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Development of Pop Up Book Learning Media on the Material of the Form of Matter and its Changes Based on Problem Based Learning to Improve the Learning Outcomes of Science for Grade IV Elementary School

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Abstract: The lack of maximum use of learning media is due to the limited ability of teachers to create creative and innovative media, as well as the delivery of material only by lecturing, especially in class IV IPAS subject matter on the form of substances and their changes makes students quickly feel bored, so that student learning outcomes are low. This study aims to develop products, test the feasibility, and effectiveness of pop up book media based on problem-based learning (PBL) learning models. This type of research, Reserch and Development (R&D) Borg and Gall model with the subject of 22 fourth grade students of SDN Ngaliyan 01. Data collection techniques through observation, interviews, questionnaires and tests. The results of media validation received 91.66% by material experts and 92.61% by media experts with a very feasible category. The N-Gain test result was 0.71 in the high category. Referring to these results, there was an increase in the average student learning outcomes from the pre-test score of 56.18 to 86.72 in the post-test after using Pop Up media based on problem-based learning (PBL), so Pop Up Book is said to be feasible and effective in improving student learning outcomes.

Keywords: Pop Up Book; Problem-based learning model; Science learning outcomes.

Introduction

Education plays an important role in life. Every citizen must receive education because education is a right and obligation of citizens (Rahayu & Wulandari, 2024). Education is the most basic need and must take place in order to become a better human being (Akareem & Hossain, 2016). In education, the learning process is the most important part (Pamorti et al., 2024). Learning is an interaction that occurs between students and teachers with the presence of learning resources (Ong & Quek, 2023; Sun et al., 2023). The role of teachers in the learning process is certainly very important because it is related to the students' thinking process which goes hand in hand with the progress of the times (Lara Nieto-Márquez et al., 2020). Teachers are the key holders of the learning process because a pleasant learning atmosphere that suits students' needs can occur due to the teacher's intervention (Monteiro et al., 2021; Nadeem et al., 2023). In elementary school learning, teachers need to make the learning process active (Parker et al., 2022). Teachers must also make learning activities more quality in order to achieve the set goals (Bobi et al., 2023).

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Education is regulated in a national education curriculum where the current curriculum is the independent curriculum. Integration of Natural Sciences (IPA) and Social Sciences (IPS) into Natural and Social Sciences (IPAS) is an important component of the independent curriculum in an effort to improve the basic education system in Indonesia (Darnawati & Yulianto, 2024). IPAS is a combination of science and social studies subjects that helps students understand the natural and social environment simultaneously (Betz et al., 2023). Teachers must innovate in developing the implementation of the independent curriculum to realize learning outcomes or learning objectives with enjoyable learning, especially in science subjects in Elementary Schools.

However, in reality, in the field, when teaching science in elementary schools, teachers still use the lecture method without the help of media, so that students have difficulty in understanding the material presented. In line with the opinion Anggraini & Kristin (2022) which states that using the lecture method in learning makes students tired because they only listen to what the teacher says, learning becomes monotonous and causes student boredom.

Based on the results of observations at SD Negeri Ngaliyan 01, it was found that the use of learning media in the classroom was not satisfactory, especially in class IV. This was due to the low ability of teachers to use and create learning media because the age of the teachers was already quite advanced. So that in its implementation, teachers only used the lecture method. Second, the learning outcomes of class IV B students in the subject of Social Sciences had the highest and lowest disparities in value, which was caused by students' unequal understanding. Many students had difficulty with the material on the form of matter and its changes. This was proven by the results of the Social Sciences assessment when working on the STS (mid-semester summative), only 13 students had scores above the KKTP (Criteria for Achieving Learning Objectives), 15 students were still below the KKTP (Criteria for Achieving Learning Objectives). The low learning outcomes of students were influenced by the learning media and learning resources used by teachers in the learning process which were still limited so that students felt bored and tired while learning was taking place.

Learning materials will be easy to understand if assisted by media. Learning media is defined as a tool that can be used by teachers and students to carry out learning activities (Hidayah & Prasetyo, 2022; Kustandi & Darmawan, 2020). By providing learning media, students can be motivated to learn and can easily receive the material (Munandar & Ahmad, 2022). The development and progress of technology in the current digital era requires educators to adapt and innovate to create more interactive learning (Asrizal et al., 2023). Technological advances can be utilized in the development of learning media. As educators, teachers must also follow the development of the times by providing technology-based media (Cheng & Tsai, 2019). Providing appropriate learning resources and media is a teacher's effort to support successful learning (Cynthia et al., 2023). The learning process using learning media can also align students' perceptions of the material presented and improve cognitive abilities, skills from low to high levels (Fuad et al., 2020).

The use of the IPA learning model also needs to be considered so that children are actively involved and do not feel bored, one of the models that can be used is Problem Based Learning. This model helps students in problem-solving skills, increasing knowledge and understanding, and activeness in gaining knowledge (Saputri, 2020). Therefore, because the learning of science in elementary schools studies the universe and society, then in learning emphasizes learning activities that provide direct experience to students to develop the potential possessed by students, one of which can be achieved by using the Problem Based Learning learning model.

Based on these problems, the researcher wants to provide a solution by developing a Pop Up Book learning media for the material on the form of matter and its changes based on Problem Based Learning. *Pop Up Book*is a book that shows a display for moving and interacting using paper as a material for folding, rolling, forming, wheels, or rotating (Nengsi, 2021). Ningtiyas et al., (2019) stated that Pop Up Book is a card or book that when opened can present a 3-dimensional or raised construction. In addition to being more interesting, this media is also appropriate for elementary school children whose age is at the concrete operational stage..The Problem Based Learning (PBL) learning model was chosen because it has many solutions to solving a problem and improves students' critical thinking skills because the indicators of critical thinking skills are in accordance with the syntax or steps of Problem Based Learning (Kusumawati et al., 2022).

There are several studies that discuss Pop Up Books as learning media in Elementary Schools. Research conducted by Firman & Julianto, (2021) with the title "Development of Pop Up Book Media in Science Subjects, Animal Life Cycle Material, Grade IV Elementary School" in his research proved that there was an increase in learning outcomes, it was possible to find a significant increase in the n-gain analysis with an average gain of 0.73. Furthermore, research conducted by Hikmah et al. (2022) "Development of Pop Up Book Media on Water Cycle Material in Class V of SD Negeri

04 Puding Besar". From this study, it was found that the average value of expert assessment was 92%, and the assessment of practicality of use by students with an average of 97.18%. The effectiveness assessment was obtained from the results of multiple choice questions on water cycle material in class V of elementary school with a mean of 82.04% with the category "Very Effective". From the results of this study, it can be concluded that Pop Up Book is interesting to use as a learning media, on each page it not only makes the learning process more enjoyable but also increases student involvement so that it can improve student learning outcomes (Resmaniti & Karlimah, 2019).

The novelty of this research from existing research is that in this research the Pop Up Book media is focused on the material of the form of matter and its changes based on Problem Based Learning which is used as a learning model so that students will be more active in expressing their opinions and can think critically. Therefore, this research was conducted with the aim of helping teachers to deliver learning materials in an interesting and innovative way with the help of Pop Up Book learning media and learning models that are not boring so that students become enthusiastic about learning so that student learning outcomes will increase.

Method

This research is a Research and Development (R&D) development research. Sugiyono (2019) states that the research and development approach or Research and Development (R&D) is research used to produce certain products, and test the effectiveness of these products. The Borg and Gall model is the model used in this study, according to Sugiyono, (2019) steps with the Borg and Gall model include: 1) potential and problems; 2) data/information collection; 3) product design; 4) design validation; 5) design improvement; 6) product trial; 7) product revision; 8) usage trial; 9) product revision; 10) mass production of the product. Researchers use the Sugiyono development model only up to 8 development steps due to time and cost constraints to carry out mass production. The stages in the Borg and Gall model can be seen in the Figure 1.

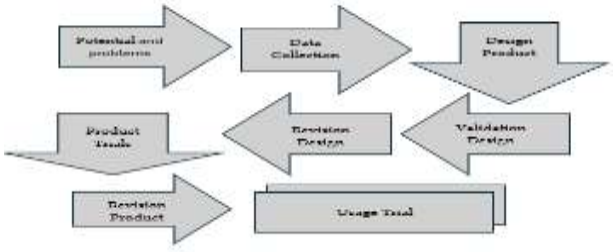

Figure 1. Borg and Gall model with 8 stages like research Saktilia & Wulandari, (2024)

The Research with the Borg and Gall model with eight stages that will be carried out to develop, namely through the potential and problem stages, data collection stages, product design, design validation, design revision, product trials, product revisions, and finally the usage trial. The product developed is the Pop up Book media on the material of the form of matter and its changes based on Problem Based Learning for fourth grade students of Ngaliyan 01 Elementary School. Pop Up Book media is a book that displays the potential for movement and interaction through the use of paper as a material for folding, rolling, forming, wheels or rotation (Ningsih et al., 2020). Before the Pop Up Book media is tested in learning, the media will be validated by media experts and material experts to determine the feasibility of the media. The development of Pop Up Book media in this study is expected to make students enthusiastic in their learning process and help improve student learning outcomes. Such as research conducted by Jannah & Istiah, (2021). The development of Pop Up Book media has succeeded in improving student learning outcomes, this can be seen in the increase in pre-test and post-test results from an average pre-test value of 56.50% to 86% at the time of the post-test. Eri Karisma et al. (2020) added, Pop Up Book media has the advantage of being able to encourage students' interest in reading because it introduces books in a fun way, can be used to optimize critical thinking skills, and makes it easier for children to interpret something abstract through interesting images. Pop up book media can help change abstract concepts into more concrete ones through visual representations that can then be easily understood by students (Rahayu & Marzuki, 2024).

Results and Discussion

The development of Pop up Book media based on problem based learning for class IV of Ngaliyan 01 Elementary School was developed through R&D (Research and Development) research using the Borg and Gall research model which was carried out in 8 stages such as research (Kristi & Andriani, 2023; Liana et al., 2022) namely potential and problems; data collection; product design; design validation; design revision; product trial; product revision; and usage trial.

Potential and Problems

Several problems were found in the learning of science in SD Negeri Ngaliyan 01, based on data obtained through observation activities, interviews, student learning outcomes and documentation of science learning. Based on the results of interviews with the homeroom teacher of class IV B, it was found that the learning outcomes of students were low, especially in

the science subject and there was also a lack of application of creative and innovative learning media. The teaching materials used by teachers are still limited to media provided by the school in the form of textbooks, pictures, and media in the form of YouTube and PowerPoint learning videos. According to Hamid & Alberida, (2021) interesting and non-monotonous teaching materials will certainly provide learning motivation. So that the learning outcomes of the subject of science have the highest and lowest value disparities which are caused by students' uneven understanding. Then for the learning model implemented by teachers in science learning is less varied, so that it has not shown any significant development in student learning outcomes. The application of learning methods in science learning, teachers still use conventional learning methods such as lecture methods, discussion methods. Students will tend to be less active and not used to thinking critically and conveyinghis opinion if using conventional methods (Firmansyah & Jiwandono, 2022).

The selection of Pop Up Book learning media based on Problem Based Learning is in accordance with the potential and problems that occur in class IV B of Ngaliyan 01 Elementary School because according to Piaget's learning theory, cognitive development occurs when students are able to understand the material being taught. The stages of student thinking emphasize concrete thinking to abstract thinking (Rachmawati & Daryanto, 2015). So the selection or procurement of the right media is very necessary. The function of learning media is used to describe something concrete into abstract (Ambarwati et al., 2021).

Data collection

Data collection at this stage was carried out by distributing questionnaires on the needs of teachers and students of grade IV of Ngaliyan 01 Elementary School. The questionnaires on the needs of teachers and students must include criteria for selecting learning media, such as learning objectives and materials, learning strategies, student characteristics, equipment, media needs, costs, student needs, media quality, materials, and student learning conditions (Kisworo, 2017). The results of the questionnaires distributed showed that 1) students need more interesting media. 2) Pop Up Book learning media is designed with bright colored covers and illustrations. 3) Pop Up Book learning media is equipped with learning achievements and learning objectives. 4) the type of font and font size used are Comic Sans Ms. 5) the language used is easy to understand. The selection of design, images, and type of writing can indicate the quality of the media (Permatasari et al., 2019).

Product Design

After collecting data through a needs questionnaire, the results were formulated into a product prototype that will be developed by the researcher. The product produced in this study is a Pop Up Book learning media with the material of the form of matter and its changes in science learning for grade IV. At this stage, the researcher designed the media design based on the results of the teacher and student needs questionnaire analysis. The learning material is adjusted to the development of learning media according to the learning achievements and learning objectives that have been set. The product design is made using the Adobe Illustrator application printed in poster form on A3 260 gsm paper (297 × 420 mm) using ivory paper. The Pop Up Book learning media will be based on Problem Based Learning. The following is the Pop Up Book learning media design.

Figure 2. Learning Media Cover View*Pop Up Book*

Figure 3. Foreword and Table of Contents Vie

Figure 4. Display of Instructions for Use and Elements, Learning Outcomes, and Learning Objectives

Figure 5. Display of the material to be studied

Design Validation

Products that have been made must first be validated by experts before being tested (Wulandari, 2017). Each expert or specialist is asked to assess the design, so that its strengths and weaknesses can be identified (Sugiyono, 2019). At this stage, validation of the feasibility of the Pop Up Book learning media was carried out by two expert lecturers, namely material experts and media experts. Each expert provided an assessment or validation using a feasibility assessment validation instrument for the Pop Up Book learning media design. The feasibility assessment was carried out by providing a questionnaire (Suhailah et al., 2021). The following observations by material experts and media experts are presented in the Table 1.

Figure 6. Developer Profile View

Table 1. Pop Up Book Media Material Validation Results

Assessment Aspects	Percentage (%)	Criteria
Suitability of the material to learning objectives.	100	Worthy
Suitability of the material to the students' level of thinking.	100	Worthy
Suitability of the material to the questions in the media.	73.33	Quite decent
Conformity of image to material	93.33	Worthy
Total	91.66	Very Worth It

The research that developed the Pop Up Book media, namely that conducted by Venny Rosizha (2022), showed a score of 94.54% in the media aspect, while in the material aspect it had a score of 91.42% and was declared valid. Further research, received an assessment by media experts Pop Up Book obtained a percentage of 91.85% while 95.5% from material experts, in the very effective category (Agustina et al., 2023). Another study conducted by Fikri Kamela and Desi Wulandari, the results of the study of educational-based monopoly media obtained a percentage of 90.77% by material experts in the very feasible category and the assessment by media experts received a percentage of 88.69%, in the very feasible category (Kamelia & Wulandari, 2024). Research by Mar'atussolichah et al. (2024) who developed the benkangen game media based on local Magelang wisdom received a category that was very worthy of being tested with an average score of 90% from expert media and material validators. Table 1 and 2 show the assessment of the pop-up book learning media by material experts 91.66% and media experts 92.61%. These results are included in the very valid/feasible category because they obtained a value above 80% which meets the criteria (Arikunto, 2018). So it shows very positive results which means that pop up books are worth using.

Table 2. Pop Up Book Media Validation Results

Assessment Aspects	Percentage (%)	Criteria
Suitability of media to learning objectives.	100	Worthy
According to the level of student development.	100	Worthy
The media is easy for teachers and students to use.	73.33	Quite decent
Attractive visual display design.	97.14	Worthy
Total	92.61	Very worthy

Design Revision

After the product design is validated through discussions with expert lecturers, its weaknesses can be identified. Researchers make improvements to the design based on suggestions from material and media experts, who have conducted assessments. After the product is improved, the media will be consulted again

with material and media experts until it is stated that the media is worthy of being tested.

(a) (b) (c) (d) (e) (f)

Figure 7. Pop Up Book Design Before and After Revision: (a) The Cover Before Revision Has the Name of the Supervisor on the Cover and the Logo is Reverse; (b) Cover After Revision Deleting the Name of the Supervisor on the Cover and the Logo is Not Reversed; (c) PBl Syntax Before Revision Not Yet Appropriate; (d) PBl Syntax After Revision is Organized and Systematic; (e) Image of Agar-Agar Hardening as an Example of Freezing; and (f) Image of Ice Cream as an Example of Freezing.

Product Trial

Product trials are conducted in small groups, this stage aims to obtain information and input regarding the effectiveness of Pop Up Book learning media. Product trials will involve students as respondents (Ihsan et al., 2022). Initial trials were conducted involving 6-12 subjects and data from interviews, observations and questionnaires were collected and then analyzed. The results of the analysis from the initial trials became input for revising the initial product. The product trials in this study were conducted by demonstrating the use of Pop Up Book learning media in small-scale trials, the researcher took a sample of 6 students. In implementing small-scale trials, the researcher used a purposive sampling technique, namely a sampling technique with certain considerations (Sugiyono, 2019). The consideration in taking this sample is that the researcher selected a sample of 6 students heterogeneously based on class ranking, namely 2 top-ranking students, 2 middle-ranking students, and 2 bottom-ranking students. The purpose of sampling is to ensure that the trial of this product is balanced and even so that it can be used by all students, both top and bottom-ranking. After 6 students used the media, the researcher gave a response questionnaire to the teacher and students to determine the student and teacher responses to the Pop Up Book learning media in science learning on the material of the state of matter and its changes. The

results of filling out the student and teacher response questionnaires were used to improve the learning media that had been developed by the researcher.The percentage value of the questionnaire is in the range of 76%-100%, the effective criteria if the percentage value is in the range of 51%-75%, the fairly effective criteria if the percentage value is in the range of 26%-50%, and the less effective criteria if the percentage value is in the range of 0%-25%. The following is the recapitulation of the filling of the teacher and student response questionnaires to the product trial in a small-scale test.

Figure 8. Small Scale Product Trial

Table 4. Teacher and Student Responses to the Use of Pop Up Book Media

Respondents	Evaluation (%)	Information
Teacher	100	Very Positive
Student	100	Very Positive

With the results of the assessment of teacher and student responses to learning media*Pop Up Book*. The media is worth testing.

Product Revision

Revision of Pop Up Book media based on Problem Based Learning at this stage was carried out according to the suggestions and input given by teachers and students during the product trial. However, the results of filling out the teacher and student response questionnaires received good responses and there was no input for improvement. Therefore, after conducting the product trial, the researcher did not need to revise the media, so that the media developed was feasible and could be directly tested in a large-scale product usage trial.

Trial Usage

Large scale trials were conducted on 22 fourth grade students of Ngaliyan 01 Elementary School, Semarang City, using a Pre-Experimental design with the One Group Pretest-Posttest Design model. In the early stages, students worked on the Pretest questions to determine students' initial abilities before getting the material on the form of matter and its changes with the help of pop-up book media. Then at the end of the learning, students were given a posttest to determine the changes after being given learning with pop-up book media based on Problem Based Learning. This is in line with the opinion Ule et al. (2021) to determine the effectiveness of the product being developed, namely by providing pretest and posttest questions.

Researchers also distributed questionnaires responding to the media.*pop up book*based on Problem Based Learningigto teachers and students. The response questionnaire is used to assess the effectiveness of media in science learning, especially the material on the form of matter and its changes. The results of the response questionnaire are used as consideration for improving the learning media products that have been developed.The assessment criteria used are very effective 76%-100%, effective criteria 51%-75%, quite effective criteria81-100%, feasible criteria 61-80%, less feasible criteria with a value of 41-50%. Below is a table of value acquisition in the table.

Figure 9. Large Scale Product Trial

Table 5. Results of Student and Teacher Responses to Media Use*Pop Up Book*based on Problem Based Learning

Respondents	Percentage (%)	Criteria
Teacher	100	Very Effective
Student	98	Very Effective

Similar research developed concrete media in the form of*pop up book*in learning, the assessment of media use by teachers was 94% and 97% by students. Other similar studies found a percentage of 94% by teachers in the very practical category and 89.24% by students in the very practical category. Based on the results of the analysis of teacher and student assessments of the media*Pop Up Book*In large-scale trials, it received a good response with a percentage of 100% from teachers and 98% from students in the very appropriate category so that there is no need to make improvements and it can be used in learning.

Effectiveness of Pop Up Book Learning Media Based on Problem Based Learning

Media effectiveness test Pop Up Bookbased on Problem Based Learning will be tested for average increase and average difference. However, before that, it is necessary to conduct a normality test which aims to determine whether the data is normally distributed or not. The number of samples in this study was less than 50, so the normality test in this study used the Shapiro Wilk test (Quraisy, 2020). The basis for decision making if the data is normally distributed is the Sig. value > 0.05. Meanwhile, the data is not normally distributed if the Sig. value < 0.05. The results of the normality test are presented in the Table 6.

Table 6.Results of Pretest and Posttest Normality Test

Learning Outcomes	Statistics	Df	Sig.
Pretest	0.939	22	0.186
Posttest	0.942	22	0.222

The results of the significance value of the pretest value using Shapiro-Wilk obtained a significance value of 0.186> 0.05 and a posttest value with a significance of 0.222> 0.05. Based on these values, it can be concluded that the pretest and posttest data are normally distributed. This is in line with the research conducted by Darnawati & Yulianto (2024), from the results of the normality test in the study, a significance value of 0.317> 0.05 was obtained for the pretest value and 0.085> 0.05, thus the distribution of pretest and posttest normality was normally distributed.

Next, the researcher conducted a test of the average difference with. The T-test used was*paired sample t-test.*With decision making based on sig. value (2-tailed), if sig. value (2-tailed) < 0.05 then Ho is rejected and Ha is accepted, if sig. value (2-tailed) > 0.05 then Ho is accepted and Ha is rejected. The following are the results of calculating the difference in the pretest and posttest averages using SPSS version 26. The T-test results are presented in the table

Table 7. T-Test Results Pretest and Posttest Values

Test criteria	T	Df	Sig. (2-tailed)
Pair 1 pretest score-posttest score	-16.47	21	0.000

The results of the pretest and posttest mean difference test, showed that the sig value. (2 tailed) is 0.00. In the calculation, the significance value is 0.00 <0.05. Then Ho is rejected and Ha is accepted. So there is a significant difference between the results of students' pretest and posttest data before and after using Problem Based Learning-based Pop Up Book learning media. This is reinforced by research with the obtained Sig. (2-tailed) of 0.000 which is less than 0.05 so it can be concluded that there is an average difference between the pretest and posttest in the study or there is an influence in the use of Pop Up Book learning media (Kasih & Mawardi, 2023).

Researchers continued the last test, namely the average increase in pretest and posttest using the N-Gain Test. Below is presented the N Gain Test table

Table 8. Results of the N-Gain Test of Pretest and Posttest Values

Learning outcomes	Student	Average	N-Gain Value	Criteria
Pretest	22	56.18	0.717	Tall
Posttest	22	86.72		

Learning outcomes can be seen from the ability of students after participating in learning activities (Ibrahim et al., 2023). From the data above, it can be seen that the average increase (N-gain) shows that fourth grade students of Ngaliyan 01 State Elementary School in Semarang city obtained an N-gain value of 0.717 and is included in the high criteria. The increase in the average shows that the use of learning media Pop Up Book based on problem-based learning is effectively used in learning science material on the form of substances and their changes in grade IV students of SD Negeri Ngaliyan 01 Semarang city.

Pop Up Book learning media that is packaged attractively, makes sense so that it increases interest in student participation in learning, and increases students' curiosity which can increase student criticality in learning (Kasih & Mawardi, 2023).

In line with studies that state Pop Up Book media is suitable for use in elementary school children, it really helps students to understand concrete events needed media that can visualize these. Especially in science learning

Reviewing the results of the analysis of the development of pop up book media based on Problem Based Learning to improve learning outcomes of IPAS subject matter of the form of substances and their changes in class IV SD Naliyan 01 Semarang City, it is declared very feasible to use in learning to improve student learning outcomes. It is proven that there is a difference in the average score before using Pop Up Book media 56.18 and after learning using Pop Up Book media, the average student score has increased by 86.72.

Conclusion

Based on the results of research into the development of learning media*pop up book* based on Problem Based LearningigIt can be concluded that the media developed can improve students' science learning outcomes.class IV of Ngaliyan 01 Elementary School.

This can be seen from the results of the teacher response questionnaire of 100% and students of 98%, a very effective category for use in learning. In addition, there was an increase in pre-test and post-test scores in the N-gain test of 0.717 with high criteria. Therefore, pop-up learning mediaProblem Based Learning basedng effective in improving student learning outcomes in the subject of Natural Sciences, material on the Forms of Matter and Their Changes.

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Author Contributions
The lead author, HTR, conducted the research, developed the product, and analyzed the data. The second author, DW, supervised and guided the research.

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Reference

Agustina, D., Subayani, N. W., & Nugraha, A. S. (2023). Pengembangan Media Pop Up Book Materi Kenampakan Permukaan Bumi di UPT SD Negeri 87 Gresik. *Jurnal Jendela Pendidikan*, *3*(01), 41–49. https://doi.org/10.57008/jjp.v3i01.372

Akareem, H. S., & Hossain, S. S. (2016). Determinants of education quality: what makes students' perception different? *Open Review of Educational Research*, *3*(1), 52–67. https://doi.org/10.1080/23265507.2016.1155167

Ambarwati, D., Wibowo, U. B., Arsyiadanti, H., & Susanti, S. (2021). Studi literatur: Peran Inovasi Pendidikan pada pembelajaran berbasis Teknologi Digital. *Jurnal Inovasi Teknologi Pendidikan*, *8*(2), 173–184. https://doi.org/https://doi.org/10.21831/jitp.v8i2.43560

Anggraini, M. C., & Kristin, F. (2022). Pengembangan Media Pembelajaran IPS Berbasis Permainan Monopoli untuk Meningkatkan Motivasi dan Hasil Belajar Siswa Kelas 4 Sekolah Dasar. *JIIP - Jurnal Ilmiah Ilmu Pendidikan*, *5*(10), 4207–4213. https://doi.org/10.54371/jiip.v5i10.1015

Arikunto, S. (2018). *Prosedur Penelitian*. Rineka Cipta.

Asrizal, Jasmi, L., Pohan, N. R., & Putra, N. (2023). Effect of Modules in Natural Science Learning on Students' Knowledge and Critical Thinking Skills: A Meta-Analysis. *Jurnal Penelitian Pendidikan IPA*, *9*(6), 134–140. https://doi.org/10.29303/jppipa.v9i6.2685

Betz, U. A. K., Arora, L., Assal, R. A., Azevedo, H., Baldwin, J., Becker, M. S., Bostock, S., Cheng, V., Egle, T., Ferrari, N., Schneider-Futschik, E. K., Gerhardy, S., Hammes, A., Harzheim, A., Herget, T., Jauset, C., Kretschmer, S., Lammie, C., Kloss, N., … Zhao, G. (2023). Game changers in science and technology - now and beyond. *Technological Forecasting and Social Change*, *193*, 122588. https://doi.org/10.1016/j.techfore.2023.122588

Bobi, B., Hidayat, T., & Syahfitri, J. (2023). Influence of Quizizz and Google Form Applications on Students' Motivation and Cognitive Learning Outcomes on Human Respiratory System Material. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 10387–10394. https://doi.org/10.29303/jppipa.v9i11.3860

Cheng, L.-C., & Tsai, S.-L. (2019). Deep learning for automated sentiment analysis of social media. *Proceedings of the 2019 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining*, 1001–1004. https://doi.org/10.1145/3341161.3344821

Cynthia, Arafah, K., & Palloan, P. (2023). Development of Interactive Physics E-Module to Improve Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 3943–3952. https://doi.org/10.29303/jppipa.v9i5.2302

Darnawati, O. E., & Yulianto, S. (2024). Development of Nearpod-Based Learning Media to Improve Learning Outcomes in Elementary School Grade V IPAS Subjects. *Jurnal Penelitian Pendidikan IPA*, *10*(11), 8568–8577. https://doi.org/10.29303/jppipa.v10i11.7552

Eri Karisma, I. K., Margunayasa, I. G., & Prasasti, P. A. T. (2020). Pengembangan Media Pop-Up Book pada Topik Perkembangbiakan Tumbuhan dan Hewan Kelas VI Sekolah Dasar. *Jurnal Ilmiah Sekolah Dasar*, *4*(2), 121. https://doi.org/10.23887/jisd.v4i2.24458

Firman, A. R., & Julianto. (2021). Pengembangan Media Pop Up Book pada Mata Pelajaran IPA Materi Daur Hidup Hewan Kelas IV SD. *Jurnal Penelitian Pendidikan Guru Sekolah Dasar*, *9*(10), 3451–3653. Retrieved from https://ejournal.unesa.ac.id/index.php/jurnal-penelitian-pgsd/article/view/43915

Firmansyah, A., & Jiwandono, N. R. (2022). Kecenderungan Guru dalam Menerapkan Pendekatan Student Centre Learning dan Teacher Centre Learning dalam Pembelajaran. *Jurnal Guru*

Indonesia, *2*(1), 33–39. https://doi.org/10.51817/jgi.v2i1.229

Fuad, M., Ariyani, F., Suyanto, E., & Shidiq, A. S. (2020). Exploring teachers' tpck: Are indonesian language teachers ready for online learning during the covid-19 outbreak? *Universal Journal of Educational Research*, *8*(11B), 6091–6102. https://doi.org/10.13189/ujer.2020.082245

Hamid, A., & Alberida, H. (2021). Pentingnya Mengembangkan E-Modul Interaktif Berbasis Flipbook di Sekolah Menengah Atas. *Edukatif : Jurnal Ilmu Pendidikan*, *3*(3), 911–918. https://doi.org/10.31004/edukatif.v3i3.452

Hidayah, S. N., & Prasetyo, T. (2022). Pengembangan Media Game Edukasi Tematik Berbasis Web Wordwall Berpadukan Classroom untuk Meningkatkan Hasil Belajar Siswa Kelas 4 Sekolah Dasar. *JIIP - Jurnal Ilmiah Ilmu Pendidikan*, *5*(7), 2632–2635. https://doi.org/10.54371/jiip.v5i7.732

Hikmah, N., Kuswidyanarko, A., & H. M. Lubis, P. (2022). Pengembangan Media Pop-Up Book pada Materi Siklus Air di Kelas V SD Negeri 04 Puding Besar. *Jurnal PGSD: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, *15*(2), 137–148. https://doi.org/10.33369/pgsd.15.2.137-148

Ibrahim, F., Hendrawan, B., & Sunanih, S. (2023). Pengembangan Media Pembelajaran PACAS Untuk Meningkatkan Hasil Belajar Siswa. *JLEB: Journal of Law, Education and Business*, *1*(2), 102–108. https://doi.org/10.57235/jleb.v1i2.1192

Ihsan, M., Zulkarnaen, A., & Nurdiana, N. (2022). Pengembangan Lembar Kerja Peserta Didik Berbasis Riset Pengaruh Getaran Makroseismik Terhadap Perilaku Ikan Lele (Clarias sp.). *BIODIK*, *8*(2), 136–144. https://doi.org/10.22437/bio.v8i2.16078

Jannah, D. R. M., & Istianah, F. (2021). Pengembangan Media Pembelajaran Pop-Up Book pada Materi Siklus Air Kelas V Sekolah Dasar. *Jpgsd*, *9*(3), 1824–1836. Retrieved from https://ejournal.unesa.ac.id/index.php/jurnal-penelitian-pgsd/article/view/39718

Kamelia, F., & Wulandari, D. (2024). Development of Educational Monopoly Learning Media in Science Subjects to Improve Students Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *10*(9), 6777–6789. https://doi.org/10.29303/jppipa.v10i9.7351

Kasih, Y. S., & Mawardi, M. (2023). Pengembangan Media Pembelajaran Pop-Up Book Terintegrasi Model Pembelajaran POEWA dalam Mata Pelajaran IPA Kelas V SD untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *JIIP - Jurnal Ilmiah Ilmu Pendidikan*, *6*(7), 5238–5243. https://doi.org/10.54371/jiip.v6i7.2465

Kisworo, B. (2017). Implementasi Media Pembelajaran Berbasi Prinsip- prinsip Pendidikan Orang Dewasa PKBM Indonesia Pusaka Ngaliyan Kota Semarang. *Journal Of Nonformal Education*, *3*(1), 80–86. https://doi.org/10.15294/jne.v3i1.8987

Kristi, D., & Andriani, A. E. (2023). Pengembangan E-Book Berbasis Problem Based Learning untuk Meningkatkan Hasil Belajar IPA Siswa Kelas V. *Jurnal Penelitian Pendidikan IPA*, *9*(SpecialIssue), 828–835. https://doi.org/10.29303/jppipa.v9iSpecialIssue.6505

Kustandi, C., & Darmawan, D. (2020). *Pengembangan Media Pembelajaran Konsep & Aplikasi Pengembangan Media Pembelajaran Bagi Pendidik di Sekolah dan Masyarakat*. Kencana.

Kusumawati, I. T., Soebagyo, J., & Nuriadin, I. (2022). Literature Study of Critical Thinking Ability with the Application of the PBL Model in the Constructivism Theory Approach. *JURNAL MathEdu*, *5*(1), 13–18. https://doi.org/10.37081/mathedu.v5i1.3415

Lara Nieto-Márquez, N., Baldominos, A., & Pérez-Nieto, M. Á. (2020). Digital Teaching Materials and Their Relationship with the Metacognitive Skills of Students in Primary Education. *Education Sciences*, *10*(4), 113. https://doi.org/10.3390/educsci10040113

Liana, D. E., Muzzazinah, M., & Indrowati, M. (2022). Development of Science E-Modules Based of Guided Inquiry to Improve Students' Critical Thinking Ability. *Jurnal Penelitian Pendidikan IPA*, *8*(3), 1368–1375. https://doi.org/10.29303/jppipa.v8i3.1668

Mar'atussolichah, Ibda, H., Al Hakim, M. F., Faizah, F., Aniqoh, A., & Mahsun, M. (2024). Benkangen game: Digital media in elementary school Indonesian language. *Journal of Education and Learning (EduLearn)*, *18*(2), 480–488. https://doi.org/10.11591/edulearn.v18i2.21091

Monteiro, V., Carvalho, C., & Santos, N. N. (2021). Creating a Supportive Classroom Environment Through Effective Feedback: Effects on Students' School Identification and Behavioral Engagement. *Frontiers in Education*, *6*(7). https://doi.org/10.3389/feduc.2021.661736

Munandar, T., & Ahmad, M. (2022). E-Modul Berbasis Nearpod pada Materi PPKn Kelas 2 Tema Hidup Rukun. *Jurnal Ilmiah Pendidikan Profesi Guru*, *5*(1), 11–20. https://doi.org/10.23887/jippg.v5i1.48503

Nadeem, M., Oroszlanyova, M., & Farag, W. (2023). Effect of Digital Game-Based Learning on Student Engagement and Motivation. *Computers*, *12*(9), 177. https://doi.org/10.3390/computers12090177

Nengsi, R. (2021). *Pengembangan Media Pop Up Book untuk Meningkatkan Kemampuan Kognitif Siswa Kelas V pada Pembelajaran IPA Tema Lingkungan Sahabat Kita* [Thesis: Universitas Bina Bangsa Getsempena]. Retrieved from https://repository.bbg.ac.id/handle/964.

Ningsih, R., Munandar, H., & Junita, S. (2020). Pengembangan Media Pop Up Book Untuk Meningkatkan Kemampuan Kognitif Siswa Kelas V Pada Pembelajaran IPA Tema Lingkungan Sahabat Kita. *Jurnal Ilmiah Mahasiswa Pendidikan*, *1*(1), 456–473. Retrieved from https://jim.bbg.ac.id/pendidikan/article/view/82/59

Ningtiyas, T., Setyosari, P., & Praherdiono, H. (2019). Pengembangan Media Pop-Up Book untuk Mata Pelajaran IPA Bab Siklus Air dan Peristiwa Alam Sebagai Penguatan Kognitif Siswa. *Jurnal Kajian Teknologi Pendidikan*, *2*(2), 115–120. https://doi.org/10.17977/um038v2i22019p115

Ong, S. G. T., & Quek, G. C. L. (2023). Enhancing teacher–student interactions and student online engagement in an online learning environment. *Learning Environments Research*, *26*(3), 681–707. https://doi.org/10.1007/s10984-022-09447-5

Pamorti, O. A., Winarno, & Suryandari, K. C. (2024). Effectiveness of Augmented Reality Based Learning Media to Improve Critical Thinking Skills on IPAS Material. *Jurnal Penelitian Pendidikan IPA*, *10*(5), 2211–2219. https://doi.org/10.29303/jppipa.v10i5.7139

Parker, R., Thomsen, B. S., & Berry, A. (2022). Learning Through Play at School – A Framework for Policy and Practice. *Frontiers in Education*, *7*(8). https://doi.org/10.3389/feduc.2022.751801

Permatasari, B. D., Gunarhadi, G., & Riyadi, R. (2019). The influence of problem based learning towards social science learning outcomes viewed from learning interest. *International Journal of Evaluation and Research in Education (IJERE)*, *8*(1), 39. https://doi.org/10.11591/ijere.v8i1.15594

Quraisy, A. (2020). Normalitas Data Menggunakan Uji Kolmogorov-Smirnov dan Saphiro-Wilk. *J-HEST: Journal of Healt, Education, Economics, Science, and Technology*, *3*(1), 7–11. Retrieved from http://download.garuda.kemdikbud.go.id/article.php?article=3025542&val=27373&title=Normalitas Data Menggunakan Uji Kolmogorov-Smirnov dan Saphiro-Wilk Studi kasus penghasilan orang tua mahasiswa Prodi Pendidikan Matematika Unismuh Makassar

Rachmawati, T., & Daryanto. (2015). *Teori Belajar dan Proses Pembelajaran yang Mendidik*. Gava Media.

Rahayu, H. P., & Wulandari, D. (2024). Development of Augmented Reality Learning Media on IPAS Subject Matter of the Respiratory System. *Jurnal Penelitian Pendidikan IPA*, *10*(10), 7562–7571. https://doi.org/10.29303/jppipa.v10i10.7740

Rahayu, L. F., & Marzuki, I. (2024). Analisis Implemantasi Media Pop-Up Book terhadap Hasil Belajar Siswa pada Mata Pelajaran IPS di Sekolah Dasar. *JIIP - Jurnal Ilmiah Ilmu Pendidikan*, *7*(12), 14241–14246. https://doi.org/10.54371/jiip.v7i12.6586

Resmaniti, D. M., & Karlimah, K. (2019). Rancangan Media Pop Up Book tentang Konsep Operasi Hitung Penjumlahan Bilangan Cacah. *Indonesian Journal of Primary Education*, *3*(1), 1–8. https://doi.org/10.17509/ijpe.v3i1.17977

Saktilia, Y. R., & Wulandari, D. (2024). Development of Interactive Flipbook-Based E-Books Through Problem Based Learning Models to Improve Science Learning Outcomes in Elementary Schools. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 6080–6094. https://doi.org/10.29303/jppipa.v10i8.7515

Saputri, M. A. (2020). Penerapan Model Pembelajaran Problem Based Learning Untuk Meningkatkan Kemampuan Berfikir Kritis Siswa Kelas V Sekolah Dasar. *Jurnal Pendidikan Dan Konseling (JPDK)*, *2*(1), 92–98. https://doi.org/10.31004/jpdk.v1i2.602

Sugiyono. (2019). *Metode Penelitian Pendidikan, Pendekatan Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.

Suhailah, F., Muttaqin, M., Suhada, I., Jamaluddin, D., & Paujiah, E. (2021). Articulate Storyline: Sebuah Pengembangan Media Pembelajaran Interaktif Pada Materi Sel. *Pedagonal : Jurnal Ilmiah Pendidikan*, *5*(1), 19–25. https://doi.org/10.33751/pedagonal.v5i1.3208

Sun, R.-Q., Sun, G.-F., & Ye, J.-H. (2023). The effects of online game addiction on reduced academic achievement motivation among Chinese college students: the mediating role of learning engagement. *Frontiers in Psychology*, *14*(7). https://doi.org/10.3389/fpsyg.2023.1185353

Ule, K. N., Bunga, Y. N., & Bare, Y. (2021). Pengembangan Modul Pembelajaran Biologi Berbasis Jelajah Alam Sekitar (JAS) Materi Ekosistem Taman Nasional Kelimutu (TNK) SMA Kelas X. *Diklabio: Jurnal Pendidikan Dan Pembelajaran Biologi*, *5*(2), 147–156. https://doi.org/10.33369/diklabio.5.2.147-156

Venny Rosizha, R. E. H. (2022). Pengembangan Media Pop-Up Book Materi Sumber Energi Sebagai Media Pembelajaran Kelas 3 SD. *Pendidikan Dan Konseling*, *4*, 6876–6887.

Wulandari, Y. (2017). Kelayakan Aspek Materi dan Media dalam Pengembangan Buku Ajar Sastra Lama. *Gramatika STKIP PGRI Sumatera Barat*, *3*(2),

77–90. https://doi.org/10.22202/jg.2017.v3i2.2049