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Elementary Students' Statistical Literacy in terms of Self-Esteem

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ABSTRACT

This study examines elementary school students' statistical literacy on data presentation in relation to self-esteem levels (low, moderate, high). Using a descriptive approach, the study involved 25 fifth-grade students at Karya Baru State Elementary School, Baubau City. Statistical literacy was analyzed through students' abilities to understand basic data concepts, interpret and relate data to real-life contexts, and communicate analytical results. Data were collected using self-esteem questionnaires, statistical literacy tests, and semi-structured interviews to support the findings. The results indicate that self-esteem has a meaningful influence on students' statistical literacy. Students with low self-esteem did not meet key literacy indicators, particularly in understanding, interpreting, and communicating data both orally and in writing. Those with moderate self-esteem showed sufficient comprehension of basic concepts and could present data in simple forms, but experienced difficulties in mathematical communication and applying concepts to new contexts. Students with high self-esteem achieved all statistical literacy indicators, demonstrating accurate reading, presentation, interpretation, and systematic communication of data. Overall, the findings emphasize the importance of integrating students' self-esteem considerations into instructional planning to improve statistical literacy in elementary education.

Keywords: Statistical Literacy, Self-Esteem, Elementary School Students

INTRODUCTION

Literacy is a fundamental skill that encompasses reading, writing, speaking, and the effective use of language in various contexts. In the field of education, literacy is not limited to language skills but also includes statistical literacy, which refers to the ability to understand and use data appropriately in daily life. This aligns with the statement by Alman, Herman, Prabawanto, & Kurino (2023) that statistical literacy is an essential component of the curriculum, preparing students to face an increasingly data-driven era. Furthermore, statistical literacy involves the ability to understand and apply statistical concepts to solve everyday problems (Ojose, 2011). Mastery of basic

statistical concepts is crucial for students to optimally develop their statistical thinking skills. Therefore, statistical literacy, as a part of statistical literacy, needs to be strengthened from the elementary school level, particularly in the topic of data presentation. However, the achievement of statistical and statistical literacy among Indonesian students remains relatively low. According to the 2018 PISA report, Indonesia ranked 72nd out of 78 participating countries (OECD, 2019b). This low achievement is influenced by various factors, including a lack of understanding of basic concepts and difficulties in connecting mathematics with real-life contexts (Hayati & Kamid, 2019). In addition to cognitive aspects, psychological factors such as self-esteem also play a significant role in the success of students' statistical literacy. The level of self-esteem can influence students' motivation, confidence, and their ability to understand and apply learning materials (Santrock, 2022). Recent studies emphasize the importance of considering self-esteem as a factor that can support the enhancement of statistical literacy from the elementary school level, especially in the topic of data presentation, Describing how teaching data/data science in elementary school can influence students' mathematical literacy supporting the idea that data presentation and processing are relevant to students' numeracy (Agustiana, Arisetyawan, & Anusaen, 2023)

In addition to cognitive factors, non-cognitive aspects such as self-esteem also influence students' statistical literacy skills (Sardin, Kusumah, Martadiputra, Priatna, & Alman, 2025). A healthy level of self-esteem can enhance students' confidence in understanding, analyzing, and communicating statistical information (Santrock, 2019). Therefore, it is important to examine elementary school students' statistical literacy in the topic of data presentation by considering self-esteem as a factor that can affect both the learning process and outcomes (Sardin et al., 2025). Sardin, Kusumah, Martadiputra, Priatna, & Alman (2025) emphasize that the interaction between statistical thinking skills and non-cognitive aspects can improve the effectiveness of learning. The researcher conducted a preliminary study involving three fifth-grade students based on their daily test scores in statistics, using a statistical literacy test. The initial results showed that students still experienced difficulties in solving contextual problems related to data presentation (Mullis et al., 2012). Based on interviews, the students reported being able to complete routine tasks, such as reading tables or determining the highest and lowest values from simple data. However, they struggled with problems requiring higher-order reasoning, for example, determining the mode from data presented in diagrams or explaining information displayed in bar graphs (Gal, Ginsburg, & Schau, 1997). Furthermore, students were not yet able to solve contextual problems that required data interpretation to address real-life situations (Sardin et al., 2025).

Statistical literacy refers to an individual's ability to understand statistical concepts, apply them in problem-solving, reason logically, connect different pieces of statistical information, and communicate the results of analysis to draw conclusions (NCTM, 2000). One important aspect of statistical literacy is statistical literacy, which is the ability to understand, analyze, and interpret statistical data, a crucial skill from elementary to secondary education (Alman, Prabawanto, & Herman, 2025; Alman, Herman, Prabawanto, & Ituga, 2025). Research indicates that appropriate learning models can have a significant impact on students' statistical literacy skills (Alman, Herman, & Prabawanto, 2024). Mastery of statistical concepts is essential for developing statistical literacy, enabling students to solve problems in real-life contexts. Findings also show that elementary school students' statistical literacy in solving PISA-style questions falls into the high and medium categories and meets most statistical literacy indicators (Alman, Herman, & Prabawanto, 2024). In the context of mathematics learning in elementary schools, particularly in the topic of data presentation, statistical literacy is necessary for students to be able to read, interpret, and communicate information presented in various forms, including tables, diagrams, and graphs. However, observations during the study revealed that many students still lack confidence when participating in mathematics lessons. During teacher explanations, some students appeared to struggle in understanding the concepts presented. Some students had not fully grasped the material but were reluctant to ask questions due to low self-confidence. This situation was also evident when completing assignments; many students faced difficulties but did not attempt to find solutions, and some even gave up before trying. Confidence in understanding and solving statistical problems is an essential component of statistical competence, as a positive attitude toward mathematics is closely related to students' academic achievement (Fitriawan, 2020). Therefore, students' self-esteem becomes a significant non-cognitive factor in supporting their statistical literacy, particularly in data presentation, as adequate confidence encourages students to attempt tasks, think critically, and communicate statistical information effectively.

Previous research has shown that there is a relationship between self-esteem and academic achievement; students with high achievement tend to have high self-esteem as well (Yeshodhara & Vishalakshi, 2012). Lackner (2015) found that self-esteem contributes approximately 13% to students' academic performance. Verdianingsih (2017) emphasized that in mathematics learning, self-esteem plays a role in improving students' learning outcomes. According to Coopersmith (in Hendriana et al., 2017), self-esteem is an individual's assessment of their own abilities, achievements, and personal value. Self-esteem influences social relationships, self-confidence, and the way individuals face challenges, including in mathematics learning. In the context of statistical literacy in elementary schools, the level of self-esteem plays a crucial role in students' statistical literacy skills, particularly in the topic of data presentation. Alman & Ituga (2025) highlighted that differences in self-confidence can affect how students

think, understand, and apply concepts in problem-solving. Therefore, self-esteem is an important non-cognitive factor that can influence how students comprehend data, interpret observational results, and communicate their findings effectively.

Students can be categorized as having low self-esteem when they perceive themselves as less capable, lack confidence in their abilities, feel they do not have sufficient skills, exhibit pessimistic attitudes, and show disinterest in daily activities. Students in this condition tend to view challenges as obstacles, give up easily before trying, and, when faced with failure, may blame themselves or even others (Fadillah, 2012). This situation indicates that self-esteem, or one's belief in their own value, is an important factor influencing students' success in achieving academic performance. Previous studies, such as those conducted by Yeshodhara & Vishalakshi (2012), Lackner (2015), and Verdianingsih (2017), have examined self-esteem from various perspectives. However, research specifically investigating the relationship between self-esteem and statistical literacy skills, particularly statistical literacy in elementary schools, remains limited. Based on this condition, it is necessary to conduct a study that examines how students' statistical literacy in the topic of data presentation is influenced by their level of self-esteem. Therefore, this study was conducted under the title: "Statistical Literacy of Elementary School Students in terms of Self-Esteem."

METHOD

This study employed a qualitative descriptive method to provide an overview of elementary school students' statistical literacy skills in mathematics learning on the topic of data presentation, taking into account their level of self-esteem. The research subjects consisted of 25 fifth-grade students at Karya Baru State Elementary School in Baubau City. Fifth grade was chosen because students at this level have learned the basic concepts of data presentation and are beginning to interpret numerical information in various forms, allowing for a more comprehensive observation of their statistical literacy development (Hasanah, Putrawangsa & Setiawati, 2024). In addition, fifth-grade students exhibit relatively stable emotional and social development, facilitating the examination of the relationship between self-esteem and statistical literacy skills (Alman & Ituga, 2025; Lina, Rahmatina & Elvi, 2024). Karya Baru State Elementary School in Baubau City was selected as the research site due to its adequate student population, supportive mathematics learning facilities, and cooperative relationship with the researcher, which facilitated data collection. Other schools were considered less suitable for providing a representative research environment. The study was conducted on March 25, 2025. The main focus was to analyze students' statistical literacy skills in completing data presentation tasks while considering variations in self-esteem levels. Data were collected using three primary instruments: statistical literacy tests, self-esteem questionnaires, and interviews.

The research implementation was divided into three stages. The first stage was the preparation stage, which included developing the research design and creating the instruments, namely a questionnaire to assess self-esteem, statistics literacy test items on data presentation material, statistics literacy indicators, and an interview guide. All instruments were validated by mathematics experts and guidance counseling lecturers to ensure content suitability and feasibility. The instruments that had been developed were then pilot-tested before being used officially, and the pilot test results were analyzed for improvement. The second stage was the implementation stage, which began with distributing the self-esteem questionnaire to all students. The questionnaire results were analyzed to categorize students into three levels of self-esteem, which then served as the basis for analyzing students' abilities (Alman & Ituga, 2025).

Table 1. Students' Self-Esteem Score Categories

No	Self-esteem Categories	Self-esteem Score
1	High	56-75
2	Medium	35-55
3	Low	15-35

In the next stage, students were asked to complete a statistical literacy test to assess their ability to solve problems related to data presentation (OECD, 2019; PISA, 2022). In addition, the researcher conducted in-depth interviews with six students selected as representatives from each self-esteem category, with two students in each category (Creswell & Poth, 2018). The data obtained from the questionnaires and test results were then analyzed using descriptive statistics (Sugiyono, 2019; Field, 2018) to describe the tendencies of quantitative data, such as frequency distribution, percentages, and mean scores. To examine differences in statistical literacy skills based on self-esteem levels, a comparative analysis was conducted across groups according to self-esteem categories

(Gravetter & Wallnau, 2017). Meanwhile, the interview data were analyzed using the interactive qualitative analysis method as proposed by Miles and Huberman (1994), which includes data reduction, data display, and conclusion drawing (Miles, Huberman, & Saldaña, 2014). The integration of quantitative and qualitative analyses aimed to provide a more comprehensive understanding of the relationship between self-esteem and students' statistical literacy skills. The final stage of the research involved compiling a report summarizing the entire process, results, and research findings (Creswell, 2014).

RESULTS AND DISCUSSION

Results

The self-esteem questionnaire was distributed to 25 elementary school students as an initial step to identify each student's level of self-confidence. The main purpose of administering this questionnaire was to categorize students into three self-esteem levels: high, medium, and low. From the questionnaire responses, information on the distribution of students' self-esteem scores was obtained, which was then processed and presented in the form of a frequency graph.

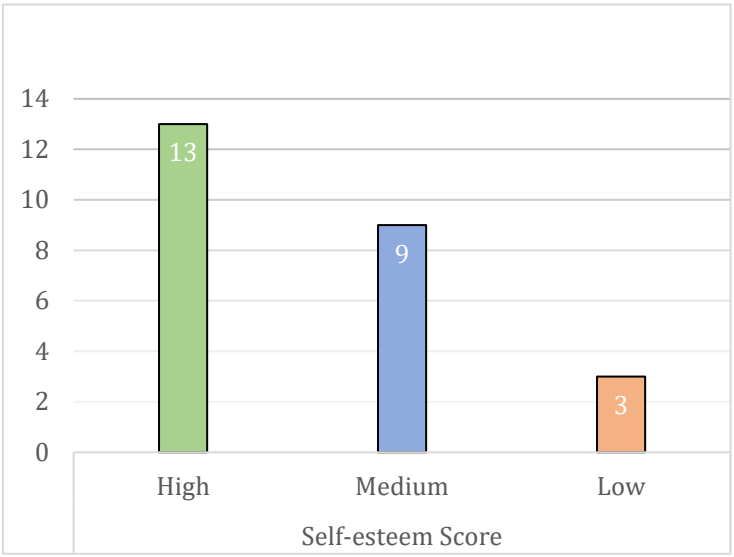

Figure 1. Students' Self-Esteem Questionnaire Scores

To gain a comprehensive understanding of elementary school students' statistical literacy, the researcher developed and administered a test specifically designed to assess students' ability to interpret data presentations. The assessment was conducted with 25 fifth-grade students at Karya Baru State Elementary School in Baubau City. The students' responses were subsequently analyzed to determine their levels of statistical literacy based on predefined indicators. The results of this analysis are presented in the table below.

Table 2. Students' Statistical Literacy Score Results

No	Students' Initials	Students' Statistical Literacy Scores					Total Score
		1	2	3	4	5	
1	DF	10	5	5	5	5	30
2	GH	10	10	15	15	10	60
3	BJ	15	15	15	15	10	70
4	FGH	15	15	10	15	15	70
5	RTG	10	15	10	10	10	55
6	WDR	10	10	10	10	10	50
7	DS	15	10	10	5	10	50
8	AL	10	15	15	15	15	70
9	ST	10	10	15	15	10	60
10	GJ	5	5	10	15	15	50

11	KL	15	10	15	5	5	50
12	MN	15	15	5	5	10	50
13	ZA	5	5	5	5	10	30
14	ZR	15	15	10	15	15	70
15	TY	15	15	15	15	15	75
16	RD	10	10	15	15	15	65
17	FH	15	15	15	10	10	65
18	NL	10	15	10	15	15	65
19	PI	15	15	15	15	15	75
20	JK	15	15	15	15	15	75
21	LU	15	10	15	15	15	70
22	YO	10	10	10	10	10	50
23	TR	10	5	10	5	10	40
24	WQ	10	5	5	5	5	30
25	SW	10	15	5	15	5	50

Based on the statistical literacy scores of fifth-grade students at Karya Baru State Elementary School in Baubau City, students' statistical literacy was categorized as high, medium, or low. Thirteen students (GH, BJ, FGH, AL, ZR, TY, RD, FH, ST, NL, PI, JK, LU) demonstrated high literacy, correctly answering most questions and showing strong understanding of data presentation. Nine students (RTG, WDR, DS, GJ, KL, MN, YO, TR, SW) were in the medium category, showing adequate understanding but struggling with more complex data interpretation. Three students (DF, ZA, WQ) fell into the low category, exhibiting limited skills and difficulties in correctly answering questions. Overall, most students (22 of 25) displayed medium to high literacy, while a small portion (3 of 25) require additional support to improve their statistical literacy in the context of data presentation.

DISCUSSION

Self-esteem is a form of self-evaluation carried out by individuals regarding their own abilities, including confidence in their achievements, both in situations of success and failure (Orth & Robins, 2014). Previous studies have shown a positive relationship between self-esteem and academic achievement, where students with high self-esteem tend to demonstrate better academic results (Alves-Martins, 2002; Lackner, 2017). Verdianingsih (2018) emphasized that self-esteem plays an important role in improving learning outcomes, particularly in the context of mathematics education. The concept of self-efficacy proposed by Bandura (1997) and reinforced by recent research (Schunk & DiBenedetto, 2019) also highlights that an individual's belief in their own abilities directly affects motivation and academic performance. Based on this theoretical foundation, this study aims to analyze the statistical literacy abilities of elementary school students across varying levels of self-esteem. Statistical literacy requires the ability to think logically, critically, and analytically (NCTM, 2000). Previous findings support the assumption that self-esteem has a significant impact on academic achievement and the ability to understand statistical concepts. Students with high self-esteem tend to be more confident in facing academic challenges, including solving mathematics problems that require higher-order thinking, whereas students with low self-esteem generally exhibit lower statistical literacy skills. Based on the data obtained from this study, several students fall into the low self-esteem category. Referring to the statistical literacy scores in the table, students with low self-esteem, such as DF (score 30), ZA (30), and WQ (30), show limited statistical literacy abilities. They struggle to understand and present data, as well as to apply logical reasoning to solve problems.

These results are consistent with previous research on the relationship between self-esteem and statistical literacy skills. Yeshodhara and Vishalakshi (2012) found that students with high self-esteem tend to have better academic performance, including logical thinking and problem-solving abilities. Lackner (2015) emphasized that confident students are more capable of overcoming difficulties in statistical concepts and applying problem-solving strategies effectively. Verdianingsih (2018) showed that differences in self-esteem levels influence students' abilities to understand contextual problems and communicate their statistical reasoning both orally and in writing. Haryanto (2019) added that students' statistical literacy is closely related to their ability to understand concepts, apply logical reasoning, and solve contextual problems, with better outcomes observed in students with high self-esteem. Furthermore, Fitriani & Susanto (2020) found variations in statistical literacy abilities among students with

moderate self-esteem, where some students could complete certain literacy indicators but still faced difficulties in written communication and concept application.

Based on the research findings, elementary school students' statistical literacy abilities vary according to their levels of self-esteem. Students with moderate self-esteem show fairly diverse abilities. For example, students coded RTG (score 55) and WDR (50) are both in the moderate self-esteem category but exhibit differences in mastery of literacy indicators. Student RTG is able to understand most of the data presentation concepts and solve some problems correctly, although errors still occur when applying concepts to new problems. In contrast, student WDR, although meeting some indicators, still struggles to communicate the results of their analysis in writing and does not fully apply concepts accurately.

Students with high self-esteem, such as BJ (70), FGH (70), AL (70), ZR (70), TY (75), RD (65), FH (65), NL (65), PI (75), JK (75), and LU (70), demonstrate better mastery of all statistical literacy indicators. This group is able to understand data presentation concepts, relate them to various life contexts, and use logical reasoning to solve problems accurately. Nevertheless, some students, such as GH (60), S9 (50), and S25 (50), still make minor errors in fulfilling one or two specific indicators.

Conversely, students with low self-esteem, such as DF (30), ZA (30), and WQ (30), show limitations in understanding basic data presentation concepts. They struggle to connect problems to different contexts, apply learned concepts to solve new problems, use logical reasoning, and communicate their thinking both orally and in writing. Students in this group tend to feel incapable, lack confidence, be pessimistic, and be less motivated when facing learning challenges (Fadillah, 2012). They often view problems or assignments as obstacles, give up easily before trying, and if they fail, tend to blame themselves or others excessively.

These findings align with meta-analytic research showing a positive effect of self-esteem on academic achievement, albeit with a moderate effect size (Korik & K, 2017). Students with high self-esteem tend to have stronger learning motivation and greater resilience when facing academic challenges. Moreover, the theory by Ghufron & Risnawita (2018) emphasizes that self-esteem is shaped through interactions with the environment, including support and recognition from teachers and peers, and influences how students respond to failure and view tasks as learning opportunities. Recent research also highlights that interventions aimed at developing self-esteem from an early age can enhance students' confidence in tackling mathematics problems, thereby potentially improving their statistical literacy skills (Alghamdi et al., 2023). Thus, self-esteem not only functions as an emotional factor but also affects affective and cognitive aspects, which significantly determine academic success and statistical literacy abilities among elementary school students.

CONCLUSION

Based on the research findings, it can be concluded that the level of self-esteem affects elementary school students' statistical literacy skills, particularly in the topic of data presentation. Students with low self-esteem tend to experience difficulties in: (1) understanding basic data presentation concepts, such as tables, charts, and how to read information; (2) relating data to real-life contexts; (3) interpreting information from various forms of data presentation; and (4) explaining the results of data analysis both orally and in writing. Students with moderate self-esteem demonstrate better abilities in understanding basic statistical concepts and can transform information into simpler forms of data presentation. They are also beginning to draw conclusions from data, although some still encounter obstacles in communicating their analysis results and applying their understanding to new problems. Meanwhile, students with high self-esteem are able to master all statistical literacy indicators effectively. They can read, present, and interpret data in various formats, understand the meaning of data in real-life contexts, and communicate their reasoning systematically and clearly. These findings indicate that self-esteem plays an important role in developing students' statistical literacy, so teachers need to consider differences in self-esteem levels when planning and implementing learning. Students with low self-esteem require more intensive guidance, gradual practice, and contextual, supportive teaching approaches. In contrast, students with moderate and high self-esteem can be given more complex and challenging data presentation activities to encourage critical and interpretive thinking skills. Practically, this study confirms that pedagogical and emotional interventions tailored to students' self-esteem levels are crucial for improving statistical literacy across all elementary school students.

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