Athens Journal of Education - Volume 12, Issue 2, May 2025 – Pages 291-306

Students' Perceptions of Their Engagement in Statistics Class Activities

*By Lukanda Kalobo**

This paper investigates how students perceive their participation in Statistics class activities. Effective pedagogical practices depend on knowing how students interact with data-related tasks. To gauge the self-reported levels of engagement, interest, and perceived relevance of Statistics activities, the study polls students in grade 12. To fully understand the perspectives of students, the study uses a quantitative strategy that includes quantitative surveys. The implications of this study add to the conversation about statistics education. The results guide the development of curricula, instructional strategies, and educational policies to encourage meaningful participation and enhance student outcomes in statistics. A generation that is data literate and capable of using data for informed decision-making is created by adapting teaching strategies to students' needs and interests. The needs and goals of the students can be used to improve statistics programs.

Keywords: statistics, engagement, pedagogical practices, teaching strategies

Introduction

In today's information-driven era, the ability to make effective decisions is crucial for organizational performance and competition (Elgendy, Elragal, & Päivärinta, 2022). Applied statisticians play a vital role in advising stakeholders across various fields, including medicine, finance, and education, with the objective of improving decision-making under conditions of uncertainty (Longford, 2021). Recognizing the growing importance of statistics skills, educational institutions have integrated statistics activities into their curricula. However, the success of these initiatives hinges upon the students' perceptions of their involvement. By gaining insights into how students perceive their engagement in statistics activities, valuable guidance can be obtained to enhance pedagogical approaches in this domain. This study aims to investigate students' perceptions of their engagement in Statistics Class activities, focusing on their levels of engagement, influencing factors, challenges faced, and suggestions for improvement.

Problem Statement

While statistics education has received much attention in recent years, there has been little study on high school students' perceptions of their participation in Statistics class activities. Understanding how students view their participation in these activities is critical for enhancing teaching tactics and the efficacy of statistics programs. There is a void in the research covering the elements that impact students'

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https://doi.org/10.30958/aje.12-2-6 doi=10.30958/aje.12-2-6

perspectives, the obstacles they face, and their ideas for improving their statistics learning experiences.

Purpose and Research Questions

Investigating students' perceptions of their participation in class activities in statistics is the purpose of this study, which aims to close the gap that currently exists. The study's research questions included the following:

- How do students perceive their level of engagement in Statistics Class activities?
- What factors influence students' perceptions of their engagement in statistics activities?
- What challenges do students encounter while engaging in Statistics Class activities?
- What suggestions do students have for improving their learning experiences in Statistics?

The solutions to these issues can help teachers, curriculum developers, and policymakers enhance the teaching of statistics.

Literature Review

Research has illustrated that engaging students within the learning process increases their attention and focus, motivates them to practice higher-level critical thinking abilities, and advances important learning encounters. To build the groundwork for future study, academics must synthesize previously published work (Watson & Webster, 2020). A literature review is a research that synthesizes and analyses previously published material to advance ideas (Post, Sarala, Gatrell, & Prescott, 2020). All research initiatives and disciplines must take into account past, pertinent literature (Snyder, 2019). Here are the key components addressed in the literature review of this study.

Statistics at High School

At its core, statistics is the study of mathematics, in which students work on collecting, processing, analysing, and concluding data. Statistical science deals with data (Bina, 2020). Kalobo (2016) believes that the use of constructivist approaches and the application of inductive approaches in statistics education, the emphasis on statistical literacy, statistical reasoning, and thinking in statistics education can all improve statistics teaching and learning. According to del Mas (2017), using statistical literacy, reasoning, and thinking to identify desired learning outcomes in statistics can be very helpful both when considering teaching objectives and when developing assessment tasks.

Students' Perceptions of Statistics

According to Bond et al. (2012), perception is the result of an interplay between cognitive and non-cognitive elements. According to Gregory (1970), this idea is a productive process that draws on prior knowledge and experience and is also in charge of organizing, interpreting, looking for meaning, or trying to make sense of a situation. According to Chiesi and Primi (2010), students start beginning classes at varying degrees of proficiency, particularly in mathematics. In every statistics lesson, students' verbal statistical reasoning and numeracy abilities are frequently put to the test and pushed. In his 1991 study, Zeidner examined students of social science who were anxious about statistics and mathematics. The results revealed a negative correlation between students' final grade in mathematics for grade 12 and their impression of themselves as mathematicians, which in turn affected their performance. Provide an overview of the research area, highlighting its relevance to educational practice and the increasing demand for data literacy skills in various domains. Define key terms and concepts related to student's perceptions of their engagement in Statistics Class activities. Clarify the scope of the review, specifying the educational levels (e.g., primary, secondary, tertiary) and the specific aspects of statistics activities (e.g., data collection, analysis, interpretation, application) that are under investigation.

Factors Influencing Students' Perceptions

Identify and discuss the factors that have been found to influence students' perceptions of statistics activities. These factors may include instructional strategies, teacher support, curriculum design, technological tools, and individual characteristics. Analyse how these factors have been addressed in previous studies and identify any gaps or inconsistencies in the findings. Perception is defined by Bond et al. (2012) as an interaction between cognitive and non-cognitive factors. Gregory (1970) defines this concept as a constructive process that relies on prior knowledge and experience, also responsible for ordering, interpreting, searching for meaning, or making sense of a situation. Students enter introductory classes with different levels of competence, especially mathematical competence (Chiesi & Primi, 2010). Their verbal statistical reasoning and numeracy skills are constantly tested and challenged in any statistics class. Zeidner's (1991) study looked at statistics and mathematics anxiety in Social Science students. The findings showed that students' mathematics self-perception and their final grade mathematics grades were negatively correlated with students' statistics anxiety, and consequently their performance.

The Theoretical Framework

The theoretical framework for the study is based on Fredricks, Blumenfeld, and Paris (2004) Model of Engagement. This model of engagement focuses on the cognitive, emotional, and behavioral aspects of students' active participation in their learning experiences (Fredricks, Blumenfeld, & Paris, 2004). Engagement is a

complex term that emphasises students' various patterns in motivation, cognition, and behavior (Appleton et al., 2008; Baron & Corbin, 2012; Fredricks et al., 2004; Phan & Ngu, 2014a; Sharma & Bhaumik, 2013). "Engaged learning involves students participating in class and thinking about what they are doing' (GAISE College Report ASA Revision Committee, 2016, p. 18). This theory suggests that students' perceptions of their engagement in statistics class activities are influenced by three dimensions of engagement: behavioral engagement, emotional engagement, and cognitive engagement (Fredricks, Blumenfeld, & Paris, 2004).

Behavioral Engagement

According to Fredricks et al. (2004), behavioral engagement refers to students' observable actions and participation in statistics activities. These statistics activities, include attending classes, contributing to discussions, completing assignments, and collaborating with peers. Behavioral engagement flourishes with routines, assignments, activities, and cues that help students know not only what is expected of them but is also conducive to learning overall. Students who are engaged in a learning process, are usually actively listening, and paying attention.

Emotional Engagement

The emotional engagement domain concerns questions regarding students' feelings of belonging or value to their teacher, their classroom, or their school (e.g., interest, boredom, happiness, sadness, anxiety) (Fredricks et al., 2004; Renninger & Bachrach, 2015). Furthermore, emotional engagement relates to students' affective experiences, such as interest, enjoyment, and motivation, which influence their attitudes toward statistics and intrinsic motivation to learn.

Cognitive Engagement

Cognitive engagement encompasses students' investment in learning, motivation, goal setting, relevance perception, effort, and self-regulated learning strategies (Pohl, 2020). In statistics, it involves mental investment, critical thinking, problem-solving, and metacognitive strategies. Promoting behavioral, emotional, and cognitive engagement is crucial for fostering active involvement, positive attitudes, and meaningful learning experiences in statistics education. Effective instructional strategies can optimize student engagement and achievement. Further research should continue refining approaches to maximize student engagement in statistics education.

Research Methodology

This study uses a quantitative survey research design to investigate students' perceptions of their engagement in statistics class activities based on the Model of Engagement (Fredricks, Blumenfeld, & Paris, 2004). The target population of this study consists of all the Grade 12 Mathematics learners in the public Further

Education and Training (FET) schools in the Motheo District, Free State Province of South Africa. Convenience sampling was used to select learners during the June 2022 winter schools. A total of 433 questionnaires were distributed in person by the researcher to the Grade 12 Mathematics learners who attended the winter school in the Motheo District by the researcher.

Survey Development

A survey questionnaire (See Appendix) is being conducted to measure grade students' engagement in statistics class activities, including self-reported levels of engagement, interest, and relevance.

Data Collection

A survey was administered to grade 12 students to ensure anonymity and confidentiality. Data Analysis This study uses quantitative methods to gain a comprehensive understanding of student perceptions of engagement in statistics class activities. Descriptive statistics were computed to summarize quantitative survey data, including measures of central tendency and variability. The categories and core of the question of students' engagement in Statistics activities are presented in Table 1.

Data Analysis

This study uses quantitative methods to gain a comprehensive understanding of student perceptions of engagement in statistics class activities. Descriptive statistics were computed to summarize quantitative survey data, including measures of central tendency and variability. The categories and core of the question of students' engagement in Statistics activities are presented in Table 1.

Table 1. Categories and Core of the Question of Students' Engagement in Statistics Activities

	Core of question	**Question numbers**
Behavioral Engagement	Students work without support; step-by-step demonstrations; make Statistics interesting; Statistics tasks can raise my confidence, attending classes, contributing to discussions, completing assignments, collaborating with peers, routines, assignments, activities, actively listening, and paying attention.	13, 16, 17, 18
Cognitive Engagement	Cognitive engagement refers to students' investment and interest in their learning, motivation to learn, goal setting, perception of the relevance of learning, effort directed toward learning, and use of self-regulated learning strategies (Pohl, 2020). It involved students asking questions; preferring to understand; the context of the problem; recognises when students fail to comprehend; the success of individual students; different ways of solving problems; marking their work; prior knowledge; mark my classmates' work.	1, 3, 4, 7, 9, 11, 12, 15, 19
Emotional Engagement	The emotional engagement domain concerns questions regarding students' boredom, happiness, sadness, anxiety, students' interest, enjoyment, and motivation. The way students participate in discussions, what questions they ask, how they seek help, and how they express curiosity. Students take part in practical problems; involve in-class activities; practice time. understand concepts; participate during corrections (Fredricks et al., 2004).	2, 5, 6, 8, 10, 14

Students' Involvement in Statistics Class Activities

In this section, the students' questionnaire (see Appendix A) was used to test students' involvement in Statistics class activities. The questionnaire uses a five-point Likert scale to assess the students' involvement. It should be noted that the Statistics questionnaire contained 19 items. Tables 2 to 5 present the responses to the questions. Since it was not clear how the subscale scores for the various subscales should be interpreted, it was decided to calculate the 95% confidence intervals (CIs) for the mean and to interpret the mean score in the context of both the lower and upper CIs. Consideration was also given to whether the lower and upper CIs were, respectively, below or above the theoretical midpoint for the range of the scores (that midpoint, on a scale from 1 to 5, being 3).

Behavioral Engagement

Table 2 indicates the students' view of their involvement in Statistics, measured against behavioral engagement.

Table 2. Behavioral Engagement

	Minimum	Maximum	Median	Mean	95% CI for mean	Standard deviation
Behavioral Engagement	1.3	5	3.71	3.58	0.0756	0.79

Figure 1 provides a summary of the behavioral engagement subscales examined in the study. It visually represents the different dimensions of behavioral engagement that were investigated.

Figure 1. Behavioural Engagement Subscales

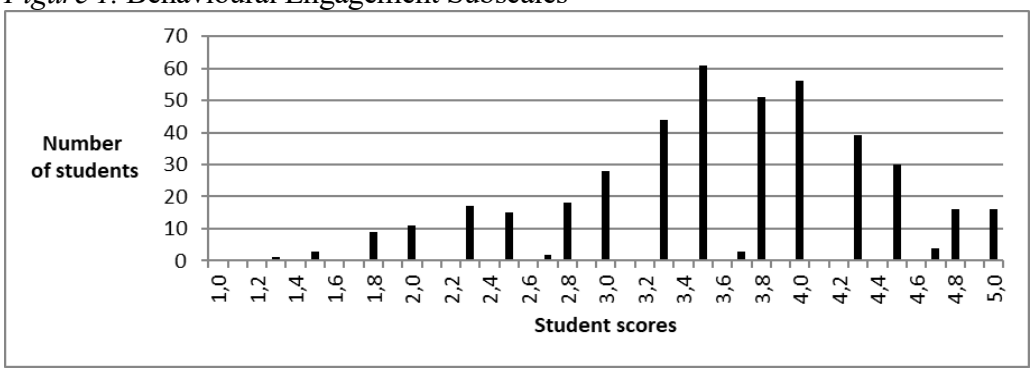


Table 2 and Figure 1 reveal a range of scores on the behavioral engagement subscale, with students scoring as low as 1.3 and as high as 5. However, the mean score, along with its confidence intervals of 3.50|3.58|3.66, indicates that students typically employed a behaviourist approach to their learning in Statistics. Specifically, in response to questions 16 (3.83|3.94|4.05), 17 (3.82|3.94|4.06), and 18 (3.47|3.59|3.71), many participants indicated that their teachers usually demonstrate step-by-step processes to make Statistics interesting and use teaching methods that enhance students' confidence. These responses align with the literature on behavioral engagement, which emphasizes student attendance, active participation in discussions, completion of assignments, and collaboration with peers. However, it is concerning that in response to question 13(2.73|2.86|2.99), some students expressed uncertainty about working without support during class activities in Statistics. Addressing this concern is important, as students need to develop independence and self-efficacy in their learning. Overall, the findings suggest that while students generally exhibit a behaviourist approach and benefit from teachers' demonstrations and support, there is room for improvement in fostering students' confidence and self-reliance during class activities in Statistics. By addressing these concerns, educators can promote greater autonomy and engagement among students, leading to more effective and meaningful learning experiences.

Cognitive Engagement

Cognitively engaged students would be invested in their learning, would seek to go beyond the requirements, and would relish a challenge (Sesmiyanti, 2018).

Table 3 indicates students' view of their involvement in statistics, measured against cognitive engagement.

Table 3. Cognitive Engagement

	Minimum	Maximum	Median	Mean	95% CI for mean	Standard deviation
Cognitive Engagement	1.8	5	3.33	3.34	0.0529	0.55

Figure 2 summarizes the cognitive engagement subscales, offering a visual 2 overview of the dimensions explored in the study. 3 4 Figure 2. Cognitive Engagement Subscales

Figure 2. Cognitive Engagement Subscales

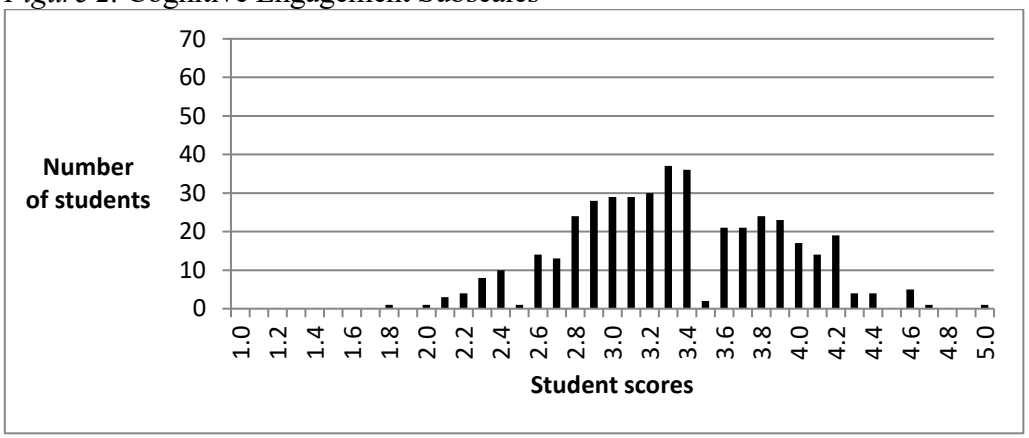


Table 3 and Figure 2 reveal varying cognitive engagement scores among students, ranging from 1.8 to 5. The mean and CIs of 3.29|3.34|3.39 indicate a level of uncertainty in their engagement. However, responses to specific questions, such as 3 (4.20|4.29|4.38), 4 (3.76|3.88|4.00), 7 (3.91|4.03|4.15), 15 (3.76|3.88| 4.00) and 19 (3.39|3.54|3.65), show that many participants frequently ask questions, apply previous knowledge, collaborate with peers, and use diverse problem-solving approaches in Statistics class. These responses align with the literature on cognitive engagement, highlighting students' investment in understanding and applying statistical concepts. On the other hand, there are concerns raised by the responses to questions 1 (2.35|2.46|2.57), 9(2.54|2.69|2.84), 11 (3.18|3.31|3.44), and 12 (2.95|3.09|3.23), where students expressed uncertainty. This includes students not asking questions, teachers lacking an individualized approach, and limited use of diverse problem-solving methods in Statistics classes. These findings emphasize the need for addressing these concerns, promoting active questioning, individualized instruction, and varied problem-solving approaches in Statistics education. By addressing these areas, educators can enhance students' cognitive engagement and improve their overall learning experience.

Emotional Engagement

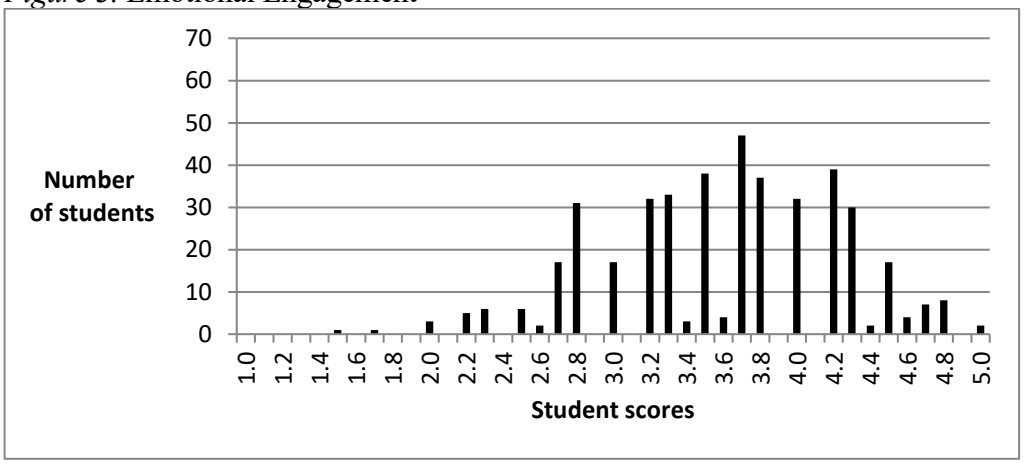
Table 4 offers insights into students' emotional engagement in Statistics classes, enhancing our understanding of their perceptions and experiences in this context.

Table 4. Emotional Engagement

	Minimum	Maximum	Median	Mean	95% CI for mean	Standard deviation
Emotional engagement	1.5	5	3.67	3.60	0.0609	0.64

Figure 3 visually represents students' emotional engagement in Statistics classes, presenting a comprehensive overview of their emotional experiences.

Figure 3. Emotional Engagement



It is obvious from Table 4 and Figure 3 that the learning environment scores ranged between 1.5 and 5, with a mean and CIs of 3.54|3.60|3.66, indicating that students usually benefit from a positive Statistics learning environment. About the responses to questions 2 (3.58|3.69|3.80), 6 (3.96|4.07|4.18), 8 (3.25|3.38|3.51), 10 (3.47|3.58|3.69) and 14 (3.66|3.79|3.92), it is notable that participants consistently expressed a high level of active involvement in their learning experiences. Across these questions, which pertain to their emotional engagement in Statistics class activities, most participants responded with "usually" to indicate their active involvement. This consistent pattern of responses, with scores ranging from 3.58 to 3.92, suggests that the participants perceive themselves as actively engaged in their learning process. Their consistent inclination towards active involvement indicates a positive disposition and a genuine commitment to their Statistics education.

Interpretation and Discussion

The way students perceive and engage with statistics class activities is multifaceted, influenced by three distinct dimensions of engagement: behavioral, emotional, and

cognitive engagement. Through a meticulous analysis of the responses collected from the questionnaire administered to the students, it becomes unmistakably clear that the majority of students who participated in this research are actively and fervently involved in statistics activities. Their active engagement stems primarily from their robust behavioral engagement, their deep cognitive engagement, and their genuine emotional engagement within the context of the statistics class. However, it is important to recognize that within this student population, a subset of individuals displays uncertainty when it comes to fully embracing behavioral engagement during statistics class activities. This hesitance often originates from their longing for additional support and guidance throughout the learning process. These students yearn for a nurturing environment that encourages and assists them in actively participating in class activities. Furthermore, there are still other students who grapple with uncertainty when it comes to employing cognitive engagement, particularly demonstrated by their reluctance to ask questions. These individuals, for various reasons, may feel hesitant or apprehensive about seeking clarification or further exploring concepts. Consequently, this reticence can potentially impede their cognitive engagement within the statistics class, preventing them from fully grasping and mastering the subject matter. Teachers need to recognise and address these uncertainties, fostering an inclusive and supportive learning environment that caters to the diverse engagement needs of their students. By providing adequate support, guidance, and encouragement, teachers can help students overcome their hesitations, enabling them to actively participate, seek clarity, and fully engage in statistics class activities. Drawing insights from the students' responses gathered through the questionnaire, it becomes evident that a significant majority of the students who participated in this research have experienced a considerable degree of emotional engagement. They have formed a meaningful connection and invested their emotions into the statistics class activities. This emotional engagement has likely played a significant role in their overall learning experience. However, it is worth noting that amidst this majority, there remains a subset of students who harbor uncertainty when it comes to independently solving problems before their teachers demonstrate the problem-solving process. These students express a reluctance to engage in independent problem-solving, preferring to rely on their teachers' guidance and instruction. This hesitation may stem from a lack of confidence or a fear of making errors without proper guidance. Addressing the needs of these students who exhibit uncertainty is crucial to fostering their cognitive engagement and self-efficacy. Teachers should strive to create a supportive and empowering environment that encourages students to gradually develop their problem-solving skills, providing them with the necessary scaffolding and guidance. By nurturing their confidence and gradually fostering independence, teachers can help these students overcome their uncertainties and actively engage in problem-solving activities.

Recommendations to be implemented to Enable Students' Engagement

To enable students' engagement in statistics class activities and address the uncertainties expressed by certain individuals. Here are some recommendations that teachers can consider:

1. Recognize the diverse needs and learning styles of students, and tailor instruction accordingly (Awla, 2014).
2. Provide a range of activities and materials that cater to students' diverse learning needs (Smale-Jacobse, Meijer, Helms-Lorenz, & Maulana, 2019).
3. Communicate the purpose of instruction (Orr, Csikari, Freeman & Rodriguez, 2022). This helps students better understand the purpose of their engagement and motivates them to actively participate.
4. Foster a supportive and inclusive classroom atmosphere where students feel comfortable expressing their uncertainties and seeking assistance. Encourage collaboration, peer support, and open communication among students (Monteiro, Carvalho, & Santos, 2021).
5. Gradually guide students toward independent problem-solving by providing scaffolded support (Margulieux & Catrambone, 2021).
6. Use a variety of techniques to enable students to progress toward a stronger understanding of the content, and ultimately more independence about their learning (Daniel, 2023).
7. Create a safe space where students can be their authentic selves, ask difficult questions, make mistakes, and grow together (Jones & Nillas, 2022).
8. Emphasize the value of questioning as a crucial component of cognitive engagement and understanding. Respond to questions with patience and clarity, promoting an open dialogue (Shanmugavelu et al., 2020).
9. Provide timely and effective feedback to students, highlighting their strengths and areas for improvement. This enhances academic engagement and motivational outcomes (Valente, Conboy, & Carvalho, 2015; Wisniewski, Zierer, & Hattie, 2020).
10. Encourage self-reflection and self-assessment to enhance metacognitive awareness, empowering students to take ownership of their learning process (Siegesmund, 2016).
11. Incorporate a variety of instructional strategies, such as hands-on activities, Real-life data and student projects, and technology-based tools (Lawton & Taylor, 2020).
12. Have students adopt teaching roles such as peer assessment, tutoring, and mentoring (Faroa, 2017).
13. Recognize, encourage, and motivate learners with positive feedback during class. Use phrases like "well done" instead of negatives (Meberta et al., 2018).
14. Employ flexibility and adaptability to continuously improve students' engagement in class activities. (Collie, Holliman, & Martin, 2016; Sheriston, Andrew, Holliman, & Payne, 2019; Nikolov, Lai, Sendova, & Jonker, 2018; Li & Wong, 2018).

Conclusion

In conclusion, this paper explored students' perceptions of their engagement in data-handling class activities, aiming to provide valuable insights for educators, curriculum developers, and policymakers to enhance data literacy education. The research findings shed light on various aspects of students' perceptions, including their levels of engagement, factors influencing their perceptions, challenges faced, and suggestions for improvement. The analysis of quantitative data revealed that students generally reported positive levels of engagement in data-handling activities. They expressed interest in practical applications and perceived the relevance of statistics skills to real-world contexts.

However, variations in students' perceptions were observed across different subgroups based on demographic factors, indicating the need for targeted instructional strategies to address individual differences. The qualitative analysis further enriched our understanding by uncovering students' experiences, motivations, challenges, and suggestions. Students highlighted the importance of collaboration, hands-on activities, and timely feedback to enhance their learning experiences in statistics. They also faced challenges related to data collection, analysis, interpretation, and application, emphasizing the need for additional support and guidance. The integration of quantitative and qualitative findings provided a comprehensive picture of students' perceptions, allowing for a deeper interpretation of the research questions. The insights gained from this study have significant implications for data literacy education. Educators can utilize the findings to tailor instructional practices, incorporating collaborative activities, hands-on exercises, and timely feedback to enhance student engagement and learning outcomes. Curriculum developers can refine data literacy programs, ensuring they align with students' needs and aspirations. Policymakers can make evidence-based decisions to improve educational policies related to data literacy, fostering the development of essential skills in students. It is important to acknowledge the limitations of this study. The sample size and composition may have some biases, limiting the generalizability of the findings. Additionally, self-report measures and qualitative interviews are subject to participant biases and subjectivity. Future research should address these limitations by conducting larger-scale studies with diverse samples to validate and extend the findings.

Longitudinal studies can explore changes in students' perceptions over time, allowing for a deeper understanding of the developmental aspects of data literacy. Furthermore, research can investigate the impact of implementing specific instructional strategies based on the identified factors and recommendations.

In conclusion, understanding students' perceptions of their engagement in Statistics Class activities is essential for enhancing data literacy education. By incorporating their perspectives, educators, curriculum developers, and policymakers can foster a more engaging and effective learning environment, equipping students with the skills to navigate and make informed decisions in a data-driven world.

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Appendix

Table 5. Student Questionnaire

No	Question	Rarely	Sometimes	Uncertain	Usually	Almost always
1	I ask questions during Statistics lessons	1	2	3	4	5
2	I take part in discussions during Statistics lessons	1	2	3	4	5
3	I prefer to understand what I am doing in Statistics	1	2	3	4	5
4	My teacher exposes us to the context of the problem in Statistics tasks	1	2	3	4	5
5	I can think of solutions to practical problems before my teacher can show us how the problems are solved	1	2	3	4	5
6	I learn a great deal when I am involved in class activities during Statistics	1	2	3	4	5
7	My teacher recognises when students fail to comprehend during Statistics lessons	1	2	3	4	5
8	I need sufficient practice time during Statistics classes	1	2	3	4	5
9	My teacher focuses on the success of individual students rather than of the group in Statistics lessons	1	2	3	4	5
10	I have a basic understanding of concepts in Statistics	1	2	3	4	5
11	I use different ways of solving problems in Statistics	1	2	3	4	5
12	I do mark my own work in Statistics class	1	2	3	4	5
13	I work without support during classwork activities in Statistics	1	2	3	4	5
14	I participate in corrections in Statistics activities	1	2	3	4	5
15	I use the Mathematics knowledge obtained in Grades 8, 9, 10, and 11 in Statistics activities	1	2	3	4	5
16	I follow my Mathematics teacher's. step-by-step demonstrations of how tasks are supposed to be done in Statistics	1	2	3	4	5
17	My teacher makes Statistics interesting	1	2	3	4	5
18	I am provided with statistics tasks that can raise my confidence	1	2	3	4	5
19	I do mark my classmates' work in	1	2	3	4	5