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Effectiveness of Pop Up Book Media Based on Problem Based Learning in Improving the Problem Solving Abilities of Grade V Elementary School Students

Nafilatun Husna, Susilawati*, Dewi Yulianawati

Elementary School Teacher Education, Faculty of Teacher Training and Education, Muhammadiyah University of Cirebon, Cirebon, 45153, Indonesia

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* Corresponding author:

E-mail: nafilatunhusna@gmail.com

susilawati@umc.ac.id

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ABSTRACT

The research was motivated by the low problem solving skills of elementary students in learning food chain material, which necessitate the use of innovative learning media and models. The novelty of this study lies in the integration of Pop Up Book media and the Problem Based Learning (PBL) model to enhance elementary students' problem solving skills in food chain learning, while previous studies have generally examined these approaches separately. This study aimed to determine the effect of PBL based Pop Up Book media on the problem solving skills of fifth grade students at SD Negeri 2 Sumber. The study employed a quasi-experimental method with a nonequivalent control group design involving 46 students. Data were analyzed using normality and homogeneity tests, an Independent Samples t-test, and N-Gain analysis. The results showed a significance value of $0.000 < 0.05$, indicating a significant effect of the intervention. The experimental class achieved a higher posttest mean score (82.43) than the control class (55.74), with N-Gain scores of 63.75% and 12.10%, respectively. These findings indicate that the intervention had a substantial positive effect on students' problem-solving skills and can serve as an effective instructional strategy for elementary science learning. Therefore, PBL based Pop Up Book media is effective in improving students' problem-solving skills.

1. Introduction

Education is a crucial process in developing students' thinking skills so they can tackle various challenges in life. The Merdeka Curriculum emphasizes student centered learning and fosters critical thinking and problem solving skills (Ministry of Education, Culture, Research, and Technology, 2022). According to Utami et al., (2025), science education does not only emphasize mastery of concepts but also students' critical thinking and problem solving skills. According to Polya (1945),

problem solving skills include understanding the problem, planning a solution, implementing the solution, and reviewing the results obtained. Science education is not only oriented toward conceptual mastery but also aims to develop students' critical, logical, and systematic thinking skills Muliastrini, (2024). Therefore, science education in elementary school should ideally be designed contextually and actively involve students in the learning process. This can help students build conceptual understanding through direct learning experiences so that students do not merely receive information from the teacher; according to Rosyida Adinia & Iqbal, (2022), problem based learning provides a more meaningful learning experience because students are directly involved in the process of conceptual understanding and problem solving.

However, these ideal conditions have not yet been fully realized in elementary school classrooms, resulting in elementary school students' problem solving skills remaining relatively low. Based on observations at SD Negeri 2 Sumber, science instruction is still dominated by lecture based methods, leading to students being less active in the learning process. Furthermore, Rozali et al., (2022) argue that limited learning activities make it difficult for students to understand abstract concepts, such as those in the food chain curriculum. This situation highlights a gap between the demands of the student centered Merdeka Curriculum and the teacher centered teaching practices still prevalent in the field. Monotonous instruction results in students being less active in problem solving. This situation results in low student engagement during the learning process. Students tend to merely receive information from the teacher without being given sufficient opportunities to explore knowledge independently. Consequently, students' higher order thinking skills (HOTS) and problem solving abilities have not developed optimally Ghanizadeh et al., (2020). Sopiansah & Ramafrizal, (2025) explain that conventional learning needs to be transformed through the implementation of the Problem Based Learning (PBL) model because this model is capable of encouraging students to be directly involved in the process of solving real world problems. Viratama, (2025) also argues in her research that students need concrete learning materials that can help them understand abstract concepts through visual and hands on experiences. Agustin, (2026) identifies the Pop Up Book as one of the learning media deemed suitable for supporting science education in elementary schools. This three dimensional visual medium presents raised and interactive images, thereby helping students understand abstract concepts in a more concrete way.

According to Yuliana (2024), in addition to the use of appropriate media, instruction must be supported by a learning model that presents contextual problems as the foundation of learning, such as the Problem Based Learning (PBL) model. Problem Based Learning (PBL) is a student centered learning model that uses the presentation of contextual problems as the foundation of learning. Anthony, (2025) states that the Problem Based Learning (PBL) framework comprises five main stages: (1) orienting students to the problem, (2) organizing students for learning, (3) guiding the investigation, (4) developing and presenting the final product, and (5) analyzing and evaluating the problem solving process. These stages align with Polya's problem solving steps, making them relevant for application in science education. Aini et al., (2023) argue that the alignment between the syntax of

Problem Based Learning and Polya's problem solving steps enables students to gain a systematic learning experience in solving problems. Hastawan, (2025) argues that the application of the Problem Based Learning model in science education helps students develop critical thinking, communication, collaboration, and problem solving skills through scientific inquiry activities.

The integration of the Pop Up Book medium with the Problem Based Learning model is seen as capable of creating more meaningful learning. Shabrina, (2025) note that the combination of appropriate learning media and instructional models is a key factor in the success of the learning process. The use of engaging media can help students understand the material, while the Problem Based Learning model can train students to apply their knowledge to solve problems encountered in daily life. Pop up books serve as a concrete visual aid that helps students understand abstract concepts, while PBL provides a learning framework that trains students to solve problems systematically. In the food chain unit, students explore the interconnections among living organisms and analyze the impacts of ecosystem changes through contextual problem solving activities.

Several previous studies have shown that the use of Pop Up Books and the Problem Based Learning model has a positive effect on students' abilities. Kurnia Putri & Purwanti, (2023) state that the Problem Based Learning model supported by Pop Up Books influences students' critical thinking skills; Hayati et al., (2025) found that the use of the PBL model supported by Pop-Up Books can enhance elementary school students' systematic problem solving abilities. Nevertheless, research specifically examining the influence of Problem Based Learning based Pop Up Books on students' problem solving skills in science lessons on the food chain remains limited. The novelty of this study lies in the integration of Pop Up Books with the Problem Based Learning model, used synergistically to enhance elementary school students' problem solving skills regarding the science topic of the food chain.

Based on the above description, this study was conducted to determine the effect of Problem Based Learning (PBL) based Pop Up Books on the problem solving skills of students at SD Negeri 2 Sumber. This study also aims to compare the effectiveness of learning using PBL based Pop Up Books with that of students learning through PBL without the use of Pop-Up Books. The hypothesis of this study is that there is a significant effect of the use of Problem Based Learning based Pop Up Book media on the problem-solving skills of students in Class 2 at SD Negeri 2 Sumber.

2. Methodology

Data Collection

This study employed a quantitative approach using a quasi experimental method and a nonequivalent control group design. This design involved two groups: an experimental class and a control class. The experimental class received instruction

using a Pop Up Book as a teaching aid based on Problem-Based Learning (PBL), while the control class used conventional instruction. Both groups were administered a pretest and a posttest to measure students' problem solving skills regarding food chain material.

Table 1. Nonequivalent Control Group Design

Group	Pretest	Treatment	Posttest
Experimental Class	O1	X	O2
Control Class	O2	-	O4

The study population consisted of all fifth-grade students at SD Negeri 2 Sumber. The sampling technique used was saturation sampling, in which the entire population was included as the study sample. The study sample comprised an experimental class and a control class, selected based on the existing class conditions at the school.

Instrument

The instruments used in this study consisted of a problem-solving ability test and an observation sheet for student activities. The test instrument consisted of open ended questions designed based on Polya's indicators of problem solving ability, namely understanding the problem, formulating a solution plan, implementing the solution plan, and evaluating the solution. Before use, the instruments underwent validity and reliability testing. Based on the results of the test instrument validity test, it was found that all 8 items were valid, with r_{calc} for item (1) 0.838, item (2) 0.934, item (3) 0.785, item (4) 0.876, item (5) 0.862, item (7) 0.906, and item (8) 0.658. Thus, the calculated r value of 0.413 indicates that it is higher than the critical value. The reliability test using Cronbach's Alpha yielded a coefficient of 0.933 for all eight test items, indicating that the instrument has a very high level of reliability. This test was administered twice: before the intervention (pretest) and after the intervention (posttest). Test scores were calculated using a problem solving skills rubric designed in accordance with the measured indicators.

In addition to the test instrument, this study used an observation sheet to observe students' activities during the learning process. The aspects observed included visual activities, verbal activities, writing activities, mental activities, and emotional activities. Observation scores were obtained based on the number of indicators that appeared in each observed aspect.

The implementation of PBL based pop up books in the experimental class followed the stages of the Problem-Based Learning model, namely: (1) Students were introduced to the food chain through pop-up books; (2) they are then divided into groups to identify problems; (3) formulate questions; (4) discuss possible solutions based on the information presented; and (5) conduct investigations and solve the given problems using the pop up book as a learning resource. Subsequently, the results of their discussions were presented and evaluated collaboratively with the teacher. Meanwhile, the control class received conventional instruction through

lectures and question-and-answer sessions without the integration of the pop-up book or the Problem-Based Learning model.

Data Analysis

The research data were analyzed using descriptive and inferential statistics. Descriptive statistical analysis was used to describe the characteristics of the data through the mean, minimum, maximum, and standard deviation. Before hypothesis testing was conducted, the data were first tested for analysis prerequisites, including normality and homogeneity tests. The normality test was performed using the Shapiro Wilk test at a significance level of 0.05. The data were considered normally distributed if the significance value was greater than 0.05 (Sig. > 0.05). Next, the homogeneity test was conducted using Levene's Test to determine the equality of variances between the experimental and control groups. The data were deemed homogeneous if the significance value was greater than 0.05 (Sig. > 0.05).

After meeting the prerequisite tests, hypothesis testing was conducted using the Independent Samples t-Test to determine differences in problem solving ability between the experimental and control classes. Additionally, improvements in students' problem-solving ability were analyzed using the Normalized Gain (N-Gain) test to assess the effectiveness of using the Problem-Based Learning (PBL)-based Pop-Up Book medium. The N-Gain categories used include high ($g > 0.70$), moderate ($0.30 \leq g \leq 0.70$), and low ($g < 0.30$).

3. Results and Discussion

Results

The results of the study indicate that the use of Problem-Based Learning (PBL) based Pop Up Books has an impact on the problem solving skills of fifth grade students at Sumber Public Elementary School regarding the food chain. Research data were obtained through problem solving ability tests administered before (pretest) and after (posttest) instruction in the experimental and control classes. The experimental class received instruction using PBL based Pop-Up Books, while the control class used conventional instruction. Students' problem-solving abilities were measured through pretest and posttest activities. The average scores of the students are presented in the following table:

Table 2. Deskriptif Statistics

Value	N	Minimum	Maximum	Mean	Std. Deviation
Pretest kontrol	23	25	78	47,87	16,335
Posttest kontrol	23	34	81	55,74	13,349
Pretest Eksperimen	23	25	78	49,96	17,693
Posttest Eksperimen	23	67	100	82,43	9,380

The research data were obtained from problem-solving tests administered to the students before the intervention (pretest) and after the intervention (posttest). A

summary of the descriptive statistics is presented in Table 1. The mean pretest score for the control class was 47.87 with a standard deviation of 16.335, while the mean posttest score increased to 55.74 with a standard deviation of 13.349. In the experimental class, the pretest mean was 49.96 with a standard deviation of 17.693 and increased to 82.43 on the posttest with a standard deviation of 9.380. The minimum and maximum scores in the experimental class also showed a higher increase compared to the control class. These results indicate that both classes had relatively equivalent initial abilities; however, after receiving the intervention, the improvement in problem-solving skills among students in the experimental class was greater than that in the control class.

The increase in scores in the experimental class indicates that the use of Problem-Based Learning (PBL)-based Pop Up Book media is able to help students understand concepts in a more concrete and engaging way. The visual and interactive nature of the media allows students to be more active in identifying problems, developing solution strategies, and drawing conclusions from the problems presented. In addition to the test instrument, namely using observation instrument, the implementation of learning using Pop Up Book media based on Problem Based Learning (PBL) shows that the learning process is going very well.

Tabel 3. Observation of Teacher and Student Activities

No	Observation	Total Score	Evaluation Criteria
1	Teacher Activities	23	95%
2	Student Activities	18	75%

It is now that the implementation of learning in teacher activities obtained a percentage of 95% with the category "Very Good".while student activities obtained a percentage 75% with the category "Good". These Percenteges indicate that the learning process using Pop Up Book media based on Program Based Learning has been implemented optimally. Before drawing conclusions through parametric inferential hypothesis testing, it is important to ensure that the prerequisite statistical assumptions have been met. The first step is to test the normality of the distribution of learning scores using the Shapiro Wilk test. A summary of the analysis results is presented in the following section.

Tabel 4. Test of Normality (Shapiro-Wilk)

Grup	Statistic	df	Sig.
Control Pretest	,921	23	,071
Control Possttest	,953	23	,332
Experimental Pretest	,920	23	,066
Experimental Posttest	,953	23	,345

Before conducting the hypothesis test, a normality test was first performed using the Shapiro Wilk method because the sample size was less than 50 students. The results of the normality test showed that the significance value for the control group pretest was 0.071, for the control group posttest was 0.332, for the experimental group pretest was 0.066, and for the experimental group posttest was 0.345. All of

these significance values were greater than 0.05 (Sig. > 0.05), so the data in both groups were declared to be normally distributed.

The results of the normality test indicate that the students' problem solving ability data are normally distributed, thus meeting the requirements for parametric statistical analysis. Further analysis can be conducted using homogeneity tests and hypothesis tests to determine the effect of using PBL based Pop Up Books on students' problem solving skills; the homogeneity test using Levene's Test yielded a significance value of 0.387 on the pretest and 0.242 on the posttest. Since both values are greater than 0.05, it can be concluded that the variances between the experimental and control classes are homogeneous. Thus, the data meet the prerequisites for hypothesis testing using the Independent Samples T-Test. The test results are presented in the following table.

Tabel 5. Results of the Independent Sample t-Test

Data	Sig. Levene	t	df	Sig. (2-tailed)	Keputusan
Posttest Control and Experimental	0,242	-7,847	44	0,000	H ₀ Rejected

Hypothesis testing using an Independent Samples t-Test on posttest scores showed that the mean score of the experimental class (82.43) was higher than that of the control class (55.74). The T-test results yielded a significance level (two tailed) of 0.000 (< 0.05), so H₀ was rejected and H₁ was accepted. Thus, there is a significant difference between the problem-solving abilities of students in the experimental class and the control class. These results indicate that the use of Problem Based Learning (PBL) based Pop Up Books has a significant effect on students' mathematical problem-solving abilities.

After confirming the significant effect through hypothesis testing, an N-Gain analysis was conducted to determine the level of effectiveness in improving students' problem solving skills. The level of learning effectiveness was analyzed using N-Gain. The analysis results showed that the experimental class achieved an average N-Gain of 63.75%, which falls into the "moderately effective" category, while the control class achieved an average N-Gain of 12.10%, which falls into the "ineffective" category. The difference in N-Gain values indicates that the improvement in problem solving skills among students in the experimental class was greater than that in the control class. This finding supports the results of the hypothesis test, which show that the use of Pop Up Books based on Problem Based Learning not only has a statistically significant effect but is also effective in improving students' mathematical problem-solving skills.

Discussion

The improvement in students problem-solving skills is closely related to the characteristics of the Pop Up Book medium, which presents learning materials in a concrete, engaging, and easily understandable manner. Fitrianingrum, (2023) learning media is important to be used as a means to facilitate the delivery of messages in the learning process and to achieve the learning objectives that have

been set. In food chain learning, the Pop Up Book visualizes the relationships among living organisms within an ecosystem through realistic three-dimensional displays. These visual representations help students develop a deeper understanding of food chain concepts. The attractive design of the media also increases students' attention and engagement during learning activities. As a result, students are able to focus more effectively on the learning content. They can identify problems more accurately and recognize cause and effect relationships within the ecosystem. Students are also encouraged to connect information from different parts of the material. Kumalasari, (2026) rather than serving merely as a visual aid, this medium acts as a pivotal instrument for elucidating complex scientific concepts through engaging animations. From a cognitive perspective, the three-dimensional and interactive features of the Pop Up Book help students transform abstract concepts into concrete representations. This process reduces cognitive load and facilitates conceptual understanding, enabling students to identify relevant information, establish relationships among concepts, and apply their knowledge when solving problems. As a result, students are better able to progress through each stage of problem solving, from understanding the problem to evaluating the solution.

In addition to the learning media, the improvement in problem solving skills is also influenced by the implementation of the Problem Based Learning (PBL) model. One approach considered effective in improving problem solving skills is the Problem Based Learning (PBL) model. PBL places students at the center of the learning process by using contextual problems as triggers for thinking and exploring knowledge Marlina L, (2025). This model places students at the center of the learning process through problemsolving activities, group discussions, information gathering, and presentations. Through these activities, students actively construct knowledge rather than passively receiving information from the teacher. They are encouraged to think critically when analyzing problems and proposing solutions. Students also learn to collaborate with their peers and communicate their ideas effectively. Such learning experiences support the development of higher order thinking skills. The combination of active learning and collaborative investigation creates a more meaningful learning environment. In Problem Based Learning (PBL), students are confronted with practical problems as the foundation for learning; in other words, students learn through problems. This model encourages students to solve problems posed by the teacher Gunawan, (2025). The effectiveness of this integration lies in the complementary roles of the media and the learning model. While the Pop Up Book facilitates students' understanding of food chain concepts through visual and concrete representations, PBL provides structured opportunities for students to apply that understanding in solving authentic problems. Consequently, students not only acquire conceptual knowledge but also develop higher-order thinking skills through investigation, discussion, and reflection activities.

The results of this study align with the research by Triyani, (2024), which showed that the implementation of Problem Based Learning and the use of Pop Up Book media can enhance student engagement, conceptual understanding, and problem solving skills. These findings reinforce the results of Silalahi & Faizal, (2022) study, which indicates that the use of PBL based Pop Up Book media is an effective

learning alternative for improving elementary school students' problem solving skills. Research by Yulandah, (2021) also indicates that the use of Pop-Up Books helps students understand the material more easily and in a more engaging manner. Similarly is also consistent with putri, (2026)(putri, 2026), who reported that the integration of Pop Up Book media and Problem Based Learning supports the development of students' learning outcomes and higher order thinking skills. These findings reinforce the conclusion that the use of Pop Up Books combined with the Problem-Based Learning model can enhance students' problem-solving skills more effectively.

These studies support the effectiveness of Pop Up Book media and PBL in enhancing learning outcomes. The similarity between the present study and previous studies lies in the finding that both Pop Up Book media and PBL contribute positively to students' learning outcomes and problem solving abilities. However, this study differs from previous research in that it specifically examines the integrated use of Pop Up Book media and the PBL model in learning food chain concepts among fifth grade elementary students. While earlier studies generally focused on the effectiveness of either Pop Up Book media or PBL separately, the present study investigates their combined implementation. This integration represents the main contribution of the study, as it demonstrates that combining visual learning media with a problem based instructional approach can produce greater improvements in students' problem solving skills than conventional instruction. Therefore, this study extends previous findings by providing empirical evidence regarding the synergistic effect of integrating Pop Up Book media and PBL in elementary science learning.

Overall, the research results indicate that the use of Pop Up Books based on Problem Based Learning is effective in improving students' problem solving skills regarding food chain concepts. This effectiveness is demonstrated by the higher average posttest scores in the experimental class compared to the control class, the higher N-Gain scores in the experimental class, and the results of the hypothesis test, which indicate a significant effect. Thus, the integration of visual learning media and problem based learning models can be used as a learning innovation capable of creating a more active, engaging, and meaningful learning process for elementary school students.

4. Conclusion

Based on the findings of this study, it can be concluded that the use of Problem Based Learning (PBL) based Pop Up Book media effectively improves elementary students' problem solving skills in learning food chain concepts. The integration of three dimensional visual media and problem-based learning activities enables students to understand concepts more concretely, actively engage in the learning process, and develop solutions to contextual problems. The findings provide theoretical support for constructivist learning principles, which emphasize the active construction of knowledge through interaction and problem solving experiences. Practically, this study offers an alternative instructional strategy for

elementary school teachers by demonstrating the potential of integrating visual learning media with student centered learning models to create more meaningful and engaging learning experiences. These findings also highlight the importance of combining appropriate learning media and instructional approaches to foster students' higher order thinking skills. However, this study was limited to a single school and focused only on food chain material. Therefore, future research is recommended to involve larger and more diverse samples, apply the intervention to different learning topics, and investigate its impact on other learning outcomes, such as critical thinking, creativity, collaboration, and scientific literacy.

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