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# Analysis of Students' Literacy and Problem-Solving Skills in IPAS Learning at Elementary Schools

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**Abstract:** This study examined fifth-grade students' scientific literacy and problem-solving skills in IPAS learning at MIN Baubau, Southeast Sulawesi, Indonesia. A quasi-experimental design was employed involving 48 students, with the experimental group (n = 24) receiving project-based learning (PjBL) supported by interactive media and the control group (n = 24) receiving conventional instruction. Data were collected using scientific literacy and problem-solving questionnaires, complemented by classroom observations focusing on student character (e.g., curiosity and motivation) and participation. Descriptively, students' scientific literacy was categorized as moderate to good (overall M = 63%), and problem-solving skills were categorized as good (overall M = 68%). Independent samples t-tests showed that the experimental group achieved significantly higher scores than the control group in scientific literacy ($t = 3.427$, $p = 0.001$) and problem-solving skills ($t = 3.865$, $p < 0.001$). A one-way ANOVA also indicated a significant effect of student character on learning outcomes ($F = 4.213$, $p = 0.019$). These findings suggest that integrating PjBL with interactive media can more effectively enhance students' scientific literacy and problem-solving skills than conventional instruction, while learner-related factors contribute meaningfully to performance. The study provides practical implications for designing IPAS instruction that combines active learning, interactive cognitive supports, and strategies to foster student engagement in elementary education.

**Keywords:** Elementary Education, Problem Solving, Scientific Literacy

## A. Introduction

Scientific literacy and problem-solving skills are fundamental competencies in science and social studies (IPAS) learning at the elementary school level. Scientific literacy refers to students' ability to understand scientific concepts, interpret data, evaluate evidence-based information, and apply scientific knowledge to explain phenomena in everyday life (Gök & Boncukçu, 2023). In elementary education, scientific literacy is not limited to memorization of facts but involves higher-order thinking processes such as critical reasoning, evidence-based decision making, and contextual application of scientific concepts. These competencies are essential in preparing students to become

scientifically informed individuals who are capable of responding to real-world challenges.

Alongside scientific literacy, problem-solving skills play a crucial role in IPAS learning. Problem-solving skills encompass students' abilities to identify problems, formulate hypotheses, design and conduct investigations, analyze results, and evaluate solutions (Syarif et al., 2025). Previous studies indicate that students with higher levels of scientific literacy tend to demonstrate stronger problem-solving abilities, as they are better equipped to connect conceptual understanding with practical applications (Putri et al., 2025). Therefore, developing both scientific literacy and problem-solving skills in an integrated manner is a key objective of effective IPAS instruction in elementary schools.

Recent research has highlighted the effectiveness of active learning strategies in fostering these competencies. Instructional approaches such as project-based learning (PjBL), inquiry-based learning, and the use of interactive media have been shown to enhance students' engagement, conceptual understanding, and problem-solving performance (Sujaryanto et al., 2025; Aristanti & Fatayan, 2024; Anggraini & Pratiwi, 2024). In particular, PjBL encourages students to actively construct knowledge through meaningful projects, collaboration, and reflection, while interactive media can support visualization, experimentation, and student motivation. However, many existing studies examine these instructional strategies in isolation or focus on a single learning outcome, such as either scientific literacy or problem-solving skills.

Despite the growing body of literature, clear research gaps remain, especially in the context of elementary IPAS learning in Indonesia. First, relatively few studies have simultaneously examined the combined effects of instructional strategies (such as PjBL integrated with interactive media) on both scientific literacy and problem-solving skills at the elementary level. Second, although student dispositions such as curiosity, creativity, and motivation are widely recognized as important factors in learning, their roles are often examined separately from instructional strategies. Third, contextual factors such as students' socioeconomic backgrounds are rarely incorporated into empirical analyses, even though they may influence learning opportunities and outcomes. As a result, there is limited empirical evidence that integrates instructional, individual, and contextual factors within a single analytical framework, particularly in Indonesian elementary school settings.

Recent studies emphasize the importance of adopting a more holistic perspective in IPAS learning. Karan and Brown (2022) argue that scientific literacy development requires not only conceptual understanding but also the ability to analyze, evaluate, and apply scientific information in real-life contexts. Similarly, Alman et al. (2024) report that project-based and problem-based learning approaches, when supported by interactive media and educational technology, significantly enhance students'

problem-solving skills. Furthermore, Dwijayanti and Wiarta (2024) demonstrate that laboratory activities and scientific discussions contribute positively to both conceptual understanding and problem-solving performance, while Hasan (2024) highlights the influence of student motivation, curiosity, and creativity on learning effectiveness. Nevertheless, empirical studies that integrate learning strategies, student characteristics, and contextual backgrounds in a comprehensive analysis remain limited.

Accordingly, this study positions itself as an integrative investigation of scientific literacy and problem-solving skills in elementary IPAS learning. Rather than claiming methodological novelty, the contribution of this study lies in its effort to examine the effects of project-based learning supported by interactive media while simultaneously considering student characteristics (such as curiosity and creativity) and socioeconomic background. By adopting this integrative perspective, the study seeks to provide a more nuanced understanding of how instructional strategies and learner-related factors jointly influence students' scientific literacy and problem-solving abilities in Indonesian elementary schools.

The findings of this study are expected to offer both practical and theoretical contributions. Practically, the results can inform elementary school teachers and curriculum developers in designing IPAS learning strategies that effectively promote scientific literacy and problem-solving skills. Theoretically, the study contributes to the literature on elementary science education by providing empirical evidence on the integrated roles of instructional approaches, student dispositions, and contextual factors. Thus, this research addresses existing gaps in the literature and provides a foundation for future studies on holistic IPAS learning models at the elementary level.

Research Questions

1. Is there a significant difference in scientific literacy between students taught using project-based learning with interactive media and those taught using conventional instruction in elementary IPAS learning?
2. Is there a significant difference in problem-solving skills between students taught using project-based learning with interactive media and those taught using conventional instruction?

Research Hypotheses

$H_1$: Students in the experimental group who receive project-based learning supported by interactive media demonstrate significantly higher scientific literacy scores than students in the control group who receive conventional instruction.

$H_2$: Students in the experimental group who receive project-based learning supported by interactive media demonstrate significantly higher problem-solving skill scores than students in the control group who receive conventional instruction.

**B. Methods**

This study employed a descriptive quantitative method with a cross-sectional approach aimed at analyzing students' scientific literacy and problem-solving skills in IPAS learning at elementary schools. The research was conducted at MIN Baubau, located in Baubau City, Southeast Sulawesi, during the even semester of the 2025/2026 academic year. The respondents consisted of 48 fifth-grade students from MIN Baubau, divided into two groups: an experimental group and a control group, each comprising 24 students. The sampling technique used was purposive sampling, based on the school's readiness and the willingness of both teachers and students to participate (Fauzi et al., 2023). Data were collected through a scientific literacy questionnaire designed to measure students' ability to understand IPAS concepts, evaluate scientific information, and apply knowledge in practical contexts. A problem-solving questionnaire was also used to assess students' skills in formulating problems, identifying solutions, and evaluating experimental outcomes. The research procedure began with selecting MIN Baubau as the study site, followed by dividing the participants into experimental and control groups. The experimental group received project-based learning supported by interactive media, while the control group was taught using conventional instructional methods.


**Figure 1. Data Collection Procedure**

The image illustrates the sequence of data collection steps used in this study. The process begins with the scientific literacy questionnaire, which aims to assess students' understanding of IPAS concepts and their ability to analyze and apply scientific information. The second step involves the problem-solving skills questionnaire, which measures students' capacity to identify problems, formulate solutions, and evaluate results. The third step focuses on classroom observations to gather qualitative data related to students' character, motivation, and interaction during the learning process. The final step is data compilation and comparison, where all collected data from questionnaires and observations are organized and analyzed to obtain a

comprehensive picture of students' scientific literacy and problem-solving abilities.

The quantitative data in this study were analyzed using descriptive statistical techniques to provide an overview of students' performance in scientific literacy and problem-solving skills. The analysis included calculating the mean, standard deviation, and score distribution to describe students' levels of understanding and skill mastery in both areas. These statistical measures were used to identify general patterns, such as the average level of literacy and problem-solving competence, as well as variations that might exist among students within each group. Descriptive analysis helped to illustrate the overall trends in how students performed during IPAS learning activities. To further examine differences between the experimental and control groups, inferential statistical tests such as t-tests or ANOVA were conducted. These tests aimed to determine whether the implementation of project-based learning and interactive media had a significant effect on improving students' literacy and problem-solving abilities. In addition, supporting variables such as student character and socioeconomic background were analyzed to understand their influence on learning outcomes. The quantitative findings were complemented with qualitative interpretations drawn from classroom observations, which provided deeper insights into students' motivation, engagement, and interaction patterns during the learning process, thereby giving a more comprehensive understanding of the research results.

## C. Results and Discussion

### Results

This study aimed to answer two main research questions: (1) How is students' scientific literacy ability in IPAS learning at MIN Baubau? and (2) How is students' problem-solving ability in IPAS learning at MIN Baubau? Based on the questionnaire results, students' scientific literacy ability was categorized as moderate to good, with an average score of 63%, while their problem-solving ability was in the good category, with an average score of 68%. This indicates that most students were able to understand IPAS concepts, evaluate scientific information, and effectively formulate and solve problems.

**Table 1. Comparison of Average Scores between Experimental and Control Groups**

| Students' Ability | Experimental Group | Control Group | Overall Average |
|---|---|---|---|
| Scientific Literacy | 68% | 58% | 63% |
| Problem-Solving Skills | 73% | 63% | 68% |

Found that students who were more active in discussions and demonstrated high curiosity achieved better scores in both scientific literacy and problem-solving skills. This finding is consistent with (Lombardi, 2022) (Afni & Bahri, 2025) who stated that

students' motivation and active engagement significantly influence both competencies. It also confirms that the development of scientific literacy and problem-solving skills depends not only on the learning model but also on students' characteristics and motivation. However, there were some findings that did not fully support this trend. For example, (Sukaria, 2025) reported that certain models of scientific literacy assessment were not entirely effective in improving conceptual understanding. This suggests that the success of instructional methods depends on their implementation, teacher readiness, and classroom context. Overall, the study concludes that students' scientific literacy and problem-solving skills at MIN Baubau are relatively good, with the experimental group performing better than the control group. These findings strengthen previous studies and demonstrate that a combination of innovative learning strategies, interactive media, and contextual approaches that consider student character and motivation can significantly improve students' scientific literacy and problem-solving skills.

To determine whether there were significant differences between the experimental and control groups, the data were analyzed using an independent sample t test and a one way ANOVA. The purpose of these analyses was to evaluate the effectiveness of project based learning combined with interactive media in improving students' scientific literacy and problem solving skills, as well as to examine the influence of supporting variables such as student character. The results showed that the differences between the two groups were statistically significant, indicating that the applied learning strategy had a real impact on student performance. The ANOVA test also demonstrated that student character contributed significantly to the development of both competencies.

**Table 2. Results of t Test and ANOVA for Students' Scientific Literacy and Problem Solving Skills**

| Students' Ability | Test Type | F or t Value | Sig. (p) | Mean Difference | Interpretation |
|---|---|---|---|---|---|
| Scientific Literacy | t test | 3.427 | 0.001 | 10.21 | Significant difference between groups |
| Problem Solving Skills | t test | 3.865 | 0.000 | 9.74 | Significant difference between groups |
| Character Influence | One way ANOVA | 4.213 | 0.019 | — | Significant effect of student character |

Shows that the t test results for scientific literacy (t = 3.427, p = 0.001) and problem solving skills (t = 3.865, p = 0.000) indicate significant differences between the experimental and control groups at the 0.05 significance level. This means that students who received project based learning with interactive media performed better than those who learned using conventional methods. The ANOVA result (F = 4.213, p = 0.019) indicates that student character had a significant influence on learning outcomes. Traits such as curiosity, motivation, and responsibility positively

contributed to the improvement of scientific literacy and problem solving abilities. Overall, the findings confirm that the combination of innovative learning strategies and supportive student characteristics effectively enhanced students' competencies in IPAS learning.

The findings of this study reveal that students' scientific literacy and problem-solving skills at MIN Baubau fall within moderate to good categories. The average scores of 63 percent for scientific literacy and 68 percent for problem-solving ability indicate that students have a sufficient understanding of IPAS concepts and are able to apply this knowledge effectively in practical contexts. The experimental group's higher performance compared to the control group shows that learning strategies integrating project-based approaches and interactive media are more effective in fostering both conceptual understanding and analytical skills. This result demonstrates that active engagement through contextual learning helps students not only retain information but also use it to explain real-world phenomena more critically and creatively. As shown in the table, the experimental group that received project-based learning and interactive media obtained higher scores compared to the control group that used conventional teaching methods. These results align with previous studies. For instance, (Suminar et al., 2024) found that project-based learning improves students' scientific literacy, while (Syahyadi et al., 2024) emphasized the importance of teacher support and a conducive learning environment. Divrik et al., 2021 reported that students' problem-solving skills improved through Problem-Based Learning and the use of interactive media, reinforcing the findings of this research.

The t-test and ANOVA results provide further evidence of the significant effect of the intervention. The t-test results show that the experimental group achieved significantly higher scores in both scientific literacy ($t = 3.427$, $p = 0.001$) and problem-solving skills ($t = 3.865$, $p = 0.000$) than the control group. These findings suggest that project-based learning supported by interactive media creates more meaningful learning experiences, allowing students to explore, investigate, and reflect on scientific problems in a structured way. The ANOVA analysis also shows a significant effect of student character ($F = 4.213$, $p = 0.019$), confirming that intrinsic factors such as curiosity, motivation, and responsibility play an important role in learning outcomes. This highlights that effective IPAS learning requires not only innovative methods but also personal engagement from the students themselves.

The improvement in students' performance supports previous research emphasizing the importance of active and contextual learning strategies. For example, found that project-based learning can improve scientific literacy, while Dharma & Lestari (2024) noted the importance of teacher guidance and a supportive classroom environment. Likewise, the use of interactive media in this study aligns with findings by Putri et al. (2025), who demonstrated that digital and interactive tools can enhance students' problem-solving abilities. In this study, students in the experimental group who were

more active in discussions and showed higher curiosity achieved better results, supporting Fang et al. (2022) and OECD, who emphasized the role of motivation and engagement in developing these competencies. Despite these positive results, some limitations were observed. Riyadi (2024) reported that certain scientific literacy assessment models are not always effective in improving conceptual understanding, which aligns with this study's finding that effectiveness depends on contextual factors such as teacher readiness and classroom management. Therefore, while project-based learning and interactive media have proven effective, their success depends on proper implementation and continuous teacher support. Overall, this study strengthens the argument that innovative learning strategies, when supported by positive student character and conducive learning environments, can significantly improve scientific literacy and problem-solving skills among elementary school students in IPAS learning.

**Table 3. Supporting Studies**

| Author(s) & Year | Title / Source | Key Finding |
|---|---|---|
| (Apriani et al., 2025) | *Systematic Literature Review: Mind Mapping Learning Model on Students' Creative Thinking Skills in Natural and Social Sciences Subjects in Elementary Schools – Terampil: Jurnal Pendidikan dan Pembelajaran Dasar* | Mind mapping strategies effectively improve creative thinking and conceptual understanding in natural and social science learning at the elementary level. |
| (Busyairi et al., 2023) | *Development of Physics Learning Tools Based on the STEM-Creative Problem Solving Model to Increase Students' Scientific Literacy and Creativity – Kappa Journal* | The integration of STEM and creative problem-solving models enhances students' scientific literacy and creative reasoning abilities. |
| (Damayanti et al., 2021) | *Students' Problem-Solving Skills through Problem-Based Learning Module: Macrozoobenthos as Bioindicator Water Quality Module – AIP Conference Proceedings* | Problem-based learning modules significantly strengthen analytical and problem-solving skills related to scientific inquiry. |
| (Darmawan & Sudarma, 2025) | *An Interactive Learning Video Innovation Based on Problem-Based Learning to Improve Students' Metacognition in Grade IV of Elementary School – Jurnal Media dan Teknologi Pendidikan* | The use of interactive learning videos in a PBL framework promotes students' metacognitive awareness and reflective thinking. |
| (Dharma & Lestari, 2022) | *The Impact of Problem-Based Learning Models on Social Studies Learning Outcomes and Critical Thinking Skills for Fifth Grade Elementary School Students – Jurnal Ilmiah Sekolah Dasar* | The problem-based learning approach significantly improves students' critical thinking and social understanding in IPAS learning. |
| (Doyan et al., 2024) | *Trends Research Project Based Learning (PjBL) Model to Improve Problem Solving Skills in Students' Science Learning (2015–2024): A Systematic Review – Jurnal Penelitian Pendidikan IPA* | PjBL models consistently enhance problem-solving and inquiry-based skills in science education over the last decade. |
| (Fitriati et al., 2023) | *Measuring the Effect of Problem Based Learning with Instructional Video on Primary School Students' Problem Solving Skills Development – Jurnal Ilmiah Teunuleh* | Combining PBL and instructional videos effectively improves students' problem-solving performance in primary education. |

**Table 4. Not Supporting / Mixed Evidence**

| Author(s) & Year | Title / Source | Summary of Findings |
|---|---|---|
| (Fitriati et al., 2023) | *The Effect of Study Habits on the Learning Outcomes of Natural and Social Sciences (IPAS) at Elementary School Students – Edunesia: Jurnal Ilmiah Pendidikan* | Study habits affect learning outcomes but do not directly enhance problem-solving or creative skills. |
| (Julius, 2022) | *The Relationship Between Self-Concept and Problem-Solving Skills on Students' Attitude Towards Solving Algebraic Problems – Contemporary Mathematics and Science Education* | Findings show that while self-concept correlates with problem-solving attitudes, the effect on elementary-level literacy and creativity remains unclear. |
| (Almarashdi & Jarrah, 2023) | *Determining the Effect of Bar Model Technique on Students' Mathematical Word Problem Solving Skills – JCTE* | The bar model technique improves mathematical problem-solving but is limited to arithmetic contexts without integration of broader creative or literacy dimensions. |

The studies summarized in Table 3 demonstrate that innovative learning approaches such as mind mapping, problem-based learning, STEM integration, and project-based learning consistently contribute to the enhancement of students' cognitive and metacognitive abilities in elementary education. Interactive learning media, when aligned with inquiry-based and contextual models, provide meaningful learning experiences that foster creativity, scientific literacy, and analytical thinking. These approaches emphasize active engagement, real-world problem contexts, and reflective processes that help students connect theoretical knowledge with practical applications. The combination of visual learning aids, instructional videos, and structured challenges enables students to develop deeper conceptual understanding and self-regulated learning skills, supporting both academic achievement and holistic intellectual growth. Conversely, the studies presented in Table 4 show mixed or limited evidence regarding the direct influence of certain instructional factors on problem-solving and creative skills. Research focusing on study habits, self-concept, or specific mathematical techniques indicates improvements in general academic performance or motivation, but these outcomes do not necessarily extend to higher-order thinking or creative problem-solving abilities. The scope of these studies tends to remain within procedural or attitudinal domains, lacking the integration of contextual and reflective elements essential for deeper cognitive development. As a result, while these studies contribute to understanding related learning behaviors, they highlight the need for more comprehensive models that link cognitive, creative, and contextual dimensions of learning.

## Discussion

The results indicate that students taught through project-based learning supported by interactive media achieved significantly higher scientific literacy and problem-solving scores than those taught through conventional instruction. This improvement can be

explained by the nature of PjBL, which positions students as active constructors of knowledge through inquiry, investigation, and the production of meaningful outputs (Dewi et al. 2022). Through projects, students engage in authentic tasks that require them to connect IPAS concepts with real contexts, thereby strengthening conceptual understanding and scientific reasoning. In addition, interactive media likely enhanced learning by supporting visualization, representation of abstract concepts, and immediate feedback. From the perspective of multimedia learning principles, well-designed visual and interactive resources can reduce cognitive overload and help learners integrate verbal and visual information more effectively, resulting in deeper comprehension and better performance in tasks requiring analysis and application.

Beyond instructional strategy, the ANOVA findings underscore that student character significantly contributed to learning outcomes. Traits such as curiosity, motivation, and responsibility likely function as internal drivers that sustain engagement during project work, encourage persistence, and support reflective thinking. This aligns with perspectives from self-regulated learning and intrinsic motivation research, which suggest that students who are more curious and motivated tend to set goals, monitor understanding, seek additional information, and revise their strategies when encountering difficulties. In a PjBL setting, these dispositions become particularly important because learning demands initiative, collaboration, and iterative problem solving. Consequently, the intervention's effectiveness may not only be attributed to the model itself but also to how the model activates and leverages learner engagement and self-regulation.

While the findings are strongly positive, several limitations should be acknowledged. First, the sample size was relatively small and drawn from a single school context, which limits generalizability to other elementary schools with different characteristics. Second, the study was conducted within a short instructional period, which may not fully capture long-term impacts on scientific literacy and problem-solving development. Third, the effectiveness of PjBL and interactive media is highly dependent on implementation quality. Teacher readiness such as skill in facilitating inquiry, managing group work, and integrating media into projects can determine whether students experience meaningful exploration or merely complete procedural tasks. These limitations suggest that future research should include larger multi-school samples, longer interventions, and explicit measurement of implementation fidelity and teacher support.

The findings also need to be interpreted in relation to the mixed evidence reported in Table 4. Studies focusing on factors such as study habits or self-concept often show improvements in general achievement or attitudes, but not necessarily in higher-order outcomes like scientific reasoning or creative problem solving. One possible explanation is that such factors, when examined alone, may not provide learners with structured opportunities to practice complex thinking processes (e.g., analyzing

evidence, designing solutions, evaluating outcomes). In contrast, the integrated approach in this study combined a pedagogical structure (PjBL) that requires inquiry and production, with cognitive tools (interactive media) that support representation and exploration. This synergy may explain why higher-order competencies improved more clearly here compared to studies that emphasize learning behaviors without embedding them in an instructional design that systematically trains scientific reasoning and problem solving (Kasemsap, 2021).

Overall, the discussion suggests that effective IPAS learning requires a synergistic combination of (1) pedagogical strategy, where PjBL creates authentic problem contexts and promotes active knowledge construction; (2) cognitive tools, where interactive media supports comprehension and inquiry through visualization and engagement; and (3) learner engagement, where curiosity and motivation sustain effort and self-regulation throughout the learning process. Therefore, efforts to improve scientific literacy and problem-solving skills in elementary IPAS should not rely on a single component. Instead, learning environments should be intentionally designed to integrate active pedagogy, supportive media, and the cultivation of student dispositions that encourage inquiry, persistence, and reflective thinking.

## D. Conclusions

This study concludes that students' scientific literacy and problem-solving skills in IPAS learning at MIN Baubau are generally at a moderate to good level. Empirically, students who participated in project-based learning supported by interactive media achieved significantly higher scores in both scientific literacy and problem-solving skills than students who experienced conventional instruction. The statistical results from the independent sample t-test confirmed significant differences between the experimental and control groups for both competencies, while the one-way ANOVA analysis demonstrated that student character particularly traits such as curiosity and motivation had a significant influence on learning outcomes. These findings indicate that instructional strategies and learner-related factors jointly contribute to students' performance in IPAS learning.

Overall, the results provide empirical evidence that project-based learning combined with interactive media is more effective than traditional approaches in enhancing elementary students' scientific literacy and problem-solving abilities. The study also confirms that student character plays an important supporting role in the success of instructional interventions, reinforcing the view that learning outcomes are shaped by both pedagogical design and individual engagement.

Future research is recommended to involve larger samples and multiple school contexts to improve the generalizability of the findings. Longitudinal studies are also needed to examine the sustained effects of project-based learning and interactive

media on students' scientific literacy and problem-solving development over time. In addition, future studies may explore and compare other instructional approaches, such as inquiry-based or challenge-based learning, to gain a deeper understanding of how different pedagogical models influence the development of higher-order competencies in elementary IPAS learning.

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