

Making quadratic functions interesting: Students teams-achievement division instructional strategy

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Abstract

Algebra plays a central role in school mathematics as it is a critical factor for success in mathematics courses such as calculus and geometry. This investigation aimed to establish the effectiveness of students teams-achievement division (STAD) strategy on students' academic achievement in algebra, Lagos State, Nigeria. A quasi-experimental model was employed for the study, which lasted for six weeks. Two secondary schools were chosen randomly and divided into experimental and control groups. The sample comprised 136 students (61 students in control group and 75 students in experimental group) from Ikorodu City, Lagos State, Nigeria. The quadratic functions assessment test, four questions (each with four items) with appropriate validation, served as the tool for data collection. Reliability was attained using the test-re-test method, with Pearson's product-moment correlation analysis yielding a reliability index of 0.86. Three hypotheses were generated and analyzed using analysis of covariance at a significance level of 0.05. The results showed that students exposed to STAD had enhanced performance in algebra. Likewise, gender did not impact the achievement of the participants in algebra. It was recommended that the Nigerian Educational Research Development Council arrange workshops, training, and seminars on incorporating learner-friendly instructional strategies such as STAD.

Keywords: ability level, gender, algebra, instructional strategy, students teams-achievement division

INTRODUCTION

Algebra is one of the topics that students find challenging when learning mathematics (Hamzat, 2018). Algebra plays a central role in school mathematics as it is a critical factor for success in mathematics courses such as calculus and geometry. It also serves as a "gatekeeper" for further education and producing a skilled workforce for a modern high-technology society. However, Oyekan (2019) pointed out that the algebra taught in schools takes a different form than the algebra taught to mathematics majors. Moreover, the algebra taught in schools is not easily defined. It is thus related to various conceptions such as algebra as generalized arithmetic, equivalence, expressions, equations, inequalities, and functional thinking (Blanton et al., 2018). In this study, we focus on functional thinking (e.g., quadratic functions), which includes "generalizing relationships between co-varying quantities and

representing, justifying, and reasoning with these generalizations through natural language, variable notation, drawing, tables, and graphs" (Karadeniz et al., 2017; Musa, 2022).

The covariance approach to functions requires understanding how a change in one variable relates to another or how those variables change together (Kezar, 2018). As a prerequisite for understanding calculus that underlies innovation and economic success across many science and engineering domains, a significant amount of time and emphasis is placed on teaching functions in the high school mathematics curriculum. Therefore, students' ability to define and make sense of functions is significant and should be emphasized (Abidin et al., 2021; Bardini et al., 2014). While the need for a dynamic conceptualization of the understanding and use of functions has been highlighted similarly, the lack of students' understanding of functions has been documented (Mulungye et al., 2016). Students'

Contribution to the literature

- This study determined that STAD instructional strategy effectively boosted student attitudes toward math and reduced anxiety associated with studying quadratic functions.
- Also, STAD method of instruction is an effective tool for instructors seeking to increase student results and foster a good learning environment.
- This study has contributed to the existing literature because it reports that STAD is a learner-friendly instructional strategy, not gender bias.

challenges in understanding functions include the following but are not limited to these; understanding functions in terms of input and output, thinking constant functions (e.g., $y=6$) are not functions because they do not vary, simply viewing functions as two expressions separated by an equal sign, believing that all functions should be definable by a single algebraic formula, and assuming that functions are linear or quadratic in unwarranted situations (Al-Rababaha et al., 2020; Booth et al., 2017). The high school mathematics curriculum includes numerous types of functions and their concepts, such as the linear, quadratic, cubic, exponential, hyperbolic, and trigonometric functions (Booth et al., 2014).

The quadratic function is one of the most significant ideas for students to learn about in school mathematics (Nielsen & Weber, 2015). Thus, a good understanding is needed since it is foundational in calculus courses (Burns-Childers & Vidakovic, 2018). However, as found by previous studies, high school and undergraduate students need help understanding functions-related concepts. Transitioning between graphical and algebraic representations, the link between the various expressions of an algebraic version of a quadratic function, and variable misconceptions are all common problems for students' understanding of quadratic functions (Ocal, 2017). A'yun and Lukito (2018) added a view of graphs as whole objects, struggles to interpret the role of parameters correctly, and a tendency to generalize from linear functions incorrectly. The science of equations is associated with algebra, and the Greek mathematician Diophantus is regarded as the author of algebra. Algebra is an Arabic word that means "reunification of broken parts" (Oyekan, 2019). It is a type of generalized arithmetic in which the numbers are represented by letters and symbols.

Teachers, parents, and educational authorities across Nigeria have always been concerned about students' low performance in mathematics examinations, specifically in quadratic functions (internal or external). According to the 2022 West African examinations council chief examiners' report, most students avoided quadratic function problems, and those who attempted them failed significantly (Musa, 2022). This observation was linked to students' misunderstandings before, during, and after their classroom experience. Additionally, education specialists conclude that several causes may be

connected to this alarming trend, including teachers' adoption of suitable and acceptable teaching strategies (Hamzat, 2018). The conventional method that most teachers employ during classroom experience has been reported to be unfriendly and discourages students from comprehending mathematics, and by extension algebra (Oyekan, 2019). Therefore, efficient delivery techniques while teaching quadratic functions are essential to ensure complete comprehension, correct mastering, and a significant improvement in memory capacity. Students teams-achievement division (STAD) is a strategy that experts advise.

This cooperative strategy, STAD instructional strategy, has been reported to promote both collaborative and independent learning simultaneously (Tran, 2013; Victor-Akinyemi, 2022). This helps achieve clearly stated learning objectives. A small group of students, each with a different ability level, work together to complete an expected learning outcome in this type of learning technique. After the teacher has finished teaching the material, students interact in mixed-gender groups to support each other for better comprehension (Wyk, 2013). This is when STAD occurs. Students were assigned to learning groups of four or five people who were diverse in ability, gender, and ethnicity. After the teacher provides a lesson, students work in groups to ensure everyone understands the task. Finally, each student takes a separate exam on the subject, during which they are not allowed to consult with one another (Tiantong & Teemuangsai, 2013). When calculating the number of points granted, the degree to which pupils match or outperform their prior performance is considered. Test results for each student are compiled, and the aggregate of each score creates the team score. Teams may receive certificates or other awards if they achieve specific requirements (Okechukwu et al., 2016).

STAD strategy is appropriate for subjects with clearly stated objectives, such as geography, science concepts, and mathematical applications and computations. However, it can be revised for practice with less noticeably identified objectives by combining more essay tests (Khalil & Elkhider, 2016). Based on the students' positive interactions with one another, their improved attitudes toward the subject, their elevated sense of self-worth, and their honed interpersonal skills, it was decided to enroll them in STAD. Also, some

accomplished students assume a tutor position and produce intended outcomes. Additionally, STAD introduces a second method for group learning. Additionally, it prepares pupils for the pressures of modern life by teaching them good teamwork (Oludipe & Oludipe, 2017).

Today, an overwhelming majority of students continue to have difficulties in mathematics. They believe mathematics is challenging because it involves understanding a complex system of rules and dealing with large numbers (Thompson, 2015). The main objective of this study is to ascertain the effectiveness of STAD instructional strategy on secondary school students' academic achievement in algebra in Lagos State. Specifically, the study would investigate the effect of STAD instructional strategy on their academic achievement in algebra based on gender and academic ability level.

Research Hypotheses

The following research hypotheses were used to guide this study.

- H₀₁.** STAD instructional strategy does not significantly improve students' achievement in quadratic functions.
- H₀₂.** There is no significant difference in the performance of male and female students in quadratic functions taught using STAD instructional strategy.
- H₀₃.** STAD instructional strategy does not significantly improve students' achievement in quadratic functions based on academic ability level.

Theoretical Framework

The theoretical foundation for this study was founded on Vygotsky's social interdependence theory, which was first proposed in 1962. Vygotsky represented students as social beings entwined with others and eager to learn new things and develop new talents. When students are working toward common objectives, according to this theory's core tenet, their respective actions affect the general outcome of the group (McLeod, 2023). They all have similar objectives, and the actions of other students impact each student's performance. When a student's successes and losses affect those of other students, there is social interdependence. McLeod (2014) states that knowledge is social and created via group efforts to analyze, learn, and solve problems. For pupils to advance beyond their current development, according to Vygotsky, they must connect with other student(s) who are more knowledgeable than themselves. Vygotsky saw learning and development as dynamic processes placed in social and cultural contexts. Therefore, in a constructivist environment, the teacher does not focus mainly on the correctness of the answer

but on the procedure followed by the students to arrive at the solution.

Teachers' ought to guide students and allow them to collaborate with more competent classmates. Students' intellectual development may be stunted if cooperative activities are not present to create such a learning environment. This framework demonstrated how communication and social interaction are crucial to learning. Those in the group who get along well together will produce good outcomes. There are only individual efforts when there is neither social interdependence nor social reliance (McLeod, 2014). Integration is necessary for increased learning. As a result, the foundation of this philosophy is collaborative teaching methods. According to Vygotsky, abstract thinking cannot develop independently; it needs language and Western education. Underprivileged in Uzbekistan of varied ages, sexes, and levels of exposure to the newly constructed schools were tested to see if this was true by Vygotsky. Only formal education showed a correlation between abstract thinking and these other factors. This theory is based on the idea that a more competent person (teacher) may give students temporary frameworks that help them reach higher-order thought stages, which are identified as the range of students' sole accomplishments and what they can accomplish with the help of the best possible social support (Victor-Akinyemi, 2022).

Literature Review

Equations are a key algebraic idea. It performs arithmetic operations in accordance with several rules. Data sets with two or more variables can be understood using specific rules. This study examines past studies related to the influence of STAD, cooperative instructional strategy, gender, and ability level on students' academic achievement in algebra and mathematics.

Few studies were available to the researchers on the influence of STAD on the academic achievement of students in mathematics. In a comprehensive review, STAD studies on different subjects were also presented in this section. Majoka et al. (2015) investigated the efficacy of STAD in secondary mathematics classrooms. This study's findings showed that STAD was a better instructional paradigm for mathematics than the conventional approach. Using STAD learning paradigm, Rusi et al. (2019) investigated practices to enhance the mathematics learning results of fifth-grade pupils. According to their study, STAD strategy can be employed as a pleasant learning tool and a solution to the challenging issue of pupils comprehending the fifth-grade mathematics curriculum. Simamora (2017) investigated how STAD learning model affected students' capacity for conceptual thinking in mathematics. According to reports, STAD learning approach impacts arithmetic students' conceptual

comprehension abilities. The impact of STAD strategy on learning outcomes in terms of numerical skills was assessed by Sa'adiyah et al. (2021). The study discovered a substantial relationship between STAD cooperative instructional strategy regarding numerical skills and learning outcomes in mathematics. According to other researchers, STAD encourages the robust and comprehensive advancement of students who participate in classroom activities (Ahmed, 2016; Olaide, 2019; Wang et al., 2017).

Likewise, empirical studies on STAD in other subjects such as sciences and arts, Tiantong and Teemuangsai (2013) explored the use of STAD strategy through the sectional Moodle to develop learning accomplishment in computer programming courses. They claimed that Moodle might be used to successfully implement the student team accomplishment STAD strategy to improve learning objectives on courses in computer programming. Yusuf et al. (2015) investigated the differences between two nations, namely the German nation and the Turkish nation, which have varying degrees of historical, cultural, and political ties to the Balkans. The achievement levels of STAD were used in this investigation. The study's conclusions showed that the introduction of STAD resulted in a significant change in the negative stereotype scores of students according to the country in which learners were raised. Furthermore, Shahedi (2016) researched to ascertain whether cooperative learning can enhance primary students' speaking abilities with a focus on STAD and its potential to affect students' interaction ability. According to this study, adopting this strategy can help students become more accurate speakers of English.

Moreover, using Kemmis and McTaggart's participatory action theory, Jamaludin and Mokhtar (2018) used STAD to assess first-semester students' attitudes toward the tourism geography course. The attitude and the teamwork fulfillment scale were assessed to comprehend students' feedback on STAD teaching method. The study found that STAD technique improved the experimental group's pupils' accomplishment test scores, attitudes, and teamwork. The effectiveness of STAD in enhancing students' talking abilities with English as an alternate language was critically investigated (Ibrahim & Adnan, 2019). According to this review, comprehending STAD improved speaking ability and collaboration fulfillment among students and provided a thorough analysis of contemporary dialogue. Lantajo and Tipolo (2018) investigated how STAD affected grade 8 student's academic performance in physics at a public school. They concluded that by working with their classmates, the students' academic achievement had been enhanced by applying STAD. Using STAD as a technique for peer-supported cooperative learning in neuroanatomy was examined by Motwani et al. (2022). They discovered that STAD significantly improves student performance over

traditional self-learning. According to Kikiola (2018), Kolapo (2016), Ogunsakin (2020), and Victor-Akinyemi (2022), STAD is a helpful instrument for peer-assisted cooperative learning in other courses like chemistry, economics, English, geography, and physics.

Concerning gender differences in the achievement of students, Gupta et al. (2014) investigated the impact of gender on students' mathematics achievement when cooperative learning is utilized as an instructional technique. When students were exposed to STAD, gender did not affect their mathematical achievement. The gender of students exposed to algebra employing PBL did not substantially contrast in performance and retention grades, according to Adediran et al. (2015), Ajai and Imoko (2015), and Nikou et al. (2014); Similarly, Lindberg et al. (2010) and Sinaga and Mukhtar (2019) found no significant influence of STAD on male and female students' academic achievement. Weisman et al. (2020) investigated the association between gender, GPA, and multi-ethnic students in STAD classes. It has been shown that when students are exposed to STAD, gender does not affect their learning outcomes. Jiang (2021) and Rodriguez et al. (2020) claimed that female students' attitudes were not on par with their male counterparts, but no difference in mathematics performance was seen. Furthermore, Anyanwu and Iwuamadi (2015), Victor-Akinyemi (2022), and Yusuf et al. (2014) found no gender differences in student performance.

Brown and Kanyongo (2017), on the other hand, discovered a gender difference in mathematics achievement. They stated that male students achieved better than their female colleagues. According to Kyavoa (2017), female pupils underperform male students in mathematics. Male students scored much higher in mathematics than their female counterparts, according to Bertolotti et al. (2020) and Kaiser and Zhu (2022). In contrast, Iweka (2017) and Sam-Kayode and Salman (2015) reported in independent research that student performance in mathematics varied greatly. They went on to say that the mean score of female students was higher than that of male students.

Ability level refers to a student's present capacities at a given time. Students are presently adept at doing it individually with a great degree of precision. The capability level is also known as the scoring level because it is based completing of the assignment without assistance from a student (Odutayo & Yusuf, 2020). Students' ability levels are classified as high, average, and low based on their academic ability. There have been studies carried out by researchers on the influence of ability level on students' achievement with varying findings. The survey by Musa (2022) concluded that students' ability levels play no role in their academic achievement in mathematics. In line with this finding, Akintunde (2017) submitted that cooperative instructional strategy influences mathematics students'

Table 1. Descriptive statistics for pre- & post-test scores of treatment & control

Group	n	M	F	Pre-test scores		Post-test scores	
				Mean	Standard deviation	Mean	Standard deviation
STAD	75	26	49	20.159	10.31	58.491	13.87
Conventional	61	29	32	27.587	10.19	52.579	12.41
Total	136	55	81				

learning outcomes based on their scoring level. On the contrary, Ayinla (2018) and Salman (2016) submitted that the ability level of learners impacts the learning outcome of learners. They further stated that average-ability students performed significantly better than high and low-ability students. Similarly, Dambatta (2019) and Enikanolaye (2021) also reported in their respective studies that the ability level of learners dictates the outcome of students in mathematics when exposed to collaborative learning styles. However, they opined that high-ability students fared better than the average and low-ability students during instruction.

MATERIALS & DESIGNS

This study's population would be all Lagos State secondary school students. While the target population would be all secondary school two (SS II) students in Ikorodu City, Lagos State, Nigeria. This study employed a quasi-experimental, non-randomized, and non-equivalent control group design. Random sampling techniques were used to select the two secondary schools and subsequently used to assign the schools to either treatment or control groups. Two secondary schools with intact classes in Ikorodu City, Lagos State, Nigeria served as the sample for this study. A total of 136 SS II students served as the sample in this study (STAD group comprising 75 students, and the control group, having 61 students). The instructional package focused on the teaching of graphing quadratic functions.

The instructional activity lasted for six weeks; the first week was used for approval from the authorities of the sampled schools, introduction, and interactions with the participants on the experiment process. The treatment spanned from the second to the fifth week, while the post-test was carried out on the sixth week. A researcher-designed assessment test titled "quadratic functions assessment test (QFAT)" was used to measure students' achievement. Quadratic graphs and quadratic equations were the topics both sets of students were exposed to. QFAT consisting of four questions (each with four items), was used for the pre- and post-tests. The treatment group was taught with STAD instructional strategy, while the control group was taught with the traditional instructional strategy. STAD instructional strategy entails separating the students into small groups, each with a different ability level, working together to complete an expected learning outcome. After that, students interact in mixed-gender groups to support each other for better comprehension. On the

other hand, the conventional group were taught with the traditional/conventional method.

QFAT test assessed students' knowledge and skills of graphing quadratic skills. The assessment test items' validity was achieved with the assistance of mathematics, educational research, measurement and evaluation, and teacher education experts. Their comments and observations were integrated into the test items for improvement. The instrument's or QFAT's reliability was tested using the test-re-test method. This instrument was administered to 40 participants who were not students at participating schools. The tests were administered over two weeks. Data from the first and second administrations were collected separately and tested for dependability using the Pearson product-moment correlation statistic, yielding a result of 0.86. With such a strong correlation, the instrument was deemed suitable for the investigation. Analysis of covariance (ANCOVA) was used to test all the hypotheses formulated at 0.05 significance level. The statistical method known as ANCOVA, or analysis of covariance, is frequently utilized to account for the effects of variables in experimental research. Covariates are factors that are not the primary subject of the investigation but might affect the outcome. ANCOVA technique enables researchers to decrease confounding variables and improve the precision of their findings. Furthermore, ANCOVA enhances statistical power by reducing error variance and improving accuracy in STAD treatment estimation.

RESULTS

H₀₁. STAD instructional strategy does not significantly improve students' achievement in quadratic functions

The analysis result is shown in **Table 1** for the descriptive statistics of mean for the pre- and post-test scores of experimental and control groups and **Table 2** for ANCOVA results for the difference between the experimental and control groups.

As shown in **Table 1**, students taught with STAD had higher mean scores (54.49 ± 13.87) than students acquainted with the conventional strategy, with a mean score (52.58 ± 12.41), which is then reflected in ANCOVA result in **Table 2**, the significant difference in the performance of the groups, $F(2,133)=23.1$, $p<0.00$). Consequently, a significant difference exists in students' performance in quadratic functions exposed to STAD instructional strategy.

Table 2. Results of analysis of covariance on differences between treatment & control groups

Source of variance	Sum of squares	df	Mean square	F-ratio	Significance	Decision
Corrected model	1,128.332 ^a	2	564.166	11.394	.000	
Intercept	4,358.988	1	4,358.988	88.603	.000	
Pre-test	23.767	1	23.767	0.480	.490	
Group	105.619	1	1,054.619	23.100	.000	
Error	6,585.286	133	49.513			
Total	154,632.00	136				
Corrected total	7,713.618	135				

Note. ^aR squared=.146 (adjusted R squared=.133)

Table 3. Result of descriptive statistics for post-test scores students exposed to STAD based on gender

Gender	Mean	Standard deviation	n
Male	55.91	13.172	42
Female	54.63	12.005	94
Total	55.39	12.642	136

Table 4. Results of analysis of covariance on differences between treatment group based on gender

Source of variance	Sum of squares	df	Mean square	F-ratio	Significance	Decision
Corrected model	1,357.164 ^a	4	339.291	6.992	.000	
Intercept	4,398.601	1	4,398.601	90.651	.000	
Pre-test	17.404	1	17.404	0.359	.550	
Group	1,059.070	1	1,059.070	21.826	.000	
Gender	228.830	1	228.830			
Group×gender	0.526	1	0.526			
Error	6,356.453	131	48.523			
Total	154,632.000	136				
Corrected total	7,713.618	135				

Note. ^aR squared=.176 (adjusted R squared=.151)

Table 5. Result of descriptive statistics on scoring level of students exposed to STAD instructional strategy

Ability group	Mean	Standard deviation	n
High	73.78	4.631	34
Medium	55.61	8.153	79
Low	29.71	4.152	23
Total	54.22	16.936	136

H₀₂. There is no significant difference in the performance of male and female students in quadratic functions taught using STAD instructional strategy.

For testing hypothesis two, the analysis results are shown in **Table 3** for the descriptive statistics of mean for male and female students taught with STAD instructional strategy, and **Table 4** for ANCOVA results for male and female students taught with STAD instructional strategy.

Table 3 shows that male students taught with STAD had a higher mean score (55.91±13.17) than female students taught with peer tutoring (54.63±12.01).

The results of ANCOVA analysis, as depicted in **Table 4**, indicated no significant difference in the performance of students taught with STAD instructional strategy based on gender, $F(1, 131)=0.011, p>0.917$. Thus, the improvement in the performance of students in quadratic functions exposed to STAD instructional strategy was not affected by gender.

H₀₃. STAD instructional strategy does not significantly improve students' achievement in quadratic functions based on academic ability level

For testing hypothesis three, the analysis results are shown in **Table 5** for the descriptive statistics of mean for students' ability level taught with STAD instructional strategy, and **Table 6** for ANCOVA result for students scoring level taught with STAD instructional strategy. **Table 7** for Scheffe post-hoc pair-wise comparison to show the source of established significant difference.

As shown in **Table 5**, students with high scoring level taught with peer tutoring had the highest mean score (73.78±4.63), followed by medium-ability level students (55.61±8.15) with low-ability level students with the lowest mean score (29.71±4.15), which reflected ANCOVA result in **Table 6** the significant difference in the scoring level of students taught with STAD instructional strategy, $F(1, 131)=6.77, p<0.002$. **Table 7** showed the high-ability level students taught with STAD strategy were statistically different (18.17) than

Table 6. Result of analysis of covariance on post-test scores of different scoring level of students exposed to STAD strategy

Source	Type III sum of squares	df	Mean square	F	Significance
Corrected model	9,333.371 ^a	6	1,555.562	37.148	.000
Intercept	5,765.343	1	5,765.343	137.681	.000
Pre-test	1,055.694	1	1,055.694	25.211	.000
STAD	206.435	1	206.435	4.930	.030
Scoring level	4,765.514	2	2,382.757	56.902	.000
STAD×ability level	567.345	2	283.673	6.774	.002
Error	2,973.090	131	41.875		
Total	251,568.000	136			
Corrected total	12,306.462	135			

Note. ^aR squared=.758 (adjusted R squared=.738)

Table 7. Result of Scheffe post-hoc pair-wise comparisons on students’ ability levels in post-test mean scores

(I) Scoring level	(J) Scoring level	Mean difference (I-J)	Standard error	Significance	95% confidence interval	
					Lower bound	Upper bound
Low	Medium	-25.90	2.983	.000	-33.35	-18.44
	High	-44.06	3.770	.000	-53.49	-34.64
Medium	Low	25.90	2.983	.000	18.44	33.35
	High	-18.17	2.668	.000	-24.83	-11.50
High	Low	44.06	3.770	.000	34.64	53.49
	Medium	18.17	2.668	.000	11.50	24.83

Note. *Mean difference is significant at p<0.05

medium-ability level students and low-ability students (44.06). Therefore, average-ability students benefitted more from exposure to STAD instructional strategy in quadratic functions.

DISCUSSION

This study discovered that STAD instructional technique increases students’ quadratic function achievement. Compared to traditional teaching strategy, STAD strategy fosters a collaborative learning environment in which students’ team up and support each other’s knowledge of algebraic ideas. The advantages of this strategy go beyond academic accomplishment since it helps students develop crucial social skills, including communication, teamwork, and leadership. This study’s findings are consistent with those of Ahmed (2016), Sa’adijah et al. (2021), Simamora (2017), Olaide (2019), and Wang et al. (2017), all of which found that students exposed to STAD strategy performed better in mathematics and other disciplines than those who were taught using traditional methods. Overall, STAD instructional strategy is promising for improving algebra education and helping students succeed in this important subject area.

This study also discovered that gender does not affect the improvement in quadratic function achievement of students exposed to STAD instructional strategy. This significant outcome implies that male and female students benefit from STAD strategy. It also suggests that gender has no bearing on the success of this teaching strategy. This is crucial information for educators who want to increase student performance in their classes. STAD is a cooperative learning system that emphasizes

group work and peer tutoring. It has been proven helpful in raising academic achievement in various subject areas. It is an appealing alternative for teachers wishing to establish an inclusive learning environment because it works equally well for both sexes. Teachers can assist their students in developing crucial abilities such as communication, teamwork, and critical thinking by employing STAD strategy. Overall, this study sheds light on the efficacy of STAD teaching strategy and its capacity to improve student performance regardless of gender (Yusuf et al., 2014; Anyanwu & Iwuamadi, 2015; Rodriguez et al., 2020; Jiang, 2021; Victor-Akinyemi, 2022). However, the findings of this study contradict those of Sam-Kayode and Salman (2015); Iweka (2017); Bertoletti et al. (2020); Kaiser and Zhu (2022), all of which found gender differences in achievement in favor of either male or female students.

Finally, this study found that STAD strategy substantially influenced average ability students’ quadratic functions achievement. STAD strategy has been found to improve the academic achievement of average-scoring algebra students significantly. This conclusion is significant because it implies that this method can help bridge the achievement gap between high- and low-achieving pupils. STAD approach is designed to promote collaboration and active learning among students, which can lead to deeper understanding and improved performance. By working together in small groups, students can share their knowledge and skills, identify areas, where they need additional support, and receive feedback from their peers. This collaborative approach also helps build social skills and teamwork abilities, which are essential for success in school and beyond. Overall, STAD

instructional strategy is a powerful tool for improving academic outcomes for all students, especially for average achievers in math. The findings of this study are separate from the outcome of Akintunde (2017) and Musa (2022), who concluded that students' ability levels play no role in their academic achievement in mathematics. On the contrary, Salman (2016) and Ayinla (2018) submitted that the ability level of learners impacts the learning outcome of learners in favor of proficient students.

CONCLUSIONS

Based on the findings of this study, it was determined that STAD teaching strategy effectively boosted student attitudes toward math and reduced anxiety associated with studying quadratic functions. Quadratic functions allow pupils to grasp complicated, changing, and abstract concepts, which stimulates the brain and helps students learn to think in new ways. Overall, STAD method of instruction is an effective tool for instructors seeking to increase student results and foster a good learning environment. This will be accomplished because algebra will assist students in organizing their thoughts, making it easier for them to formulate logical solutions when confronted with complex or dynamic situations.

The study's limitation is that not all educational environments or student demographics may be covered by it. STAD teaching strategy's efficacy may vary based on the student's prior knowledge, motivation, and unique learning preferences. Additionally, because the study's primary focus is on quadratic functions, its results could not transfer to other mathematical ideas or fields of study. Therefore, it is recommended that:

1. As a mechanism of the Ministry of Education, the Nigerian Educational Research Development Council should arrange workshops, training, and seminars on incorporating learner-friendly instructional strategies such as STAD.
2. Curriculum planners should support implementing STAD instructional strategy for teaching mathematics while monitoring and supervising schools continuously to ensure compliance.
3. Educational administrators must encourage a research culture by urging mathematics teachers to use STAD and submit thoughtful analysis and empirical submissions at the end of the academic session.
4. Administrators should plan incentives and recognition for educators who go above and beyond the standard teaching style to utilize STAD instructional strategy.

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