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# Assessment of Teaching Strategies, Utilization of Student Worksheets, and Student Engagement in Science Education

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**Abstract**

Science education is essential for developing students' ability to understand and apply scientific concepts in real-world contexts. However, existing studies often examine teaching strategies, worksheet usage, and engagement in isolation, leaving a gap in understanding their interconnected dynamics. This study examines the relationships between teaching strategies, student worksheets, and student engagement in science education. Conducted in junior high schools in North Sumatra, Indonesia, with 51 participants aged 13–15, the research employed a survey method analyzed via multiple regression. Results show a strong link between teaching strategies and worksheet use. Contextualized teaching encourages worksheets for analyzing experimental data, while project-based approaches promote their use in collaborative tasks. Worksheets significantly enhance engagement by fostering participation, confidence, and problem-solving. They provide structure, deepen understanding, and strengthen critical thinking and collaboration. Aligning teaching strategies with well-designed worksheets creates a dynamic learning environment, improving engagement and outcomes. Educators and policymakers should prioritize integrative approaches and effective teaching aids to optimize learning.

**Keywords:** Teaching Strategies, Student Worksheets, Student Engagement, Science Education

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## INTRODUCTION

Science education plays a crucial role in equipping students with the skills and knowledge needed to understand and apply scientific concepts in real-world contexts. The effectiveness of teaching strategies is pivotal in fostering active learning and engagement among students. Traditional teaching approaches, such as lectures, are often criticized for being overly teacher-centered and lacking opportunities for interaction, prompting the need for more dynamic, student-centered methods (Fadillah, Asrizal, Festiyed, et al., 2024; Fadillah, Usmeldi, & Asrizal, 2024; Fadillah, Usmeldi, Lufri, et al., 2024b). These methods, including inquiry-based and collaborative strategies, can foster a more engaging and interactive learning environment. A key component of such strategies is the use of student worksheets, which provide students with structured guidance to explore and apply scientific concepts independently or collaboratively (Bakri et al., 2020; Tanjung et al., 2025).

Student worksheets are not just tools for practice; they are designed to enhance active learning by guiding students through problem-solving processes,

experiments, and discussions (Sari et al., 2019). They help bridge theoretical concepts and practical applications, enabling students to engage with material meaningfully. Research has shown that well-structured worksheets improve students' critical thinking and problem-solving skills while also promoting independent learning (Fadillah, Hirahmah, Putri, et al., 2024; Kusumawati et al., 2020). However, the effectiveness of these worksheets often depends on their integration into teaching strategies and the level of student engagement they promote.

Student engagement is another critical aspect of effective science education. Active participation, such as contributing to class discussions or engaging in group activities, allows students to better internalize and apply what they learn (Dallimore et al., 2004). It also fosters critical thinking and communication skills, enabling students to articulate and refine their understanding of scientific concepts (Blyznyuk & Kachak, 2024). High levels of engagement have been linked to improved academic outcomes and more positive attitudes toward learning (Lin & Hou, 2024). Additionally, providing timely and constructive feedback is a key element in reinforcing learning, as it helps students understand their strengths and identify areas for improvement (Gomis et al., 2024). Effective feedback fosters a reflective learning process and motivates students to continue developing their skills.

Despite the importance of these factors, there is a need for a more integrated assessment of how teaching strategies, student worksheet utilization, and student engagement interact in the science classroom. Research often addresses these components in isolation, neglecting the interconnected dynamics that influence learning outcomes (Emiliannur et al., 2017; Festiyed et al., 2022). For instance, while teaching strategies are known to influence student engagement and worksheet usage, little is understood about how these elements collectively shape learning experiences in science education. Teachers who employ student-centered methods, such as project-based or inquiry-based learning, are likely to enhance both the use of worksheets and the level of student engagement, creating a more interactive and productive classroom environment (Strat & Jegstad, 2023; Urdanivia Alarcon et al., 2023).

Moreover, the relationship between student worksheets and classroom participation warrants further exploration. Worksheets that integrate collaborative tasks and group discussions can significantly increase student involvement, encouraging them to actively engage with both content and peers (Belland et al., 2017; Kusumawati et al., 2020). Participation in turn creates opportunities for immediate feedback, which reinforces learning and fosters a culture of continuous improvement (Wisniewski et al., 2020). When students actively participate and interact with the material, they are more likely to internalize the feedback they receive, leading to better learning outcomes.

Understanding these interrelationships is essential to creating an optimized learning environment in science education. The integration of effective teaching strategies, purposeful worksheet design, and active student participation can lead to a virtuous cycle where each component reinforces the others. For example, engaging teaching strategies encourage the use of worksheets, which in turn fosters participation and makes feedback more meaningful.

Given the need for a holistic approach, this study aims to comprehensively assess the interplay between teaching strategies, the utilization of student worksheets, and student engagement in science education. Specifically, the research will:

- Evaluate the relationship between teaching strategies applied by teachers and students' use of student worksheets.
- Examine the relationship of using student worksheets on student engagement in science classes.

This research seeks to provide actionable insights for educators, enabling them to develop best practices that enhance teaching effectiveness and student outcomes in science education. By addressing the gaps in existing studies, this study contributes to a deeper understanding of the dynamic interactions within the science classroom, paving the way for more effective and engaging educational practices.

## METHODS

### Participants

The study was conducted in junior high schools in North Sumatra Province, Indonesia. Data collection involved an online questionnaire created using Google Forms, distributed via social media platforms such as WhatsApp. A total of 51 students, aged 13–15 years, participated in the study, representing a convenience sampling method. Of the respondents, 33.96% were male, and 66.04% were female, as shown in Table 1. To ensure ethical compliance, the questionnaire included a consent statement, informing participants about the study's purpose, their voluntary participation, and their right to withdraw at any time. Responses were completed without coercion, with no incomplete or duplicate entries, ensuring all data were valid for analysis.

**Table 1.** Demographics

| Criteria | Items | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 17 | 33.33% |
| | Female | 34 | 66.67% |
| Grade | VII | 13 | 25.49% |
| | VII | 21 | 41.18% |
| | IX | 17 | 33.33% |

Although the sample size of 51 students may appear modest, the data collected from diverse schools provided insights representative of the student population in the region. This approach aligns with existing research, where smaller yet representative samples have yielded meaningful results (Shakroum et al., 2018). The use of an online survey facilitated broader reach and accessibility, enhancing participation rates while minimizing response biases (Dutwin & Buskirk, 2023).

### Measurement

The study examined three core variables: teaching strategies, utilization of student worksheets, and student engagement. These variables were selected due to their relevance in fostering effective science education (Fadillah, Rahmadani, Festiyed, et al., 2024). A four-point Likert scale was employed, with

responses ranging from "strongly disagree" (1) to "strongly agree" (4), enabling participants to provide nuanced feedback. To ensure the reliability and validity of the research instruments, a confirmatory factor analysis (CFA) was conducted using SmartPLS (V.4). The psychometric properties of the variables, detailed in Table 2, demonstrated strong factor loadings (≥ 0.50), composite reliability (CR ≥ 0.60), Cronbach's alpha (CA ≥ 0.60), and average variance extracted (AVE ≥ 0.50), ensuring the robustness of the measurement model (Hair et al., 2021).

**Table 2.** Instrument Properties

| Variable | Code | Item | Outer Loading | CR | CA | AVE |
|---|---|---|---|---|---|---|
| Teaching Strategies | TS1 | Teachers link science concepts to real-life phenomena | 0.915 | 0.885 | 0.882 | 0.775 |
| | TS2 | Teachers assign group projects based on science experiments | 0.835 | | | |
| Student Worksheets | SW1 | Worksheets help me understand experimental procedures | 0.796 | 0.803 | 0.805 | 0.674 |
| | SW2 | I use worksheets to analyze experimental data | 0.843 | | | |
| Student Engagement | SE1 | I actively ask questions in class discussions | 0.725 | 0.849 | 0.857 | 0.613 |
| | SE2 | I feel confident explaining concepts to peers or teachers | 0.887 | | | |
| | SE3 | Teachers encourage me to provide arguments during lessons | 0.832 | | | |
| | SE4 | I share ideas and solutions during problem-solving activities | 0.719 | | | |

## Data Analysis

Data were analyzed using SPSS (V.22) to explore the relationships between teaching strategies, the utilization of student worksheets, and student engagement. Multiple regression analysis was performed using the ENTER method, which allowed for a detailed examination of the contributions of each independent variable while controlling for others (Nayebi, 2020). This approach enabled the study to assess how teaching strategies influence the effective use of student worksheets, how worksheets facilitate student engagement, and how these elements interact to enhance overall learning outcomes. The analysis provided valuable insights to guide the development of best practices in science education.

## RESULTS AND DISCUSSION

## The Relationship Between Teaching Strategies and Utilization of Student Worksheets

The analysis of the relationship between teaching strategies and the utilization of student worksheets is presented in Table 3. Results indicate that teaching strategies significantly predict the utilization of student worksheets, with R-square values of 43.3% for worksheet use in guided experimental activities and 72.3% for worksheet use in analyzing experimental data. These findings underscore the critical role of teaching strategies in promoting effective use of worksheets.

**Table 3.** Analysis of Teaching Strategies and Student Worksheet Utilization

| **Codes** | **SW1** | | **SW2** | |
|---|---|---|---|---|
| | **β** | **SE** | **β** | **SE** |
| TS1 | 0.200 | 0.177 | 0.800*** | 0.118 |
| TS2 | 0.477** | 0.155 | 0.083 | 0.103 |
| Output Summary | | | | |
| USW1: R-square=0.433, F=19.124*** | | | | |
| USW2: R-square=0.723, F=65.274*** | | | | |

*Note*: ****p* < 0.01, *****p* < 0.001.

Teaching strategies comprised two dimensions: linking science concepts to real-life phenomena (TS1) and assigning group projects based on science experiments (TS2). The first dimension (TS1) positively influenced the use of worksheets for analyzing experimental data (SW2), with a high regression coefficient ($\beta = 0.800$, $p < 0.001$). This indicates that connecting science to real-life scenarios encourages students to use worksheets as tools for systematically documenting and analyzing data. Conversely, the second dimension (TS2) was more strongly associated with the use of worksheets to understand experimental procedures (SW1), with $\beta = 0.477$ ($p < 0.01$).

These results align with previous research emphasizing the importance of teaching methods that actively involve students in the learning process. Strategies such as project-based learning and real-world application encourage students to engage more deeply with learning aids like worksheets, fostering better comprehension and practical application of science concepts (Husin et al., 2024; Johnson et al., 2014). Furthermore, the integration of real-world examples not only motivates students but also bridges the gap between theoretical knowledge and practical understanding, enhancing their problem-solving abilities.

The findings also highlight the dual role of teaching strategies in both initiating and sustaining worksheet utilization. While TS1 promotes exploratory and observational learning, TS2 fosters organizational skills and systematic thinking through project-based activities. These complementary approaches enable teachers to tailor their methods according to the specific learning objectives and student needs.

## The Relationship Between Utilization of Student Worksheets and Student Engagement

The relationship between worksheet utilization and student engagement is summarized in Table 4. Worksheet utilization explained between 35.7% and 63.4% of the variance in student engagement, with significant F-values

($p < 0.001$). Engagement dimensions included active questioning (SE1), confidence in explaining concepts (SE2), providing arguments (SE3), and participating in problem-solving activities (SE4).

**Table 4.** Analysis of Student Worksheets and Engagement

| Codes | SE1 | | SE2 | | SE3 | | SE4 | |
|---|---|---|---|---|---|---|---|---|
| | **β** | **SE** | **β** | **SE** | **β** | **SE** | **β** | **SE** |
| SW1 | 0.164 | 0.176 | 0.279* | 0.110 | 0.317* | 0.144 | 0.065 | 0.145 |
| SW2 | 0.602** | 0.185 | 0.575*** | 0.115 | 0.430** | 0.152 | 0.710*** | 0.152 |
| Output Summary | | | | | | | | |
| SPT1: R-square=0.357, F=13.874*** | | | | | | | | |
| SPT2: R-square=0.634, F=43.263*** | | | | | | | | |
| SPT3: R-square=0.430, F=18.842*** | | | | | | | | |
| SPT4: R-square=0.470, F=22.190*** | | | | | | | | |

*Note*: *****$p < 0.05$, ******$p < 0.01$, *******$p < 0.001$.

Worksheets used to understand experimental procedures (SW1) had a significant positive impact on students' confidence in explaining concepts ($\beta = 0.317$, $p < 0.05$) and their ability to provide arguments ($\beta = 0.279$, $p < 0.05$). Similarly, worksheets used for analyzing experimental data (SW2) significantly influenced all engagement dimensions, with the highest impact on students' participation in problem-solving activities ($\beta = 0.710$, $p < 0.001$).

The use of worksheets enhances engagement by providing a structured approach to learning tasks. For instance, worksheets that guide experimental procedures help students feel more prepared and confident, fostering active participation and interaction during class discussions (Kusumawati et al., 2020). Additionally, worksheets designed for data analysis promote critical thinking and collaborative problem-solving, which are essential for meaningful engagement (Rimm-Kaufman et al., 2009).

Moreover, the structured nature of worksheets encourages students to take ownership of their learning process. By following clear guidelines and completing step-by-step tasks, students develop a sense of responsibility and self-efficacy, which further enhances their engagement. This aligns with the self-determination theory (Deci & Ryan, 2000), which posits that autonomy, competence, and relatedness are fundamental to fostering intrinsic motivation and active participation in learning activities.

**Integrating Strategies, Worksheets, and Engagement in Science Education**

These findings highlight the synergistic relationship between teaching strategies, worksheet utilization, and student engagement. Effective teaching strategies, such as linking concepts to real-world phenomena and fostering collaborative projects, provide the foundation for meaningful worksheet use. In turn, worksheets serve as practical tools that facilitate deeper engagement with science content through structured exploration, analysis, and communication.

The integration of these components creates a dynamic learning environment where students are not only passive recipients of knowledge but active participants in their educational journey. For example, teaching strategies that incorporate real-life phenomena enable students to see the relevance of science in

everyday life, while worksheets provide a tangible means for students to explore these connections (Fadillah & Sahyar, 2023). This interplay fosters a cycle of curiosity, exploration, and understanding, which is essential for effective science education.

Additionally, the findings underscore the importance of adaptability in teaching strategies. Teachers must be able to assess the specific needs and learning styles of their students to effectively implement strategies and worksheets that resonate with them. For instance, while some students may benefit from worksheets that emphasize procedural understanding, others may find data analysis tasks more engaging and informative.

The study reinforces the need for educators to adopt integrative approaches that align teaching strategies with appropriate learning aids. By designing worksheets that support active learning and engagement, teachers can create a dynamic classroom environment that motivates students and enhances their academic performance (Fadillah, Usmeldi, Lufri, et al., 2024a). Furthermore, these results underscore the potential of targeted interventions to optimize learning outcomes in science education.

### Implications for Practice and Future Research

The findings of this study have several practical implications for educators and policymakers. Teachers should prioritize strategies that actively involve students in the learning process, such as project-based learning and contextualized teaching. By aligning these strategies with the design and use of student worksheets, educators can create a cohesive framework that supports both individual and collaborative learning. Policymakers, on the other hand, should consider providing training programs that equip teachers with the skills needed to develop and implement effective teaching strategies and materials. Workshops on designing engaging worksheets and integrating them into science curricula can significantly enhance teaching effectiveness and student outcomes.

Future research should explore the long-term impact of these strategies on student performance and engagement across diverse educational settings. Investigating the role of digital worksheets and technology-enhanced learning tools in science education could also provide valuable insights into modern pedagogical practices (Festiyed et al., 2024). Moreover, qualitative studies examining students' perceptions of worksheets and engagement strategies could offer deeper understanding and inform the development of more student-centered approaches.

## CONCLUSION

This study provides important insights into the interplay between teaching strategies, the use of student worksheets, and student engagement in science education. The findings reveal a strong relationship between teaching strategies applied by teachers and the utilization of worksheets by students. Specifically, teaching methods that link science concepts to real-life phenomena encourage students to use worksheets as analytical tools for documenting and interpreting experimental data. Similarly, project-based tearning strategies motivate students to rely on worksheets for procedural guidance and task organization during

collaborative projects. These results highlight the pivotal role of teaching strategies in driving the effective use of worksheets, enhancing both the academic and practical aspects of learning. The study also sheds light on the significant impact of student worksheets on engagement in science classes. Worksheets designed to guide experimental procedures and facilitate data analysis positively influence various dimensions of engagement, including active questioning, confidence in explaining concepts, and participation in collaborative problem-solving. By providing a structured and accessible framework for learning activities, worksheets enable students to take greater ownership of their educational journey. It, in turn, fosters confidence, motivation, and active participation in class discussions and activities. The findings emphasize the need for a strategic alignment between teaching methods and the design of learning aids like worksheets. Teachers who adopt integrative approaches that combine effective strategies with thoughtfully designed worksheets can significantly enhance student engagement and learning outcomes. These results underscore the importance of innovative and targeted interventions to support the dynamic and active learning processes essential for success in science education.

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