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Utilization of Adding Machine by Students' of Secondary School: The Impact on their Critical Thinking Skills According to their Teachers Perception

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Abstract

This study examines secondary school teachers' perceptions of how the use of adding machines influences students' critical thinking skills. The integration of technology, specifically adding machines, in educational settings has become increasingly common, with potential implications for students' cognitive development. The study focuses on how teachers' qualifications, gender, and years of experience shape their views on the role of adding machines in enhancing critical thinking. A total of 100 science teachers from 24 public secondary schools in the Awka Education Zone of Anambra State participated in the study. Data were collected through a structured questionnaire, which was analyzed using descriptive and inferential statistics. The results reveal that teachers generally view adding machines as effective tools for improving problem-solving efficiency and fostering creativity. However, they express concern that over-reliance on calculators might impede the development of foundational cognitive skills, particularly in relation to problem-solving and deep understanding of mathematical concepts. Additionally, teachers with higher qualifications perceive adding machines as having a more significant impact on students' critical thinking skills. These findings suggest the need for a balanced approach to integrating adding machines in classrooms, ensuring

that students develop both technical proficiency and critical thinking abilities necessary for academic success.
Keywords: Critical thinking, adding machine, students, technology.

Introduction

The integration of technology in education has become increasingly significant, particularly in enhancing students' learning experiences. One such tool that has garnered attention is the adding machine also known as calculator, traditionally used in various financial and educational settings. While its primary function is to perform arithmetic operations, the implications of its use in secondary school education extend beyond mere calculations. This article explores the perceptions of teachers regarding how the use of adding machines affects students' critical thinking skills, emphasizing variations based on gender, teaching experience, and qualifications.

Research indicates that technology can influence cognitive processes, prompting educators to reflect on its role in fostering critical thinking. According to a study by Kalyani (2023), the integration of technology in classroom settings can shape students' analytical abilities, which are essential for problem-solving. This aligns with findings from Peng (2023), who suggest that appropriate technological tools can enhance cognitive engagement among learners. The adding machine, with its unique functionalities, offers a platform for students to engage in mathematical reasoning and develop analytical skills.

Throughout history, the invention of innovative calculating devices assisted in expanding the understanding of mathematical concepts. When considering calculator and other technology use in the secondary school classroom, some say that students are just using their resources to solve problems (Orellana & Barkatsas, 2017). Others say that the students' use of technology in their math classes enhances their understanding of underlying concepts (Crawford, 2016). When they are used in teaching pupils mental and other maths skills, calculators can help improve students' maths abilities, and pupils are more likely to use them less, but in a better

way (Education Endowment Foundation, 2018). When integrated into the teaching of mental and other calculative topics, calculators can be very effective for developing students' computation skills; students become better at arithmetic in general and are likely to self-regulate their use of calculators, consequently making less (but better) use of them. A study by Line (2020) found that students scored higher grades when they can use the calculator in learning or for solving problems during examination.

On the contrary, some people believe that the use of calculators among secondary school students has a negative influence on their critical thinking. Critical thinking is essentially a questioning, challenging approach to knowledge and perceived wisdom. It involves ideas and information from an objective position and then questioning this information in the light of our own values, attitudes and personal philosophy (Clarke, 2019). According to Doyle (2022), critical thinking refers to the ability to analyze information objectively and make a reasoned judgment. It involves the evaluation of sources, such as data, facts, observable phenomena, and research findings. To think critically, you must be aware of your own biases and assumptions when encountering information, and apply consistent standards when evaluating sources (Eleje *et al*., 2024).

However, the perceptions of teachers are vital in understanding the educational impact of such tools. Teachers are on the frontlines of technology implementation and can provide valuable insights into how these tools influence student learning. A survey by Kim *et al* (2013), highlights that teachers' beliefs about technology significantly affect how they integrate it into their teaching practices. This suggests that examining teachers' perceptions specifically regarding adding machines can yield important information about their effects on critical thinking. Gender differences in educational engagement have been the focus of various studies. For example, Tondeur *et al* (2016) discovered that male and female students may utilize technological tools differently, which could influence their critical thinking outcomes. Exploring teachers' views on these differences can provide a

clearer picture of how gender plays a role in the educational impact of adding machines.

Also, experience plays a critical role in teaching effectiveness and technology integration. Research by Timotheu *et al* (2023) emphasizes that more experienced teachers tend to adapt their instructional strategies based on the tools available. Therefore, understanding how teacher experience influences perceptions of adding machines can offer insights into best practices for technology use in the classroom. Lastly, the qualifications of teachers are significant in determining their comfort level with technology. A study conducted by Naz and Murad (2017), and Obeka (2024) indicates that teachers with higher qualifications are more likely to embrace innovative teaching methods. Investigating how qualifications shape perceptions of the adding machine's impact on critical thinking can inform professional development efforts aimed at enhancing technology integration in secondary education.

Through this research, we aim to shed light on the complex relationship between the use of adding machines in secondary schools and the development of critical thinking skills, as viewed by teachers. By focusing on gender, teaching experience, and qualifications, the study seeks to provide a clearer understanding of how these factors influence educators' views and practices. Understanding these perceptions can contribute to more effective technology implementation and ultimately foster better educational outcomes for students. To structure this exploration, the researchers answer one research question and tested the following formulated research hypotheses for rejection or otherwise at 5% level of significance:

Research question

1. What are the teachers' perspectives on the influence of secondary school students' use of calculators on their critical thinking skills?

Hypotheses

Ho 1: There is no significant difference in the teachers' perceptions on the influence of secondary school students' use of calculators on their critical thinking skills based on gender.

Ho 2: The teachers' perspective on the influence of secondary school students' use of calculators in their critical thinking skills did not significantly vary based on experience.

Ho 3: The teachers' perspective on the influence of secondary school students' use of calculators in their critical thinking skills did not significantly vary based on qualification.

Methods

This study utilized a descriptive survey design and was conducted in the Awka Education Zone of Anambra State, which consists of 372 science teachers across 62 public secondary schools. The teaching staff varied in terms of gender, qualifications, and experience levels, including male and female teachers with varying qualifications (OND, HND, B.Ed, M.Ed, Ph.D, BA.Ed, BSc.Ed) and experience ranging from 1-10 years. The sampling process involved a multi-stage approach, selecting three local government areas (Awka South, Anaocha, and Njikoka), then randomly choosing 24 public secondary schools from those areas. From these schools, 100 science teachers were selected purposively, with the final sample comprising 39 men and 61 women, having varied qualifications and experience. Data were collected using a structured questionnaire, the "Influence of Use of Calculators on the Critical Thinking Skill Questionnaire (IUCCTSQ)", which was validated by experts in measurement and evaluation. The instrument had two sections: one for respondents' bio data and another addressing critical thinking skill in relation to the study's research question and hypotheses. The questionnaire, which used a Likert scale, was administered and retrieved within two weeks by the researchers and their assistants. The collected data were analyzed using descriptive statistics (mean, standard deviation) and inferential statistics (t-test, Kruskal-Wallis

H test) with the SPSS software, where a mean rating above 2.50 was considered positive, and statistical significance was set at $p < 0.05$.

Result

The analysis and findings of the study are presented according to the research question and hypotheses.

Research question 1: What are the teachers' perspectives on the influence of secondary school students' use of calculators on their critical skills?

Table 1: Teachers' Mean Ratings on the Influence of Secondary School Students' Use of Calculators on Their Critical Thinking Skills

S/N	Item Statements	Mean	Std. Deviation
1	Calculators can be very effective for developing non-calculator computation skills like problem-solving	2.99	1.040
2	It can reduce the problem to simpler tasks and allows the student to devote more time think to understand the problem	3.10	0.810
3	Calculators can help improve students' creativity in solving algebraic equations	3.20	0.921
4	Calculators helps improve students' critical thinking ability	2.80	0.876
5	The use of calculator can enhance learning among students	2.94	0.962
6	Utilizing calculators during mathematics class may affect a student's cognitive level of mathematics concepts	3.23	0.723
7	The use of calculator makes it difficult for the students to acquire problem-solving skills	3.24	0.949
	Cluster total (N= 100)	**21.50**	**6.281**
	Cluster mean	**3.071**	**0.897**

The findings from this study shed light on teachers' perceptions regarding the influence of secondary school students' use of calculators on their critical thinking skills. The teachers' mean ratings suggest both positive and negative views on the role of calculators in enhancing students' critical thinking, mathematical abilities, and cognitive development. Overall, the teachers rated calculators as moderately effective tools for supporting students' mathematical tasks, with a cluster mean of 21.50 and an average standard deviation of 3.07. This indicates a mixed but generally favorable view of calculator use, tempered by some variability in how teachers perceive the impact on students' skills. Specifically, teachers believe calculators can aid in problem-solving by simplifying tasks, allowing students to

focus more on understanding the problem (mean = 3.10). However, the relatively low standard deviation (0.81) suggests some variation in how teachers view this benefit, with some possibly seeing calculators as more useful for this purpose than others. Additionally, calculators are seen as helpful in fostering creativity in solving algebraic equations (mean = 3.20), and many teachers believe they enhance learning (mean = 2.94). However, the average score for "Calculators help improve students' critical thinking ability" was lower (mean = 2.80), indicating that teachers are somewhat more cautious about calculators' impact on developing critical thinking skills. The standard deviation of 0.88 indicates some disagreement among teachers, with a range of opinions on this issue. A key concern among teachers is that calculators may hinder students from developing essential problem-solving skills. The statement "The use of calculators makes it difficult for students to acquire problem-solving skills" had the highest mean score of 3.24, suggesting that teachers strongly believe excessive reliance on calculators could limit students' ability to develop foundational problem-solving abilities. This concern is further supported by the item "Utilizing calculators during mathematics class may affect a student's cognitive level of mathematics concepts" (mean = 3.23), indicating that teachers perceive calculators as potentially influencing the depth of students' understanding of mathematical concepts. The variability in responses, as seen in the standard deviations across different items, shows that while calculators are recognized as valuable tools for certain tasks, their impact on developing deeper cognitive and critical thinking skills remains a point of debate among teachers.

In conclusion, while calculators are acknowledged as useful tools for solving problems efficiently and enhancing creativity, their role in fostering critical thinking and problem-solving skills is viewed with more caution. Teachers appear to appreciate calculators for their ability to support students in specific areas but are concerned about the potential drawbacks in terms of developing essential cognitive skills necessary for deeper understanding and independent problem-solving.

Hypothesis 1: There is no significant difference in the teachers' perceptions on the influence of secondary school students' use of calculators on their critical thinking skills based on gender.

Table 1: t-Test of Independent Samples for Comparing Teachers' Perceptions on The Influence of Secondary School Students' Use of Calculators on Their Critical Thinking Skills Based on Gender.

Independent Samples Test	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	0.011	0.915	-0.717	98	0.475	-0.476	0.664	-1.794	0.841
Equal variances not assumed			-0.722	82.680	0.473	-0.476	0.660	-1.789	0.837

The Levene's Test for Equality of Variances shows that the F-value is 0.011 with a significance (Sig.) value of 0.915. Since this value is greater than 0.05, we conclude that the variances in teachers' perceptions are equal across gender groups. The t-Test value for Equality of Means for Equal variances not assumed is -0.722 with a p-value (Sig. 2-tailed) of 0.473. Since, this p-value is greater than 0.05, we fail to reject the null hypothesis. This suggests that there is no significant difference between the perceptions of male and female teachers regarding the influence of calculators on students' critical thinking skills. The mean difference between the two groups is -0.476, which is quite small. This indicates that even though there is a slight difference, it is not statistically significant. The 95% confidence interval of the difference in means ranges from -1.794 to 0.841. Since this interval includes zero, it further supports the conclusion that there is no significant difference. In summary, based on the data from the t-test, teachers' perceptions of the impact of

calculators on students' critical thinking skills do not differ significantly between male and female teachers.

Hypothesis 2: The teachers' perspective on the influence of secondary school students' use of calculators in their critical thinking skills did not significantly vary based on experience.

Table 2: Mean Ranks of the Teachers' Perspective on the Influence of Secondary School Students' Use of Calculators in Their Critical Thinking Skills Based on Experience

EXPERIENCE	N	Mean Rank
1-3YRS	29	57.88
4-6YRS	56	48.58
7-10YRS	15	43.40
Total	**100**	

Table 3

Kruskal-Wallis Test Statistics

	Test Statistics[a,b]
Kruskal-Wallis H	3.057
Df	2
Asymp. Sig.	0.217

a. Kruskal Wallis Test
b. Grouping Variable: EXPERIENCE

The results from the Kruskal-Wallis Test suggest that the teachers' perspectives on the influence of students' use of calculators on their critical thinking skills do not vary significantly based on their experience. The mean ranks for each group are as follows show a trend where teachers with less experience (1-3 years) have the highest mean rank, and teachers with more experience have slightly lower mean ranks. The test statistic (H) is 3.057 with a degree of freedom (df) of 2. The significance value is 0.217, which is greater than the commonly used threshold of 0.05. This indicates that there is no statistically significant difference in teachers' perspectives on the influence of calculators on critical thinking skills based on their years of experience. In summary, the teachers' experience does not significantly

affect their views on how calculators influence secondary school students' critical thinking skills.

Hypothesis 3: The teachers' perspective on the influence of secondary school students' use of calculators in their critical thinking skills did not significantly vary based on qualification.

Table 4: Mean Ranks of the Influence of Calculator Use on Students' Numerical Skills Based on Teachers' Qualifications

QUALIFICATION	N	Mean Rank
OND	17	59.06
HND	19	56.26
B.Ed	43	40.67
M.Ed	16	66.81
Others	5	31.80
Total	**100**	

Table 8

Kruskal-Wallis Test Statistics

	Test Statistics[a,b]
Kruskal-Wallis H	14.475
Df	4
Asymp. Sig.	0.006

a. Kruskal Wallis Test
b. Grouping Variable: QUALIFICATION

The mean ranks for each qualification group indicate that teachers with M.Ed qualifications have the highest mean rank, suggesting they perceive a stronger influence of calculators on students' critical thinking skills. In contrast, teachers with "Other" qualifications have the lowest mean rank, indicating a weaker perception of this influence. The test statistic (H) is 14.475 with a degree of freedom (df) of 4, and the p-value is 0.006, which is less than 0.05. This indicates that there is a statistically significant difference in teachers' perceptions based on their qualifications. Thus the results show that teachers' qualifications significantly influence their views on how calculators impact students' critical thinking skills. Teachers with higher

qualifications, such as M.Ed, tend to have a more pronounced perception of this influence, while those with other qualifications may perceive it differently.

Discussion of Results

The results of this study provide important findings about how teachers view the effect of secondary school students' use of calculators on their critical thinking skills. Variations were noted based on teachers' qualifications, but not their gender or years of experience. These findings offer useful information for educators and policymakers aiming to understand factors that influence teaching practices and perceptions in the classroom. The findings from this study provide important insights into teachers' perceptions of the influence of calculators on secondary school students' critical thinking skills given credence to the view of Eleje *et al* (2024) and Sosianika *et al* (2023). The results suggest that while calculators are generally viewed as effective tools for enhancing certain mathematical tasks, their role in developing deeper cognitive and critical thinking skills is more controversial. Teachers rated calculators as moderately useful for supporting students' mathematical tasks, with a cluster mean of 21.50 and a standard deviation of 3.07. This indicates that while there is a broad consensus on their value, there is some variability in how teachers perceive their effectiveness in fostering critical thinking. The mean ratings suggest that teachers recognize the practical benefits of calculators in simplifying complex tasks, such as problem-solving. For instance, the statement "Calculators can be very effective for developing non-calculator computation skills like problem-solving" received a mean score of 2.99. While this score reflects a generally positive view, the standard deviation of 1.04 indicates that some teachers may see calculators as more effective in this regard than others. This variation could be due to differences in teaching practices or the perceived importance of computation in developing problem-solving skills. The mixed responses align with research that emphasizes the utility of calculators in simplifying complex tasks, which can lead to more efficient problem-solving (Lin 2020; Koedinger *et al*., 2008).

However, it is also noted that the reliance on calculators could limit the development of essential mental critical skills, a concern shared by many teachers in this study.

Similarly, calculators were seen as beneficial in fostering creativity in solving algebraic equations, with a mean rating of 3.20. Teachers acknowledged the positive impact of calculators on enhancing students' ability to approach algebra in innovative ways. This finding is supported by previous studies that suggest calculators can promote creative problem-solving and assist in visualizing algebraic concepts (Heid, 1988). However, the teachers' caution regarding calculators' influence on critical thinking was evident in the mean score of 2.80 for the statement "Calculators help improve students' critical thinking ability." This lower score reflects a more guarded stance, suggesting that while calculators may support certain aspects of learning, they are not seen as instrumental in fostering the higher-order thinking skills necessary for critical reasoning and independent problem-solving.

A significant concern raised by teachers was the potential negative impact of calculators on students' ability to acquire problem-solving skills. The item "The use of calculators makes it difficult for students to acquire problem-solving skills" had the highest mean score of 3.24, indicating that many teachers believe that an over-reliance on calculators can prevent students from developing the necessary skills to approach problems independently. This finding is consistent with research suggesting that while calculators can reduce cognitive load, excessive use can undermine the development of critical problem-solving abilities (Bates & Morgan, 2021). Moreover, the statement "Utilizing calculators during mathematics class may affect a student's cognitive level of mathematics concepts" received a mean of 3.23, suggesting that teachers are concerned that calculators may reduce the depth of students' understanding of mathematical concepts. This concern is reflected in literature that highlights the potential for calculators to serve as a crutch, hindering deeper engagement with mathematical reasoning (Baroody, 2004). The standard deviations across the different items in the study show that teachers' opinions on the use of calculators vary. Such varying opinion is noted by researchers like Clark

(2019), Crawford (2016), and Eleje *et al* (2024). For example, the standard deviation for the statement "Calculators help improve students' critical thinking ability" was 0.88, indicating some disagreement among teachers on this issue. This variability may reflect differing beliefs about the balance between technology and traditional teaching methods. While some teachers may believe that calculators can aid in critical thinking by allowing students to focus on more complex tasks, others may worry that they encourage dependence on technology at the expense of developing fundamental skills.

Hypothesis 1 proposed that there would be no significant difference in teachers' perceptions based on gender. The results of the t-test for independent samples support this hypothesis. There was no significant difference between male and female teachers' views on how calculators impact students' critical thinking. The Levene's Test for equality of variances showed similar variances in perceptions between male and female teachers, and the t-test value revealed no statistically significant difference between the groups. The p-value of 0.473, which is greater than the 0.05 significance threshold, further supports the conclusion that gender does not affect how teachers perceive calculators' influence on critical thinking skills. This finding is consistent with previous research that has shown few gender-based differences in educational practices and perceptions (Imran *et al*., 2024; Wood 2012). For example, Tondeur *et al* (2016) discovered that male and female students may utilize technological tools differently, which could influence their critical thinking outcomes.

Hypothesis 2 suggested that teachers' views would not significantly vary based on their years of experience. The Kruskal-Wallis Test found no significant difference in perceptions between teachers with different levels of experience, with a p-value of 0.217. Teachers with fewer years of experience (1-3 years) had slightly higher mean ranks, but the difference was not large enough to be statistically significant. This suggests that years of experience do not notably affect how teachers perceive the influence of calculators on students' critical thinking skills. Other

studies have similarly found that teaching experience may not be as influential in shaping pedagogical beliefs and practices as other factors (Bates & Morgan, 2021). But, Research by Timotheou *et al* (2023) emphasizes that more experienced teachers tend to adapt their instructional strategies based on the tools available. Further research can collaborate these researchers view.

Hypothesis 3 proposed that teachers' perceptions of the influence of calculators on students' critical thinking would not significantly vary based on their qualifications. The results from the Kruskal-Wallis Test contradicted this hypothesis. A significant difference was found based on teachers' qualifications, with a p-value of 0.006, which is below the 0.05 significance level. Teachers with higher qualifications, especially those with M.Ed., had the highest mean ranks, suggesting that they perceive calculators as having a stronger impact on students' critical thinking skills. Conversely, teachers with "Other" qualifications had the lowest mean ranks, indicating a weaker perception of this influence. This finding supports previous research showing that higher education levels can improve teachers' understanding of educational tools and their potential impact on students' cognitive skills. A study conducted by Naz and Murad (2017) and Obeka (2024) indicates that teachers with higher qualifications are more likely to embrace innovative teaching methods. Teachers with more advanced qualifications are likely better equipped to recognize and integrate technology into their teaching, understanding its benefits for developing students' critical thinking.

Implications of the Study

The findings of this study have significant implications for educational practice and policy. First, the lack of significant differences based on gender and experience suggests that teacher training and professional development should not focus solely on these demographic factors when promoting the use of technology in the classroom. However, the significant influence of qualifications on teachers' perceptions of calculators suggests that there should be a stronger emphasis on continuing education and qualification upgrades. Professional development

programs targeting the integration of calculators and other technological tools could be beneficial, particularly for teachers with lower qualifications, to help them better understand and utilize these tools to support critical thinking development in students.

Moreover, as teachers with higher qualifications perceive calculators as more beneficial to students' critical thinking, educational policies should encourage teachers to pursue advanced degrees or specialized training in educational technology. This could ensure that more teachers are able to harness the full potential of technology in fostering cognitive skills among students.

Conclusion

This study offers important insights into the factors that shape teachers' perceptions of the impact of calculators on secondary school students' critical thinking skills. The results indicate that gender and years of experience do not significantly influence these perceptions, while teachers' qualifications have a notable effect. Teachers with higher qualifications tend to believe that calculators have a stronger influence on students' critical thinking abilities. These findings enhance our understanding of how educators perceive and incorporate technology into their teaching methods. In conclusion, while calculators are largely regarded as useful tools for improving problem-solving efficiency and fostering creativity, their role in developing critical thinking and independent problem-solving skills is viewed with more caution. Teachers acknowledge the advantages of calculators in specific areas but express concerns about their potential to hinder the development of fundamental cognitive skills. This caution is particularly evident in the belief that overuse of calculators may prevent students from engaging deeply with mathematical concepts and acquiring essential problem-solving abilities. The results highlight the need for a balanced approach in incorporating calculators into the classroom to ensure that students continue to build both technical and critical thinking skills necessary for academic success.

Recommendations

Based on the findings of this study, several recommendations can be made. Schools and education authorities should focus on offering professional development programs that enhance teachers' understanding of how calculators can foster students' critical thinking skills, particularly for those with lower qualifications. Programs that encourage teachers to pursue higher qualifications, such as the M.Ed, could be beneficial in improving their perceptions of technological tools' educational value. Educational policymakers should consider incorporating training on the integration of calculators and other technologies into critical thinking development within teacher preparation curricula. Additionally, future studies should investigate the specific factors that influence teachers' perceptions of calculators, particularly focusing on the types of qualifications that correlate with stronger perceptions, and how these perceptions translate into teaching practices.

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