in large-scale trials, included in the medium category. Based on these results, the Solar System Pop-Up Book media is considered suitable and quite effective for use in IPAS learning because it can help increase student motivation and learning outcomes through more interesting, active, and interactive learning activities.</i></p> <p>© UPI Journal and Publication Office 2026</p>	<p>Article History: Sent/Received 10 Apr 2026 First Revision 20 May 2026 Accepted 10 Jun 2026 First Available online 20 Jun 2026 Publication Date 20 Jun 2026</p> <hr/> <p>Keywords: Learning Media; Pop-up Books; the solar system; Learning Motivation.</p>

1. INTRODUCTION

Law Number 20 of 2003 concerning the National Education System Article 1 explains various definitions and terms related to the implementation of education in Indonesia. This article explains that education is one of the planned efforts in realizing an active, effective, creative and fun learning process, so that students can develop individual abilities optimally. In addition, this article also defines terms such as student, national education, and various other components related to the education system, having a purpose by providing a clear understanding of the nature and purpose of education in Indonesia. The national education system in Indonesia has a function to develop the ability and shape the character of students, as well as play a role in improving the dignity of the nation and educating the lives of the Indonesian people as stated in Law Number 20 of 2003 Article 3. The main goal of national education is to explore the ability of students to grow into individuals who believe and fear God Almighty, have noble ethics, are physically and spiritually healthy, are good at knowledge, are proficient, innovative, independent, and become democratic and responsible citizens.

In fact, to achieve the goals of national education in Indonesia, it must go through good and quality educational institutions, one of which is in schools, because schools can improve the quality of human resources and can produce more competitive individuals (Syafii et al., 2023). In practice, the quality of education does not stand alone, but is influenced by various interrelated elements. A good quality education can also only be achieved with the support of qualified teachers, who are competent and professional in carrying out their duties (Panjaitan & Hafizzah, 2025). However, in reality, there are still educators who have difficulty preparing for the learning process, lack of interactivity in teaching that only focuses on teacher-centered, and monotonous use of learning media. Educators not only use textbook media for the learning process, but must also use learning tools that are skillfully created by educators because they can affect optimal learning outcomes (Kurnianto & Sarwono, 2023). The problems experienced by educators can have an impact on the learning process that takes place, for example in Natural and Social Sciences (IPAS) courses. IPAS itself is a subject that directs students to understand various scientific concepts through the study of the relationship between living things and celestial bodies in space, as well as the relationship between humans as individuals and as part of society and the surrounding environment. (Amanda et al., 2024).

Social studies learning requires the ability to think critically from students and is able to generate knowledge through careful observation through phenomena that have occurred (Suhelayanti et al., 2023). One of the science learning that can be obtained in grade VI of elementary school is to have the goal of enabling students to understand celestial bodies and the process of rotation and revolution of the Earth and its impact on daily life. Students are expected to be able to get to know the names of the planets along with their order and characteristics. Our solar system includes eight known planets that are divided into two categories, namely the inner (terrestrial) planets such as Mercury as the first planet, Venus second, Earth third and Mars fourth, and the outer planets namely Jupiter as the fifth planet, Saturn the sixth, Uranus the seventh, and Neptune the eighth (Pradina et al., 2024).

This IPAS material relies heavily on contextual and visual because it is difficult for students to understand an understanding that is not clear or difficult to observe directly, and the explanation of the material only uses books without using digital and concrete media (Delvya et al., 2026). In the learning process, using learning tools to explain abstract material is very important, because it will be easier for students to understand and be actively involved in the

learning process. In addition, the use of learning media is favored by students because it can help improve learning outcomes more optimally (Jauza & Albina, 2025). Interactive and varied learning media can make the learning process more enjoyable for students while increasing students' desire to learn, and students will be more active in the learning process. However, if educators do not make optimal use of learning resources and use inappropriate media, learning can feel boring and less effective (Dandung et al., 2023).

Motivation is very important in the learning process because when students don't have the motivation to learn, they won't learn seriously (Elvira & Nirvana, 2022). Learning motivation is one of the main elements in learning, namely teacher interaction which is then responded to by students, with teacher and student interaction to achieve learning goals. Motivation will always play an important role in optimizing students' learning efforts, which in turn will have an impact on improving their learning outcomes (Diandaru, 2023). One of the things that must be improved to achieve student success is high motivation to learn. The grades obtained by students will be better and maximum if they have high motivation to learn. Higher motivation to learn will result in better grades. Thus, learning motivation is very influential in students' efforts in learning. Increase learning motivation in learning science, especially the material "Wandering in the Universe" by applying the Solar System Pop-Up Book learning media.

Many students find it difficult to maintain their enthusiasm for learning, especially when facing various challenges and difficulties in understanding the material. Several factors make students have difficulties when learning because the learning process tends to be monotonous, such as students are only taught with lecture and question and answer methods. The use of dominant lecture methods will result in students having low motivation to learn (Rachman & Setiyawati, 2023). The selection of the same learning method continuously results in a decrease in students' motivation to learn, without using teaching media or other learning methods. The paradigm shift in learning is caused by a shift in orientation from teacher-centered learning to student-centered learning (Ilahy et al., 2022). The learning process that previously focused more on the teacher's explanation is now starting to actively involve students, and which used to only focus on the material in the book is now more associated with real situations in daily life.

The problems that occur in SD Negeri Jatisari class VIB in learning science materials are the low desire to learn and the low use of learning media. From the results of interviews and observations in class VIB and homeroom teacher class VIB, in learning "Wandering in the Universe" in class VIB experienced obstacles in the learning process, namely the lack of learning media materials, so that students only learned from package books and simple teaching media from the use of plasticine by students and occasionally used visual learning media to watch videos and powerpoints which made learning less interactive. From the questionnaires that have been given to students, the results are obtained that when teaching and learning, science subjects are more interesting and easy to understand if they use interactive learning media and the existence of games or interactive activities such as doing quizzes. These results show the need for innovation in the use of learning media in order to create a more active and interactive learning atmosphere with student involvement in the use of media.

The development of the Solar System Pop-Up Book media is one of the interactive media and has visuals that attract students' interest. There are images in it and a 3D Pop-Up visual display on the image, so this medium provides a direct understanding of the material that students are learning (Ningsih et al., 2023). The use of Solar System Pop-Up Books in science

learning can illustrate abstract concepts such as the Solar System, so that it can interest students and be easier to understand. The three-dimensional images in the Pop-Up Book can make it easier for students to learn the sequences and relationships between objects in the solar system, for example visualization of the rotation of planets orbiting the sun. In the context of science learning, Pop-Up Books are used to introduce and explain material (Mogi et al., 2025). The use of more realistic visual models will make learning easier to understand than just memorizing words and pictures (Aziz et al., 2025). For example, the use of three-dimensional images to depict planets or orbital movements can enrich the learning experience, increase student participation, and make it easier for students to understand the relationships between celestial bodies. Solar System Pop-Up books as a learning medium can increase students' motivation to learn in science lessons on "Wandering in the Universe".

The latest in this research is in the development of Pop-Up Book media, namely the use of Quick Response (QR) technology in the form of cards. The researcher has an update on the use of QR technology that can be scanned through QR cards, this QR will contain 3D digital images of Augmented Reality (AR) technology using the Assemblr Edu platform and interactive quizzes using the Educaplay platform using Augmented Reality (AR) digital combined with Pop-Up Book media in the form of concrete and interactive media, will create a learning process that can attract students' attention. In previous research, the Pop-Up Book was used to make it easier for students to understand the material easily by observing 3D images concretely and can be observed directly, namely to increase students' activeness in the learning process and be able to interact with Pop-Up media in the Pop-Up Book media. However, its development is only limited to concrete forms that can only interact when opening and closing the Pop-Up Book media, there are also some that are interactive such as pulling Pop-Up media. In this study, the Pop-Up Book media not only presents 3D Pop-Up images in concrete form, but also presents 3D images digitally that can interact such as enlarged and small, and rotated 3D Augmented Reality (AR) images, as well as the existence of interactive quizzes that can be done with the aim of becoming a competition in the learning process to get perfect scores, so that the desire to improve student learning makes learning more active and interactive.

The integration of QR cards that connect digital Augmented Reality (AR) through Assemblr Edu and interactive quizzes via Educaplay on Pop-Up Book media is a significant new contribution as it not only retains the characteristics of concrete and manipulative media, but also develops the learning experience into a more interactive digital environment. Previous research has generally utilized Pop-Up Books as a three-dimensional visual medium that helps students understand concepts through concrete forms, embossed images, or simple motion mechanisms. Although effective in increasing learning motivation, the resulting interaction is still limited to the observation of static physical objects. In contrast to the study, AR integration allows students to access three-dimensional virtual objects that can be observed from various angles, manipulated, and explored in greater depth. Thus, students not only see the representation of concepts, but also actively interact with the learning object, so that the learning experience becomes richer than conventional Pop-Up Books.

In addition, the integration of interactive quizzes through Educaplay provides added value that has not been found in many previous Pop-Up Book studies. After learning the material through physical media and AR visualization, students can directly test their understanding through quizzes that provide hands-on feedback. Thus, the developed media not only functions as a means of delivering material, but also as a formative evaluation tool. The combination of concrete visualization, AR exploration, and interactive assessments creates a

more comprehensive learning experience than previous research that focused only on concrete forms or simple physical interactions, making it an innovation relevant to the needs of 21st century learning.

This integration is designed to adapt to the needs of students who find it easier to learn things in real life, while also reinforcing digital technology in the learning process. Based on the previous explanation, this study has the following objectives: (1) to find out the stages of making learning media for the Solar System Pop-Up Book about the material of Wandering in the Universe for students at SD Negeri Jatisari; (2) to find out the feasibility of the Solar System Pop-Up Book media through assessment by media experts and material experts; and (3) to find out whether the use of the Solar System Pop-Up Book media can increase students' learning motivation in learning Natural & Social Sciences at Jatisari State Elementary School.

2. RESEARCH METHODOLOGY

This media development research uses the Research and Development (R&D) method, which produces products in the form of learning media for the Solar System Pop-Up Book to increase learning motivation in science subjects in Class VIB of SD Negeri Jatisari. R&D research is a research approach used to create new products or improve and improve existing products (Rustamana et al., 2024). The model used in this study is the ADDIE development model by going through five stages in the development process, the five stages are Analysis, Design, Development, Implementation, Evaluation. This study applies the ADDIE model because the stages are arranged sequentially and systematically, so that it can help researchers in the process of designing, developing, and evaluating learning media in stages to obtain maximum results. The flow of the ADDIE model in this study can be seen in Figure 1.

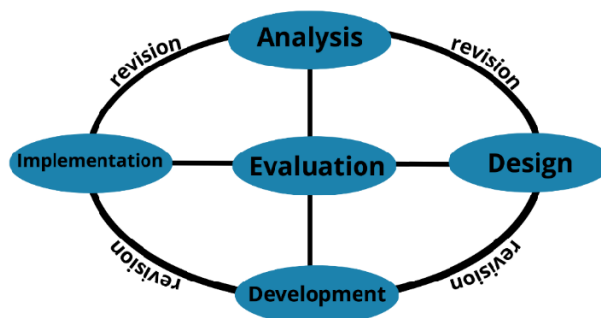


Figure 1. MODEL ADDIE

This research approach uses qualitative and quantitative approaches (mixed methods). The quantitative method was used to measure the level of learning motivation before and after the use of the Solar System Pop-Up Book media, as well as the effectiveness of the developed media, while the qualitative method was used to answer the formulation of the problem of media feasibility developed through students' responses, experiences, and perceptions of the developed media.

The Analysis Stage began with preliminary study activities carried out by researchers to analyze, investigate, and collect various information related to problems at SD Negeri Jatisari, Semarang City. Furthermore, at the Design stage, the researcher began to create the initial framework of the Solar System Pop-Up Book media which was developed based on the results of observations and interviews with teachers and students, accompanied by the preparation of the required research instruments. The next stage is product development, where the

researchers develop the Solar System Pop-Up Book media through the design of the Wandering in the Universe material which is equipped with images, QR cards, and questions with QR codes to be inserted into the media.

At the implementation stage, the product that has been developed is first validated by media experts and subject matter experts to assess the feasibility of the content, appearance, and technical aspects of media use. Input from validators is used as a basis for revisions and improvements to the product until it is declared suitable for use. Furthermore, the media was tested on a small group of students. Before the trial was carried out, students were given a brief briefing on how to use the Pop-Up Book, scan a QR card to access the Augmented Reality (AR) feature, and do interactive quizzes. After that, students use media in learning activities, while researchers observe and collect data related to student responses, learning outcomes, and learning motivation after using the Pop-Up Book media. The data obtained is then used to determine the level of eligibility, effectiveness, and ability of the media in increasing students' motivation to learn. Furthermore, the Evaluation stage (product assessment) where the researcher assesses the level of media effectiveness and identifies weaknesses and shortcomings that still exist to be improved, so that the results of this research are in the form of a final product that has met the eligibility criteria and is valid for use in learning activities. Product development is carried out by aligning with the needs of students, so that its use can make the learning process more effective.

This research process involved several students from VIC and VIB classes including 9 students from VIC classes as a small-scale trial selected by purposive sampling with heterogeneous considerations, namely 3 high-ranked students, 3 middle students, and 3 lower students (Sugiyono & Lestari, 2021), as well as 27 students from class VIB as a large-scale trial used as a trial of media use. The implementation stage is to measure the feasibility of the learning media that has been developed and is able to provide optimal results. Data was collected through various methods such as conducting observations in the classroom, conducting interviews with homeroom teachers, documenting and distributing questionnaires of needs, and conducting assessments through pretests and posttests using a pretest-posttest design in one group. In addition, an assessment questionnaire was used to measure the validity of the materials and media shown to subject matter experts and media experts, as well as responses from teachers and students to determine the level of media eligibility.

This study uses two data analysis approaches, namely feasibility testing and effectiveness testing. The feasibility of the media is assessed by expert validators, namely material validation and media validation, with the results of the assessment analyzed quantitatively through the Likert scale on a scale of 1 to 5. The percentage of scores obtained was then grouped based on a feasibility scale consisting of five categories, namely very feasible, feasible, moderately feasible, less feasible, and unfeasible. Category determination refers to the expert validator assessment guidelines as listed in Table 1.

Table 1. Product Eligibility Criteria

Presentase (%)	Criteria
1%-20%	Not Eligible
21% - 40%	Less Worthy
41%-60%	Quite Decent
61%-80%	Worthy
81%-100%	Very Valuable

The effectiveness test was carried out through a validity and reliability test of the instrument with the calculation criteria of $r >$ the table r and $p < 0.05$, as well as reliability using Cronbach's Alpha with a limit of ≥ 0.60 (Azizah & Chalimatusadiah, 2025). Furthermore, the normality test as a prerequisite test was then carried out using the Shapiro-Wilk method, based on the number of respondents under the age of 50. The hypothesis test in this study uses the Paired Sample T-Test to see the difference in average values between two paired data. The use of testing is carried out after the data is declared to be distributed normally.

In addition, the improvement of student learning outcomes is analyzed through the calculation of N-Gain based on the formula proposed by Hake (1999). The N-Gain value represents the ratio between the increase in the score obtained (posttest minus pretest) and the maximum possible increase (ideal score minus pretest). The results of the calculation are then categorized into three levels, namely low if the g value is less than 0.3, while if the g value is in the range of 0.3 to less than 0.7, and high if the g value is equal to or more than 0.7.

Table 2. N-Gain Score Criteria

N-gain value	Criteria
$G > 0.70$	Height
$0.30 < G < 0.70$	Medium
$G < 0.30$	Low

The N-gain calculation is carried out by measuring the difference between students' pretest and posttest scores to assess the effectiveness of the learning media. The results of the calculation are then classified using the criteria presented in Table 2 so that it can be known how much learning outcomes have increased after the media has been used.

3. RESULT AND DISCUSSION

The development research that has been carried out has produced learning media in the form of a Solar System Pop-Up Book to increase students' learning motivation in Wandering in the Universe material in elementary school VIB classes. The development process is carried out through five stages in the ADDIE model, including the analysis, design, development, implementation, and evaluation stages. which provides a systematic structure that makes it easier for media designers to be able to adapt content to the needs and abilities of students (Hekmawati et al., 2025).

The initial stage is the Analysis stage. From the results of observations carried out in class VIB, it was found that many students felt bored and less motivated when learning took place because learning often ran with teacher-centered teachers only relying on textbooks as a learning medium, so learning became monotonous. This emphasizes the need for a variety of teaching methods to increase student motivation as expressed by (Jaenudin et al., 2023) Learning that is not well planned and only originated will have an impact on decreasing student activities and motivation when participating in the learning process.

In line with this, the research conducted by (Hariani et al., 2022) It shows that in the

learning process of delivering material, package books are used as the main learning media, so there needs to be a variety in the use of learning media to increase students' activeness and motivation to learn. Therefore, the researcher developed the Solar System Pop-Up Book media on the Wandering in the Universe material to increase students' learning motivation, so that it can provide a variety of learning media used in learning.

In addition to observation, the researcher also conducted interviews to obtain information about the approach taken by the teacher when conducting learning. An interview was conducted with the homeroom teacher of SD VIB Negeri Jatisari explained that during learning he still relies heavily on textbooks and occasionally uses learning media in the form of plasticine in science learning. Then the researcher distributed a needs questionnaire that was used to find out the expectations and needs of students in the learning process. The results of the needs questionnaire show that more than 90% of students feel bored when learning does not use learning media only using textbooks. The homeroom teacher also admitted that the use of media during learning in class VIB is very rare because of limited media, so learning becomes less effective and monotonous. According to (David, 2023), The use of learning media can increase students' motivation in learning. Effective media is not only visually and visually appealing, but it can also make it easier for students to understand the material, thereby increasing students' motivation to learn.

The next step is the Design stage, where the researcher begins to design the basic concept of the learning media to be developed. This process begins by determining the order of delivery of material to be published in the media, namely the topic of Wandering in the Universe. After that, the researcher arranges the flow of material delivery sequentially and systematically so that students can more easily digest what is taught. In the development process, this media utilizes a number of digital platforms as the main tool for researchers. Like the use of the Canva platform, this platform is used to do the initial design of the Solar System Pop-Up Book media display by adding visual design and engaging material content that is easy to digest and relevant to the needs of students at the elementary school level. The presence of the Canva platform makes it easier for researchers to manage various visual elements, from image selection, typefaces, color combinations, to compiling materials that are easy and easy to understand. As a result, the media developed has an attractive appearance and is also easy for students to understand. Furthermore, the researchers also used the Assembler Edu platform to create a barcode for Augmented Reality (AR) that would be placed on an AR card so that students could see the sun, planets, and other celestial bodies in 3D digitally, and used Educaplay to create interactive quizzes that make the learning process less boring and students can engage in it. Figure 2 shows the initial design of the Solar System Pop-Up Book media developed.



Figure 2. Early Design of Solar System Pop-Up Books

The initial design of learning media containing the use of Solar System Pop-Up Book media has the goal that students can use the media carefully and can last a long time with correct use. Then it contains about the material of the sun, planets, rotation and revolution of the earth and celestial bodies and there is a QR barcode pasted at the top right that can be scanned to do an interactive quiz, and also students can interact such as pulling or opening a section of the Pop-Up Book to be able to see the explanation of the material provided in it. Finally, there is a QR card storage area where the cards can later be removed and scanned to view the three-dimensional Augmented Reality (AR) developed using the Assemblr Edu platform.

The next step is the Development stage, which is the initial design that has been made in advance and then begins to be shaped into a product that will later be used during the process. The media that has been developed, then the researcher will test the feasibility of the product by collecting data and assessing from expert validators. Assessing the feasibility of the product through three stages, namely the validation assessment of media experts and maters through validation sheets, after the use of media, response questionnaires from teachers and students will be carried out, learning outcome assessments will be carried out through pretest and posttest as well as questionnaires to increase student learning motivation. This instrument will be used to determine the feasibility of learning media and validate the developed product (Sekarsari & Maharani, 2025). The media that has been developed is then validated by media experts and material experts. Media experts evaluate in terms of appearance, ease of use, and eligibility in learning. In addition, the assessment from subject matter experts includes the suitability of the material with the learning objectives, the accuracy and completeness of the content, the clarity of the material explanation, the use of language, and the suitability of the questions submitted. (Hapsari & Zulherman, 2021) states that conducting validation is necessary to assess the feasibility of the developed media and identify its weaknesses.


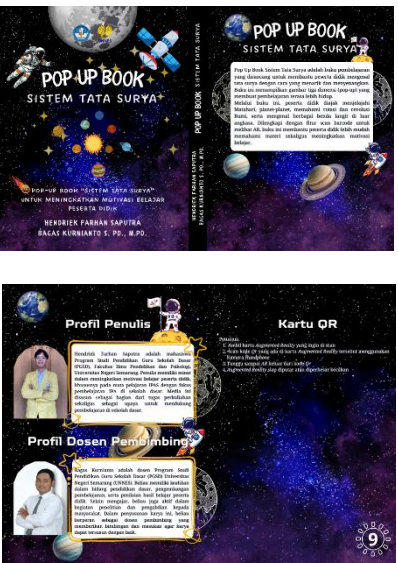
Table 3. Validation Sheet Recapitulation Results

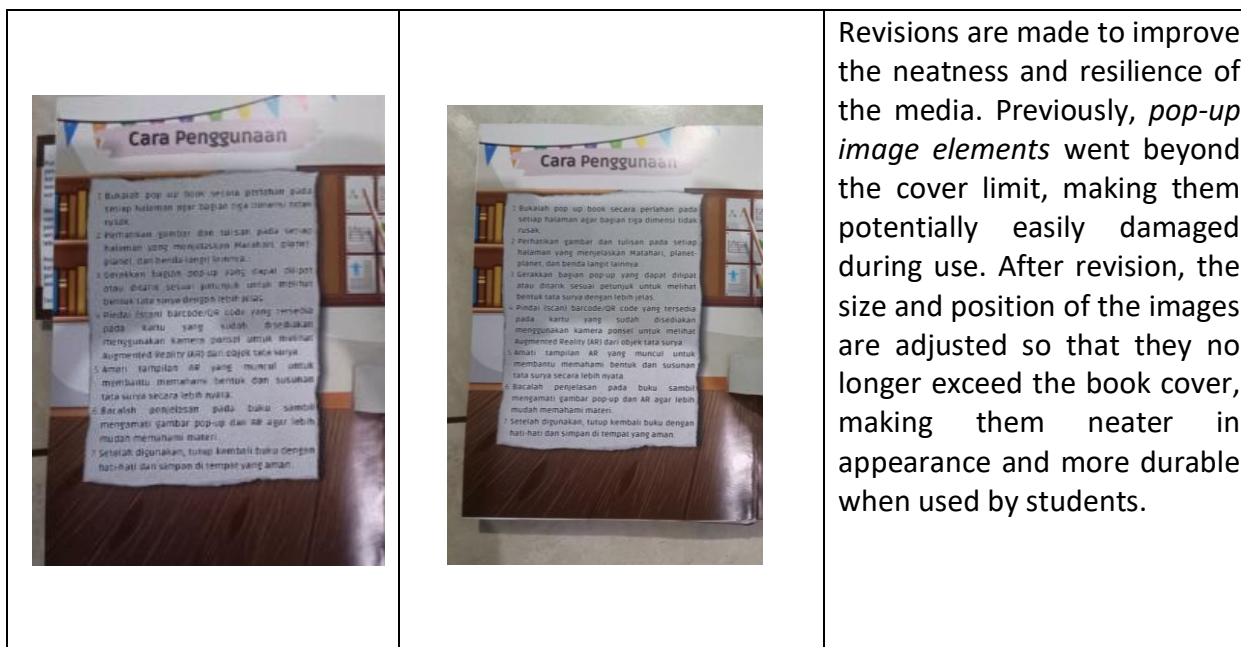
Validation	Shoes	Max Score	Presentase (%)	Category
Media Specialist	96	100	96	Very Valuable
Content Specialist	89	100	89	Very Valuable
Quantity	185	200	92,5	Very Valuable

The validation recapitulation data presented in Table 3 shows that the validation results by media experts resulted in a feasibility rate of 96%, which puts the media in a very feasible category. Material expert validators gave an assessment with a percentage of 89% which is also in the very feasible category. Thus, overall the average media feasibility reached 92.5% and was declared very feasible.

The results of this study confirm that the Solar System Pop-Up Book Media has met the eligibility criteria to be used as a learning medium in science subjects. On the other hand, validation results from media experts showed a percentage of 96%, which shows that the Solar System Pop-Up Book media has a well-structured layout, clear text readability, attractive visual quality, and the use of language that is easy for students to understand. This shows that the product not only meets the feasibility in terms of content, but is also able to attract attention and increase students' motivation to learn through their performance. With an average combined score of 92.5% from both experts who are in the very feasible category, the Solar System Pop-Up Book is stated to be able to be used as a learning medium with slight improvements based on suggestions and input from experts.

Table 4. Solar System Pop-Up Book Media Initial Conditions and Revised Results

Initial conditions	Revised Results	Explanation
 <p>The initial book cover features a dark space background with various planets and a rocket. The title 'POP UP BOOK SISTEM TATA SURYA' is prominent. Below the cover are two profile cards: 'Profil Penulis' for Hendriek Farhan Saputra and 'Profil Dosen Pembimbing' for Bagas Kurnianto. The layout is somewhat cluttered with text and graphics.</p>	 <p>The revised book cover is cleaner and more focused on the title 'POP UP BOOK SISTEM TATA SURYA'. It includes a QR code and a small introductory paragraph. The profile cards for the author and mentor are also revised, with clearer text and better layout integration. The overall design is more professional and visually appealing.</p>	<p>Revisions were made to improve the aesthetics, readability, and neatness of the design. The reduction of the logo makes the cover simpler and focuses on the title, the addition of the back completes the structure of the book, as well as the placement of the author's name in front clarifies the identity of the work. Meanwhile, the transfer of the author's information to the inside is done so that the cover is not too dense and remains visually appealing.</p>



Revisions are made to improve the neatness and resilience of the media. Previously, *pop-up image elements* went beyond the cover limit, making them potentially easily damaged during use. After revision, the size and position of the images are adjusted so that they no longer exceed the book cover, making them neater in appearance and more durable when used by students.

After the learning media of the Solar System Pop-Up Book is declared feasible, it goes through the validation stage with several revisions according to expert advice and input. The researcher moved on to the next stage, namely the Implementation Stage of the Solar System Pop-Up Book media in the VIB class of SD Negeri Jatisari. This Implementation Stage is used by conducting a product effectiveness test in the use of direct learning, with an assessment that focuses on the extent to which students' learning motivation increases after using the Solar System Pop-Up Book media. With the results obtained at this stage, researchers can conduct direct observations on students when using the Solar System Pop-Up Book media, then get a concrete and real picture of the level of effectiveness of the products that have been developed. The data obtained was then analyzed in stages, starting from pretest and posttest test questions obtained through a test of 50 multiple-choice questions. After testing the questions, then testing the validity and reliability of the questions being tested, this is done to find out the valid and reliable questions. From the test questions, 21 valid and reliable questions were obtained, then the researcher used 20 questions for pretest and posttest analysis. This assessment is carried out to find out the difference between students' initial knowledge and final knowledge after the Solar System Pop-Up Book media is applied in the learning process.

After obtaining valid and reliable question items, the researcher continued with the implementation of pretest and posttest trials in small-scale groups and large-scale groups. Trials in small-scale groups were carried out on a limited basis to determine the feasibility of media as well as materials for product improvement. Meanwhile, large-scale group testing was carried out with a larger number of participants to obtain validation results and more representative data and could show the level of reliability of the developed media.

Table 5. Results of small-scale normality tests

	Normality Test					
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Let's say.	Statistic	df	Let's say.
<i>Prates</i>	.255	9	.096	.940	9	.586

Post-tests	.248	9	.116	.913	9	.338
-------------------	------	---	------	------	---	------

The results of the analysis in Table 5 show that the normality test using the Shapiro-Wilk method obtained a significance value of 0.586 in the pretest data and 0.338 in the posttest data with a sample of 9 students. The significance value of the two data is above 0.05 so that the research data is declared to be distributed normally. Once the normality assumptions are met, the next stage is hypothesis testing using a parametric paired sample t-test.

Table 6. Small-scale T-test results

		Paired Sample Test				
		Pairing Differences				
		Means	Deviation hours	t	df	Sig. (2-tailed)
Pasangan	<i>Pre-test pre-tests</i>	-28.889	7.817	-11.086	8	<,001

Referring to the t-test results of the paired samples presented in Table 6, a significance value (Sig. 2-tailed) of less than 0.001 or less than 0.05 was obtained. These findings suggest that there is a significant difference between pretest and posttest scores. Thus, the learning media developed can improve student learning outcomes in small-scale trials. Furthermore, an N-Gain analysis was carried out to determine the level of improvement in student learning outcomes.

Table 7. Small-Scale N-Gain Test Results

Descriptive Statistics						
	N	Minimum	Maximum	Means	Deviation hours	
N_Gain	9	.56	.88	.6884	.10748	
Valid N (in the direction of the list)	9					

Based on the results of the N-Gain test in Table 7, an average value of 0.6884 was obtained which was included in the medium category because it was in the range of $0.3 \leq g < 0.7$. These results show that the learning media developed is able to improve student learning outcomes quite well. After the small-scale trial is carried out, the next stage is the implementation of large-scale trials to find out the effectiveness of the media more broadly.

Table 8. Large-scale normality test results

Normality Test						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	df	Let's say.	Statistics	df	Let's say.
<i>Prates</i>	.184	27	.019	.926	27	.054
<i>Post-tests</i>	.161	27	.071	.941	27	.126

Referring to Table 8, the Shapiro-Wilk normality test yielded a significance value for the pretest of 0.054 and a posttest of 0.126. Since these two values are above 0.05, it can be

concluded that the pretest and posttest data in large-scale trials are distributed normally, so they are eligible to proceed to the paired sample t-test.

Normality testing in large-scale trials showed results that were not much different from small-scale trials. In the previous stage, the significance value of the pretest was 0.586 and the posttest 0.338 was also above 0.05 so that the data was declared normal. Based on these results, the research data is eligible for further analysis using the paired sample t-test to determine the difference in pretest and posttest results after students learn using the developed learning media.

Table 9. Large-Scale T-Test Results

		Paired Sample Test				
		Pairing Differences		t	df	Sig. (2-tailed)
		Means	Deviation hours			
Pasangan	Pre-test pre-tests	- 30.926	11.688	-13.749	26	<.001

Table 9 shows that the significance value (2-tailed) of the paired sample t-test is <0.001 (< 0.05), so the difference between the pretest and posttest in large-scale tests is declared significant. The comparison of these scores shows a higher posttest, which means there is an increase in learning outcomes after media use.

The results of the large-scale test showed similarities with the results obtained at the small-scale trial stage. In the previous test, the significance value was also below 0.05, to be precise < 0.001, with an average difference of -28.889. The findings show that students' grades after learning are better than before using learning media. The difference in mean on a larger scale that is higher compared to a smaller scale shows that the developed medium is still able to give good results even when applied to a larger number of students. From these results, it can be seen that the Solar System Pop-Up Book media helps students more easily understand the learning material so that the value of learning outcomes increases in both stages of the trial. After the test, the analysis is continued using the N-Gain test to see the level of improvement in student learning outcomes in more detail.

Table 10. Large-scale N-Gain test results

Descriptive Statistics						
	N	Minimum	Maximum	Means	Deviation	
N_Gain	27	.00	1.00	.6593	.21730	hours
Valid N (in the direction of the list)	27					

The average N-Gain obtained based on Table 10 was 0.6593 and was classified as moderate ($0.3 \leq g < 0.7$). This achievement shows that *the Solar System Pop-Up Book* is able to help improve student learning outcomes in large-scale testing. The difference between the lowest (0.00) and highest (1.00) N-Gain scores confirms the variation in each individual's learning improvement. Despite the sharp differences, the average N-Gain still shows that the media developed has a good influence on the overall learning progress of students.

The data of small-scale and large-scale trials both prove that the Solar System Pop-Up Book media has a good influence on student learning outcomes in the material "Wandering in the Universe". In normality testing, the Shapiro-Wilk significance value for pretest and posttest scores on both scales was > 0.05, which means that the data followed a normal

distribution. On that basis, the conditions for using a paired sample t-test parametric test are met. The consistency of normality results at the two trial stages with different sample sizes also showed that the data distribution was relatively stable.

The results of the t-test of paired samples on a small scale showed a significance of < 0.001 with a mean difference of -28.889 . The same pattern is seen on a large scale, where the significance is also < 0.001 and the average difference reaches -30.926 . These findings confirm that post-test achievement is higher than pretest, which means that there has been an improvement in learning outcomes after participating in the media-assisted learning developed. The higher average difference between large and small scales means that Pop-Up Books are still effectively used despite the larger number of participants. This medium makes it easy for students to digest the material of the solar system, rotation, and revolution thanks to the three-dimensional visual presentation, engaging illustrations, and active involvement of students during the learning process.

The results of the N-Gain test also confirm the results of previous tests. On a small scale, an average N-Gain of 0.6884 is obtained, while on a large scale it is 0.6593 and both are in the medium category. The results of this study show that learning media is able to improve student learning outcomes quite well. In addition to improving material understanding, the use of Pop-Up Book media also makes students more active, enthusiastic, and interested when participating in learning. Thus, the Solar System Pop-Up Book media can be said to be feasible and effective enough to be used in learning the IPAS material "Wandering in the Universe".

Table 11. Student Response Questionnaire Results

No.	Indicator	Presentase
1.	The display of three-dimensional images, colors, and shapes on the <i>Solar System Pop-Up Book</i> media attracts students' attention during learning.	92,5%
2.	<i>The Pop-Up Book Media</i> helps students understand material about planets, rotations, and revolutions more easily.	94%
3.	The use of <i>Pop-Up Book</i> media makes students more active, enthusiastic, and confident in learning IPAS.	92%
4.	Students' enthusiasm and interest in participating in learning using the <i>Solar System Pop-Up Book media</i> .	93,5%
Quantity		93%

Based on the results of the student response questionnaire in Table 11, the Solar System Pop-Up Book media obtained an average percentage of 93% with a very good category. These results show that the media developed received a positive response from students during the learning process. In the media display indicator, a percentage of 92.5% was obtained, which shows that images, colors, and three-dimensional shapes in media are able to attract students' attention while learning. In addition, the material comprehension indicator obtained a percentage of 94%, which shows that the Pop-Up Book media helps students understand planetary matter, rotation, and revolution more easily.

The learning activity indicator showed a percentage of 92%, which shows that learning media is able to build student participation so that they are more enthusiastic, responsive, and confident when participating in science learning. Meanwhile, the student enthusiasm and interest indicator obtained a percentage of 93.5%, which shows that students feel interested

and happy learning using the Solar System Pop-Up Book media. Based on the overall results, the media developed is considered very good and suitable for use in learning IPAS Traveling in the Universe material.

Table 12. Results of the VIB Teacher Response Questionnaire

No.	Indicator	Presentase
1.	The media display is attractive and suitable for learning IPAS	98%
2.	The material is easy for students to understand	97%
3.	Media helps teachers explain the material more clearly	97%
4.	Media increases students' interest and learning activities	97,3%
Quantity		97,3%

Based on the results of the VIB homeroom response questionnaire in Table 12, the Solar System Pop-Up Book media obtained an overall percentage of 97.3% with the very good category. The results of this study show that the developed media is suitable for use in science learning. The display media obtained a percentage of 98% because it was considered interesting and able to support the learning process in the classroom. In addition, the material presented in the media is also easy to understand by students with a percentage of 97%. Teachers also consider that media helps explain material about the solar system, rotation, and revolution more clearly so that students can more easily understand learning. In addition, the use of Pop-Up Book media makes students more interested and active when participating in learning with a percentage of 97.3%. From these results, it can be seen that the Pop-Up Book media developed is suitable for use and is able to help the social studies learning process become more interesting and easy to understand by students.

Table 13. Results of the Student Learning Motivation Questionnaire

Nope.	Indicator	Presentase
1.	Students' diligence and responsibility in learning social studies	95%
2.	Students' interest and enthusiasm to learn social studies	91%
3.	Attention, activeness, and confidence of students in social studies learning	97%
4.	Independence and how students learn in understanding IPAS material	89%
Quantity		93%

Based on the results of the student learning motivation questionnaire in Table 13, an overall percentage of 93% was obtained with the very good category. The results of this study show that the use of the Solar System Pop-Up Book media has a positive impact on students' learning motivation in the material "Wandering in the Universe". During the learning process, students appear to be more enthusiastic, more actively participate in learning activities, and more interested in paying attention to the material being explained. The attractive display of media and the existence of three-dimensional shapes make it not easy for students to feel bored while studying social studies. In addition, students also look more confident when

asking questions, discussing, and when expressing opinions in class. This shows that Pop-Up Book media can help create a more enjoyable learning atmosphere and make students more motivated in learning.

The results of the study show that the Solar System Pop-Up Book media developed has the feasibility of being applied to the learning of science material "Wandering in the Universe" and can help improve student motivation and learning outcomes. This is evidenced by the validation of media experts of 96% and material experts of 89% with an overall average of 92.5% which is included in the very feasible category. In addition, the student response questionnaire obtained a percentage of 93%, the response of the homeroom teacher 97.3%, and the student's learning motivation of 93% with the category of excellent. The media trial also showed an increase in student learning outcomes after using learning media. In the N-Gain test, an average value of 0.6884 was obtained on a small scale and 0.6593 on a large scale with the medium category, so that the medium was considered quite effective to be used in learning. The use of three-dimensional visual displays, attractive images, QR cards containing celestial objects, and interactive quizzes make students more active, enthusiastic, and easy to understand the material.

These findings are in line with research (Pradiani et al., 2023) WHO obtained the validation results of material experts of 90.66%, teachers of material experts of 100%, and media experts of 90.66% with the category of very valid. Student responses to small group tests obtained a percentage of 94.4% and field tests 97.1% with the very practical category, while student learning outcomes reached 93.10% with the very effective category. In addition, the research (Rachman et al., 2022) Showing validation results from experts also strengthens the feasibility of this media: subject matter experts give 94.6% ratings, media experts 96%, and linguists 91%. Meanwhile, the student response reached 83%. These figures confirm that Bookable Pop-Up to present more interesting learning and make it easier for students to understand the material. Based on the findings of the research which is strengthened by previous research, it can be concluded that the Pop-Up Book Solar System Pop-Up Books is very suitable for studying the science material "Wandering in the Universe". This media has been proven to create a more interactive learning atmosphere, generate motivation, and encourage improved student learning outcomes.

4. Conclusion

The Solar System Pop-Up Book Media on the material "Wandering in the Universe" developed has met the eligibility criteria for use in science learning in elementary schools. The feasibility of the media can be seen from the validation results of material experts of 89% and media experts of 96% with an overall average of 92.5% so that it is included in the very feasible category. In addition, the results of the student response questionnaire obtained a percentage of 93% and the response of the homeroom teacher was 97.3% with the category of excellent.

The application of media in learning activities also shows changes in the learning outcomes of students in grade VIB of Jatisari State Elementary School. The results of the paired sample t-test on a small and large scale showed a significance value below 0.05, which means that there is a difference between the before and after learning to use the media. In addition, the results of the N-Gain analysis showed an average of 0.6884 in small-scale trials and 0.6593 in the large-scale medium category. Data shows that the media developed is quite helpful for students in understanding learning materials while increasing learning motivation. This is also supported by the results of the learning motivation questionnaire which showed a percentage of 93% with the very good category. The use of three-dimensional displays, QR cards featuring

Augmented Reality (AR)-based celestial bodies, and interactive quizzes make students more interested and more active during the learning process.

However, this research still has some limitations. The implementation of research was only carried out in one school and focused on one IPAS material so that the results of the research could not describe the conditions broadly. In addition, the interactive features in the developed media are still simple and limited to the material "Wandering in the Universe". Therefore, further research is expected to develop similar media on other materials with more varied features and involving a larger number of students so that the results obtained are maximized

REFERENCES

- Amanda, S., Nabila Zulkim, S., Adrias, A., Azmi Alwi, N., Hamka, J., Tawar Bar, A., Padang Utara, K., & Padang, K. (2024). *Development of Wordwall-Based Social Science Learning Media to Improve Student Learning Outcomes*. 2(4), 304–313. <https://doi.org/10.61132/morfologi.v2i3.842>
- Aziz, M.M., Faroka, H., Ananda, R.S., Apriliani, M., & Asih, N.S. (2025). Pop-up Book Design Innovation in Visual Education: A Review of the Structured Literature. *Authorship: Journal of Nusantara Research*, 1(6), 829–832. <https://doi.org/https://doi.org/10.59435/menulis.v1i6.419>
- Azizah, N., & Chalimatusadiah. (2025). Validity Test and Reliability Test of Research Instruments to Understand the Concept of Algebraic Dasaar. *Journal of Tambusai Education*, 9(1), 6637–6643. <https://doi.org/https://doi.org/10.31004/jptam.v9i1.25533>
- Dandung, V. B., Prasasti, P. A. T., & Listiani, I. (2023). Digital pop up book media for elementary school food chain material class V. *Al-Madrasah: Journal of Madrasah Ibtidaiyah Education*, 7(4), 1544. <https://doi.org/10.35931/am.v7i4.2613>
- David, R.M. (2023). *THE USE OF INTERACTIVE POWER POINT MEDIA IN LEARNING IN SCHOOLS IS A NECESSITY IN THE DIGITAL ERA* (Vol. 5). <https://doi.org/https://doi.org/10.22373/fitrah.v5i1.2768>
- Delvya, Y., Pandia, B.R.S., & Al-jumroh, S.F. (2026). *The Influence of POP-UP Book Media on Learning Motivation in SD Muhammadiyah Aimas*. 8(1), 176–182.
- Elvira, N. Z., & Nirwana, H. (2022). Literature Study: Students' Learning Motivation in Learning. *Journal of Educational Literacy*, 1(2). <https://doi.org/10.56480/eductum.v1i2.767>
- Fauziyah Rachman, E., & Setiyawati, E. (2023). *The effect of the Make a match type cooperative learning model on students' learning motivation on solar system materials in elementary school*. IV, 489–496. <http://jurnaledukasia.org>
- Hapsari, G. P. P., & Zulherman. (2021). Development of animated video media based on the Canva application to increase students' motivation and learning achievement. *Journal of Basicedu*, 5(4), 2384–2394. <https://doi.org/https://doi.org/10.31004/basicedu.v5i4.1237>
- Hariani, N. D., Wibowo, S., Nurhayati, E., Stkip, P., & Sidoarjo, P. (2022). THE DEVELOPMENT OF THE SOLAR SYSTEM MINIATURE MEDIA (MISITAYA) USES DIRECT INSTRUCTION FOR GRADE VI ELEMENTARY SCHOOL STUDENTS. *Scientific Journal of Basic Education*, (<https://journal.unpas.ac.id/index.php/pendas/issue/view/406>). <https://doi.org/https://doi.org/10.23969/jp.v7i2.6224>
- Haris Diandaru, B. (2023). *STUDENTS' LEARNING MOTIVATION IN MATHEMATICS LEARNING AT MTs NEGERI 2 SEMARANG CITY*. <https://doi.org/https://jurnal.bbpmptateng.id/index.php/jpw/article/view/17>
- Hekmawati, S., Subkhan, M., Atikah, T. S., & Susilawati. (2025). Indragiri Journal. *Indragiri Multidisciplinary Research Journal*, 5(1), 4. <https://ejournal.indrainstitute.id/index.php/jipm/article/view/558/241>
- Jaenudin, Hidayat, S., & Atikah, C. (2023). THE USE OF TEACHING MATERIALS FOR HOME LEARNING APPLICATIONS TO IMPROVE STUDENTS' LEARNING MOTIVATION AND

- LEARNING OUTCOMES IN SOLAR SYSTEM SCIENCE CLASS VI SD NEGERI SORONGAN 1 KEC. CIBALIUNG (Use of Teaching Materials for Learning at Home. At *Sultan Ageng Tirtayasa University* (Vol. 10, Number 2). <https://doi.org/http://dx.doi.org/10.62870/jtppm.v9i2.17895>
- Jauza, N. A., & Albina, M. (2025). The use of creative and innovative learning media in improving the quality of learning. *Journal of IHSAN Journal of Islamic Education*, 3(2), 15–23. <https://doi.org/10.61104/ihsan.v3i2.886>
- Kurnianto, B., & Sarwono, R. (2023). The development of TPACK-based learning tools in improving students' learning activities and problem-solving skills. *Scholaria: Journal of Education and Culture*, 133(3), 210–221. <https://doi.org/https://doi.org/10.24246/j.js.2023.v13.i3.p210-221>
- Mogi, T., Kua, M.Y., Rewo, J.M., & Lawe, Y.W. (2025). Development of Pop Up Book Learning Media in Science Subjects with Solar System Materials for Grade V Students of SDI Mengeruda. *JagoMIPA: Journal of Mathematics and Science Education*, 5(1), 210–222. <https://doi.org/10.53299/jagomipa.v5i1.1118>
- Ningsih, Y. F., Hariadi, N., Sugeng, I., Kandupi, A. D., Utomo, A. W., & Bimantoro, A. P. (2023). Development of digital pop up book learning media in PJOK learning. *Porkes Journal*, 6(1), 15–24. <https://doi.org/10.29408/porkes.v6i1.12214>
- Nurrisa, F., & Hermina, D. (2025). *Qualitative Approach in Research: Strategies, Stages, and Data Analysis*. pp. 2, 793–800.
- Pradina, N. R., Reka Pradina, N., Insan, ;, Azyfah, E., Yuliningsih, ;, & Kurniawati, W. (2024). Analysis of Natural Science Learning on Solar System Materials in Elementary School. *Journal of Mathematics and Natural Sciences*, 2(1), 270–283. <https://doi.org/10.59581/konstanta.v2i1.2409>
- Qosid Ilahy, W., Trisetiyoko, D., & Wahid, F.S. (2022). The Effect of the Use of Solar System Props on Student Motivation and Learning Outcomes. *Scientific Journal of Educational Vehicles*, 8(16), 644–653. <https://doi.org/10.5281/zenodo.7106237>
- Rachman, A., Sari, D., Puspita, T., & Rini, W. (2022). DEVELOPMENT OF WETLAND ECOSYSTEM POP UP BOOKS FOR ELEMENTARY SCHOOL STUDENTS. *ELSE (Journal of Elementary School Education) Journal of Elementary School Education and Learning*, 6. <https://doi.org/https://doi.org/10.30651/else.v6i1.12175>
- Rustamana, A., Sahl, K. H., Ardianti, D., Syaumi, A. H., & Solihin. (2024). Research & Development in Education. *Bima Journal: Publication Center for Language and Literature Education*, 2(3), 60–69. <https://doi.org/10.61132/bima.v2i3.1014>
- Sekarsari, A., & Maharani, S.D. (2025). Development of Digital Pop-Up Book Media in Pancasila, Education and Learning Materials for Indonesian Social and Cultural Diversity Class III SDN 12 Sembawa. *Journal of Papeda: Journal of Basic Education Publications*, 7(2), 244–252. <https://doi.org/10.36232/jurnalpendidikandasar.v7i2.2057>
- Sugiyono, P.D., & Lestari, DP (2021). Communication Research Books. In Sunarto (Ed.), *Journal of Development Economic Dynamics* (1st edition, Vol. 1, Number 3). Alfabet.
- Suhelayanti, Z, S., Rahmawati, I., Tantu, Y. R. P., Kunusa, W. R., Suleman, N., Nasbey, H., Tangio, J. S., & Anzelina, D. (2023). *Books-References-Learning-Science-Natural-and-Social-IPAS (1)*

(R. Watrianthos & J. Simarmata, Eds.). The publisher of Yayasan Kita wrote.

Yunanda Pradiani, N.P.W., Turmuzi, M., & Fauzi, A. (2023). Development of Pop-Up Book Learning Media to Build Space in Elementary School Mathematics Learning Content Class V. *Scientific Journal of the Education Profession*, 8(3), 1456–1469. <https://doi.org/10.29303/jipp.v8i3.1503>