Inquiry-based student worksheets to support numeracy skills

Wilibaldus Bhole
Universitas Nurul Huda, Sumatera Selatan, Indonesia
wilibaldusbhoke87@gmail.com

Abstract
Background: This study was motivated by the difficulties students face in understanding the concepts taught in the topics of Integers and Decimals.

Aim: The research aimed to determine the impact on students' numeracy skills after utilizing Student Worksheets (SW) with an Inquiry-Based Learning Model in Grade V at SDI Lengkosambi.

Method: A quasi-experimental design with pre-test and post-test was employed. Data were collected through numeracy tests conducted before and after the implementation of the SW.

Results: The findings revealed a significant improvement in students' numeracy skills. The average numeracy score increased from 60% before using the SW to 80% after its implementation. Additionally, the numeracy test scores showed an increase from 42% in the initial AKM Numeracy test to 50% in the final AKM Numeracy test.

Conclusion: The use of SW with an Inquiry-Based Learning Model effectively enhanced students' numeracy skills. This improvement indicates that students became more enthusiastic about learning and were better able to solve numeracy-related problems.

Introduction
Numeracy skills are crucial for students' academic success and everyday life, encompassing the ability to understand and work with numbers in various contexts (Peng et al., 2020). Research indicates that interventions focusing on quantitative and spatial mathematical language can enhance early numeracy skills in preschool children (O’Meara et al., 2024), including practical applications such as budgeting for disadvantaged groups (Kim, 2023). Functional numeracy, the skills needed for everyday mathematical tasks like managing medication or cost-effective shopping, is essential (Ichikowitz et al., 2023). Parents play a significant role in fostering children's numeracy skills through daily activities (Bonifacci et al., 2021). The importance of numeracy skills in the workplace and daily life underscores the need for a strong foundation in numeracy (Purnomo et al., 2022). Therefore, numeracy skills must be developed from the elementary school level to ensure a solid foundation for students' future. Companies value graduates with strong numeracy skills and often include numeracy assessments in their recruitment processes (Mealings, 2022). Children entering school with limited numeracy skills may face difficulties later (Napoli et al., 2021), and home numeracy practices have been linked to enhanced mathematical skills in elementary school children (Girard et al., 2021).

In Indonesia, there is a growing concern about the low levels of numeracy skills among students, as evidenced by various national and international assessments (Hidayatullah & Csíkos, 2022). Indonesian students often perform below expected levels of mathematics proficiency compared to their global counterparts, with international surveys such as PISA and TIMSS consistently showing poor rankings in mathematics (Hidayatullah & Csíkos, 2022).
Additionally, Indonesian students' numeracy abilities, particularly in operations like multiplication, are notably low (Andriani et al., 2022; Rohendi, 2019). The importance of addressing this issue is underscored by the development of the Numeracy Skills Test as part of the Minimum Competency Assessment (MCA) in the country, aiming to improve students' mathematical abilities (Purnomo et al., 2022). To further improve numeracy skills, it is crucial to consider teachers' Pedagogical Knowledge (PK) and Pedagogical Content Knowledge (PCK), which significantly impact instructional quality and students' learning outcomes (Yilmaz, 2019). In this study, we propose "Inquiry-Based Student Worksheets" as a means to address these numeracy challenges.

Inquiry-Based Student Worksheets (IBSW) are educational tools designed to engage students through the principles of inquiry-based learning (IBL), which encourage exploration, questioning, and problem solving (Liu et al., 2020). IBL includes structured, guided, and open inquiry, which varies based on teacher guidance and student autonomy (Rodríguez et al., 2019). Structured inquiry involves teacher-provided problems and frameworks, guided inquiry includes questions that encourage independent exploration, and open inquiry allows students to lead the cycle of inquiry (Rodríguez et al., 2019). Research shows that IBL has a positive impact on students' motivation, achievement, and interest in learning in various educational contexts, such as science, mathematics, and nursing (Bulková et al., 2020; Safitri, 2021; Supriatna et al., 2024; Wong et al., 2023). Incorporating IBL principles through IBSW is expected to significantly increase student engagement, critical thinking, and knowledge acquisition.

The novelty of this research lies in the implementation of the Inquiry-Based Student Worksheet (IBSW) developed by Yokri & Saltifa (2020), specifically designed to enhance students' numeracy skills. While previous studies have shown the effectiveness of inquiry-based learning (IBL) in various educational settings (Liu et al., 2020; Supriatna, 2024; Wong, 2023), this research uniquely addresses the specific numeracy challenges faced by Indonesian students. The development of IBSW was meticulously carried out, integrating IBL principles into student worksheets to foster a more engaging and effective learning environment. This customized approach not only meets general educational needs but also addresses the unique contextual factors influencing numeracy skills in Indonesia, offering new perspectives and practical solutions to persistent educational challenges.

**METHODS**

**Research Design:**

This study used a quasi-experimental design with a pre-test and post-test control group to assess the impact of using Inquiry-Based Student Worksheets (IBSW) (Baş, 2021). This design allows comparison of results before and after the intervention between the experimental and control groups, thereby facilitating the evaluation of the effectiveness of IBSW in improving learning outcomes. Quasi-experimental designs are widely used in educational research to evaluate interventions, offering a structured framework for assessing new initiatives and programs (Zajić & Maksimović, 2022). By comparing pre- and post-intervention outcomes, this design provides valuable insight into the effectiveness of educational strategies and tools such as IBSW. In conclusion, a quasi-experimental design with pre-test and post-test measurements in the control
group is a powerful method for evaluating the impact of educational interventions such as IBSW on students' numeracy abilities.

**Participants:**

The study participants consisted of fifth-grade students at UPTD SDI Lengkosambi. The experimental group comprised students using Inquiry-Based Student Worksheets (IBSW), while the control group consisted of students using conventional teaching methods. Participants were randomly selected to ensure the equivalence of both groups prior to the intervention.

**Instruments:**

The instruments used in this study included a numeracy test designed to measure students' numeracy skills. This test was administered to both groups before (pre-test) and after (post-test) the intervention. The numeracy test included curriculum-aligned questions aimed at evaluating students' understanding of numeracy concepts.

**Data Analysis:**

Data analysis was conducted using both descriptive and inferential methods. Descriptive analysis was employed to describe the pre-test and post-test data from both groups, including mean values, standard deviations, and score distributions. Inferential analysis was conducted using the t-test to compare the changes in pre-test and post-test scores between the experimental group and the control group. The purpose of the t-test was to determine whether there was a statistically significant difference in the improvement of numeracy skills between the two groups following the intervention.

**RESULTS AND DISCUSSION**

**Result**

This study employed a quasi-experimental design with pre-test and post-test in the control group to assess the effectiveness of using Inquiry-Based Student Worksheets (IBSW) in enhancing students' numeracy skills. The research involved a total of 30 fifth-grade students at UPTD SDI Lengkosambi. These students were randomly assigned to one of two groups: an experimental group and a control group, each consisting of 15 students. The experimental group utilized IBSW during the intervention period, while the control group continued with conventional teaching methods. This design allowed for a comparative analysis of numeracy outcomes between the two groups, both before and after the intervention, to evaluate the effectiveness of the implemented instructional approach.

The pre-test and post-test results demonstrated significant differences between the experimental and control groups.

**Experimental Group:**

In the pre-test, the average numeracy score of students in the experimental group was 42%. After the intervention using Inquiry-Based Student Worksheets (IBSW), the average score significantly increased to 80% in the post-test. This indicates that the inquiry-based learning method had a substantial positive impact on enhancing students' numeracy skills.
Control Group:
In the pre-test, the average numeracy score of students in the control group was 45%. After following conventional teaching methods, the average score increased to 50% in the post-test. Although there was an increase, it was much smaller compared to the experimental group, indicating that conventional teaching methods were less effective in improving students' numeracy skills.

Table 1. Average Pre-Test and Post-Test Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Average Pre-Test Score</th>
<th>Average Post-Test Score</th>
<th>Average Score</th>
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<tbody>
<tr>
<td>Experimental</td>
<td>42%</td>
<td>80%</td>
<td>38%</td>
</tr>
<tr>
<td>Control</td>
<td>45%</td>
<td>50%</td>
<td>5%</td>
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Descriptive Analysis:
Descriptive analysis revealed an increase in numeracy skills in both groups following the intervention. In the experimental group, the average pre-test score was 42%, which increased to 80% in the post-test, showing an improvement of 38%. In contrast, the control group had an average pre-test score of 45%, which increased to 50% in the post-test, showing an improvement of 5%. These data indicate that students who used the Inquiry-Based Student Worksheets (IBSW) experienced a significantly greater improvement in numeracy skills compared to those who were taught using conventional methods.

Table 2. Average Pre-Test and Post-Test Scores

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Inferential Analysis:
To further understand the difference in numeracy score improvements between the two groups, inferential analysis was conducted using a t-test. The t-test results indicated a statistically significant difference (p < 0.05) in the improvement of numeracy skills between the experimental and control groups. The experimental group showed a higher increase, demonstrating the greater effectiveness of the inquiry-based learning approach using IBSW compared to conventional teaching methods. These results support the finding that the inquiry approach in mathematics education can significantly enhance student learning outcomes.

Discussion
The findings of this study indicate that the use of Inquiry-Based Student Worksheets (IBSW) significantly enhances numeracy skills among fifth-grade students at UPTD SDI Lengkosambi. The notable increase in average scores from 42% to 80% in the experimental group, compared to a smaller increase from 45% to 50% in the control group, demonstrates the effectiveness of this instructional method. IBSW promotes active learning through deep inquiry activities, encouraging students to ask questions, investigate, and discover concepts independently (Sari et al., 2023). This approach leads to a better understanding of numeracy concepts compared to the passive learning often associated with conventional methods. Additionally, the high level of student engagement in IBSW boosts motivation and interest in the subject matter, further enhancing their ability to grasp and apply numeracy skills.

The inquiry method significantly enhances students' critical thinking and analytical skills, fostering their ability to analyze information, recognize patterns, and apply numerical concepts.
across various contexts, which aligns with research findings on the positive impact of inquiry-based methods on critical thinking skills (Aswirna et al., 2024). Moreover, the development of numeracy skills, essential for academic success and decision-making in fields such as physics, business, and daily life activities, involves not only performing arithmetic operations but also interpreting and applying mathematical concepts in real-life situations. Moreover, IBSW allows for a personalized learning experience, catering to individual student’s learning paces and styles, unlike conventional methods that often adopt a one-size-fits-all approach.

This study’s results align with previous research findings by Liu et al. (2020) and Supriatna (2024), which highlight the significant improvements in students' understanding and motivation through inquiry-based learning. Wong (2023) and Bulková et al. (2020) also found similar outcomes in science and mathematics education, respectively, reinforcing the effectiveness of the inquiry approach in developing critical thinking and enhancing learning outcomes. Therefore, this study supports the integration of IBSW in numeracy education, providing a dynamic and effective learning environment that prepares students to face academic and everyday challenges competently.

CONCLUSIONS
This study demonstrates that Inquiry-Based Student Worksheets (IBSW) significantly improve numeracy skills among fifth-grade students at UPTD SDI Lengkosambi. The experimental group showed a substantial increase in scores compared to the control group, highlighting the effectiveness of the IBSW approach. The inquiry-based method fosters active learning, critical thinking, and higher student engagement. These findings align with previous research, supporting the integration of IBSW in numeracy education. Consequently, IBSW offers a promising instructional strategy to enhance numeracy skills and overall student performance.

REFERENCES


