ISSN: 2945-4190

World Journal on Education and Humanities Research
Creative Commons Attribution 4.0 International
Vol. 4, Issue 3, pp. 124-139
Received, July 2024; Revised Augusts 2024;
Accepted September 2024

Article

Investigating The Performance of The Grade 9 Students in Quadratic Inequalities Using Modular Distance Learning

Lorie Jane Letada
Emerson Peteros
GenGen Padillo

Corresponding Author: letadalorie@gmail.com

Abstract: This study employed a quasi-experimental design to examine the performance of Grade 9 students in learning quadratic inequalities using printed and digitized modular distance learning. A total of 40 were divided into two groups based on their final Grade 8 mathematics scores. One group received printed self-learning modules, while the other received digitized modules. Data were gathered using a profile survey, pretest, posttest, and the Most Essential Learning Competencies (MELCs)-aligned self-learning modules. Statistical analysis using chi-square and t-tests showed no significant relationship between the students' profiles (age, gender, income, availability of devices, and final grade) and their pretest or posttest performance. Furthermore, no significant difference was found between the pretest and posttest scores of the printed and digitized groups. These findings suggest that both learning modalities were equally effective in improving student performance in quadratic inequalities.

Keywords: Quadratic inequalities, Modular distance learning, Digitized learning modules, Student performance, Mathematics education

Introduction

Mathematics is central to the secondary education curriculum, serving as a foundation for logical reasoning and critical thinking (Kudaibergen, 2020). Among the core topics, algebra plays a critical role in the development of abstract reasoning and problem-solving skills (Lee et al., 2020). Quadratic inequalities, specifically, help students understand complex relationships between variables and are essential for higher-level mathematics and science courses (Damayanti et al., 2019). Mastering these concepts is critical for student success in STEM fields, as they lay the groundwork for more advanced mathematical understanding (Donvito & Otero, 2019).

Quadratic inequalities require students to engage deeply with problem-solving processes, fostering critical thinking (Medová et al., 2020). By analyzing and solving these inequalities, students develop logical reasoning skills that are transferable to real-world scenarios (Wilkie, 2019). The abstract nature of quadratic inequalities teaches students to think beyond numerical calculations and consider relationships between variables, a skill that is essential in various fields such as engineering, economics, and data science (Didis Kabar, 2023). These cognitive skills are vital for students' success in both academics and their future careers (Damayanti et al., 2019).

In traditional classroom settings, students often face challenges in grasping quadratic inequalities due to the abstract nature of the concepts (Muchoko et al., 2019). One common difficulty is the inability to visualize the solution sets and understand the graphical representations of quadratic inequalities (Sönnerhed, 2021). Additionally, students struggle with applying the appropriate methods, such as factoring or completing the square, which are essential techniques for solving these inequalities (Damayanti et al., 2019). The fast-paced nature of traditional classrooms can also hinder individual learning, leaving some students behind (Donvito & Otero, 2019).

Modular distance learning is a self-paced approach where students use instructional modules to learn independently, typically with minimal interaction with teachers (Velychko et al., 2019). This learning modality has gained prominence due to the global shift towards remote education during the COVID-19 pandemic, allowing students to continue learning without attending physical classrooms (Rupasinghe et al., 2023). Modular learning is implemented through printed or digital modules that contain lessons, exercises, and assessments, offering flexibility for both teachers and students (Garinganao & Bearneza, 2021). This method is especially relevant in times of crisis, as it provides an accessible way for students to continue their education from home (Adamuz-Povedano et al., 2021).

One of the primary benefits of modular learning in mathematics education is that it allows students to progress at their own pace, which can be particularly advantageous for mastering complex topics like quadratic inequalities (Wilkie, 2019). This flexibility helps students who may need more time to fully grasp abstract mathematical concepts (Didis Kabar, 2023). However, modular learning also has limitations, such as the lack of immediate feedback and limited opportunities for peer collaboration, which are critical in understanding difficult subjects like mathematics (Damayanti et al., 2019). Additionally, without direct teacher guidance, students may struggle with self-regulation and motivation, which can negatively affect their learning outcomes (Sönnerhed, 2021).

Investigating the performance of Grade 9 students in quadratic inequalities under modular distance learning is crucial because these

ISSN: 2945-4190

students are at a critical stage in their mathematical development (Damayanti et al., 2019). Preliminary findings suggest that while modular learning offers flexibility, it may not provide the structured support that some students need to fully grasp challenging topics like quadratic inequalities (Muchoko et al., 2019). Observations have shown that students often require more guidance and real-time feedback to succeed in this modality, particularly when dealing with abstract mathematical concepts (Garinganao & Bearneza, 2021). Investigating their performance can help educators refine modular distance learning approaches to better support student achievement in mathematics.

Methodology

This study employed a quasi-experimental design to investigate the performance of Grade 9 students in modular distance learning using two modalities: printed and digitized modules. A total of 40 participants from Quiot National High School in Cebu, Philippines, were divided into two equal groups based on their final grades from the previous school year. The participants were systematically assigned to either the printed or digitized groups by arranging their grades in descending order and selecting odd-numbered students for the digitized group and even-numbered students for the printed group. The printed modular distance learning group received hard copies of the self-learning modules, which they collected and submitted at the school. The digitized group, on the other hand, received electronic versions of the modules via Facebook Messenger and completed pre- and post-tests through Google Forms. Data were collected using a profile survey, pre-test, post-test, and the self-learning modules aligned with the Department of Education's Most Essential Learning Competencies (MELCs). A pilot test was conducted on Grade 10 students to ensure the reliability and validity of the 50-item multiple-choice pre- and post-tests. The statistical treatments applied included frequencies, percentages, chi-square, and t-test to analyze the data.

Results and Discussion

Table 1. Age and Gender of the Respondents

Age (in years)	Male		Female		Total	
	F	%	*f*	%	*f*	%
16 and above	4	10.00	8	20.00	12	30.00
15	3	7.50	13	32.50	16	40.00
14 and below	3	7.50	9	22.50	12	30.00
Total	10	25.00	30	75.00	40	100.00

Table 1 presents the age and gender distribution of the 40 respondents in the study. Of the total participants, 25% were male and 75% (30 students) were female, indicating a higher proportion of female students in the sample. Regarding age, 30% were 16 years old and above, with more females (20%) in this age group compared to males (10%). The majority of the respondents, 40%, were 15 years old, with females again dominating at 32.5% compared to only 7.5% of males. Lastly, 30% were 14 years old or younger, with females making up 22.5% and males 7.5%.

Table 2. Internet Accessibility of the Respondents

Internet Accessibility	F	%
Yes	37	92.50
No	3	7.50
Total	40	100.00

Table 2 shows the internet accessibility of the respondents. A significant majority of the respondents, 92.5%, reported having access to the internet, while only 7.5% indicated they did not have internet access. This high percentage of internet accessibility suggests that most students are equipped to participate in digital learning modalities, such as accessing online resources and submitting assignments electronically. However, the small portion of students without internet access highlights the need for alternative methods, such as printed materials, to ensure that all students can engage in the learning process.

Table 3. Combined Family Monthly Income

Monthly Income (in pesos)	F	%
above 14,000	10	25.00
7,000 – 14,000	19	47.50
below 7,000	11	27.50
Total	40	100.00

Table 3 shows the combined family monthly income. The majority of respondents, 47.5% (19 students), reported a family income between 7,000 and 14,000 pesos per month. A quarter of the respondents, 25% (10 students), had a family income above 14,000 pesos, while 27.5% (11 students) reported earnings below 7,000 pesos per month. These figures indicate that nearly half of the students come from families within the middle-income range, while a significant portion belongs to lower-income households.

Table 4. Availability of Devices at Home

Devices	F	Rank
Smartphone	32	1
Desktop	11	2
TV	7	3.5
Laptop	7	3.5
Radio	4	5.5
Tablet	4	5.5
None	2	7

*Multiple Response

ISSN: 2945-4190

Table 4 outlines the availability of various devices at home, ranked according to frequency. Smartphones were the most commonly available device, with 32 respondents reporting having access to one, making it the top-ranked device. Desktops ranked second, available to 11 respondents. Both televisions and laptops tied for third place, with 7 respondents having access to each. Radios and tablets were tied for fifth place, available to 4 respondents each. Notably, 2 respondents reported having no devices at home, indicating a potential barrier to accessing digital learning resources. This data emphasizes the widespread use of smartphones for learning but also suggests that some students may face challenges due to limited access to other devices.

Table 5. Final Grade of the Respondents in Grade 8 Mathematics

Level	Numerical Rating	*f*	%
Outstanding	90 – 100	3	7.50
Very Satisfactory	85 – 89	10	25.00
Satisfactory	80 – 84	9	22.50
Fair Satisfactory	75 – 79	18	45.00
Did not meet the Expectations	Below 75	--	--
Total		40	100.00

Table 5 displays the final grades of the respondents in Grade 8 Mathematics. The largest group of respondents, 45% (18 students), received a grade in the "Fair Satisfactory" range, scoring between 75 and 79. A quarter of the respondents, 25% (10 students), achieved "Very Satisfactory" grades, with scores ranging from 85 to 89. Additionally, 22.5% (9 students) earned "Satisfactory" grades, scoring between 80 and 84. Only a small percentage, 7.5% (3 students), attained an "Outstanding" grade, with scores between 90 and 100.

Table 6. Pretest Performance Level of the Respondents on Illustrating Quadratic Inequalities by Graphing

Level	Range of	Printed		Digitized		Total	
	Scores	F	%	f	%	f	%
High	13 – 18	--	--	1	2.50	1	2.50
Moderate	7 – 12	7	17.50	5	12.50	12	30.00
Low	0 – 6	13	32.50	14	35.00	27	67.50
Total		20	50.00	20	50.00	40	100.00

Table 6 shows that on illustrating quadratic inequalities by graphing, out of 40 students, only 1 or 2.50 percent got the total score between 13 to 18, categorized as high level, and only 1 or 2.50 percent from the digitized group got the highest score, and none got from the printed group. There is 12 or 30.00 percent of the students who got 7 to 12, categorized as moderate level, composed of 5 or 12.50 percent students from digitized groups and 7 or 17.50 percent from the printed group. Furthermore, 27 or 67.50 percent of students got scores ranging between 0 to 6, categorized as low level, composed of 13 or 32.50

percent from the printed group and 14 or 35.00 percent from the digitized group. Evidence from this table clearly shows that students who took pre-test in terms of illustrating quadratic inequalities through the graphing method are too high in figures ranging the scores between 0 to 6. This evidence only infers that students have little knowledge of the said learning competency, especially students with non-visual learners, which will affect their performance toward graphing quadratic inequalities. Bosman and Schulze (2018) found in their study on learning style preferences and mathematics achievement among secondary school students that an individual's learning style correlated with their mathematics performance.

Table 7. Pretest Performance Level of the Respondents on Solving Quadratic Inequalities

Level	Range of Scores	Printed		Digitized		Total	
		f	%	f	%	f	%
High	10 – 13	--	--	1	2.50	1	2.50
Moderate	5 – 9	12	30.00	11	27.50	23	57.50
Low	0 – 4	8	20.00	8	20.00	16	40.00
Total		20	50.00	20	50.00	40	100.00

Table 7 shows that on solving quadratic inequalities, out of 40 students, only 1 or 2.50 percent got the total score between 10 to 13, categorized as high level, and only 1 or 2.50 percent from the digitized group got the highest score, and none got from the printed group. There is 23 or 57.50 percent of the students who got 5 to 9 scores, categorized as moderate level, composed of 11 or 27.50 percent students from digitized groups and 12 or 30.00 percent from the printed group. Furthermore, 16 or 40 percent of students got scores ranging between 0 to 4, categorized as low level, composed of 8 or 20.00 percent each from the printed and digitized group. With the composition of the students who - took a pre-test to solve quadratic inequalities, only one student got a high-level score ranging from 10 to 13, which interprets that the remaining students have trouble remembering the pre-requisite knowledge of the said learning competency. Students tend to forget basic skills in mathematics, resulting in their difficulties in solving quadratic inequalities. According to Baring & Alegre (2019), explaining to the students the importance of mathematics on how to serve it is a fundamental foundation in real situations.

Table 8. Pretest Performance Level of the Respondents on Solving Problems Involving Quadratic Inequalities

Level	Range of Scores	Printed		Digitized		Total	
		f	%	*f*	%	*f*	%
High	13 – 19	1	2.50	2	5.00	3	7.50
Moderate	7 – 12	7	17.50	4	10.00	11	27.50
Low	0 – 6	12	30.00	14	35.00	26	65.00
Total		20	50.00	20	50.00	40	100.00

Table 8 shows that on solving problems involving quadratic inequalities, out of 40 students, only 3 or 7.50 percent got the total score between 13 to 19, categorized as high level, and only 2 or 5.00 percent from the digitized group and 1 or 2.50 percent from the printed group. Eleven or 27.50 percent of the students got 7 to 12 scores, categorized as moderate level, composed of 4 or 10.00 percent students from digitized groups and 7 or 17.50 percent from the printed group. Furthermore, 26 or 65.00 percent of students got scores ranging between 0 to 6, categorized as low level, composed of 14 or 35.00 percent from the digitized group and 12 or 40.00 percent from the digitized group. Based on the data gathered, the students' entry-level knowledge on solving problems involving quadratic inequalities where only three students out of forty students imply that students find difficulties in word problems, mainly when translating word problems into mathematical symbols. According to Mingke & Alegre (2019), the students' performance toward mathematical word problem solving was not based on the teaching strategies nor on the instructional materials, but it is on the pupils' attitude towards the said skill.

Table 9. Posttest Performance Level of the Respondents on Illustrating Quadratic Inequalities by Graphing

Level	Range of Scores	Printed		Digitized		Total	
		F	%	*f*	%	*f*	%
High	13 – 18	1	2.50	5	12.50	6	15.00
Moderate	7 – 12	11	27.50	10	25.00	21	52.50
Low	0 – 6	8	20.00	5	12.50	13	32.50
Total		20	50.00	20	50.00	40	100.00

Table 9 shows that on illustrating quadratic inequalities by graphing, out of 40 students, 6 or 12.50 percent got the score between 13 to 18, categorized as high level, and only 1 or 2.50 percent from the printed group while 5 or 12.50 percent from digital group. There is 21 or 52.50 percent of the students who got 7 to 12, categorized as moderate level, composed of 10 or 25.00 percent students from digitized groups and 11 or 27.50 percent from the printed group. Furthermore, 13 or 32.50 percent of students got scores ranging between 0 to 6, categorized as low level, composed of 8 or 20.00 percent from the printed group and 5 or 12.50 percent from the digitized group. It reveals that students, regardless of the modality they are utilizing, was moderately developed the concept of illustrating quadratic inequalities by graphing during modular distance learning. Despite teachers' physical absence, students can still develop the skill mentioned above using the self-learning modules. Moreover, Ndlovu (2019) suggested that the curriculum developers design more explorative learning activities with graphing calculators to better understand quadratic inequalities.

Table 10. Posttest Performance Level of the Respondents on Solving Problems Involving Quadratic Inequalities

Level	Range of Scores	Printed		Digitized		Total	
		F	%	f	%	f	%
High	13 – 19	2	5.00	3	7.50	5	12.50
Moderate	7 – 12	14	35.00	12	30.00	26	65.00
Low	0 – 6	4	10.00	5	12.50	9	22.50
Total		20	50.00	20	50.00	40	100.00

Table 10 shows that on solving quadratic inequalities, out of 40 students, only 9 or 22.50 percent got the total score between 10 to 13, categorized as high level, and only 7 or 17.50 percent from the digitized group got the highest score, and 2 or 5.00 percent got from the printed group. There is 20 or 50.00 percent of the students who got 5 to 9 scores, categorized as moderate level, composed of 10 or 25.00 percent students from digitized groups and 10 or 25.00 percent from the printed group. Furthermore, 11 or 27.50 percent of students got scores ranging between 0 to 4, categorized as low level, 3 or 7.50 percent from the digitized group, and 8 or 20.00 percent from the printed group. The data showed that students who got low-level performance in the post-test find difficulties in solving quadratic inequalities. Students' lack of motivation in learning, especially during modular distance learning, affects their understanding of the said competency. Otoo et al. (2018) investigated the students' self-motivation to learning mathematics. Results showed that students' interest affects the learning of mathematics.

Table 11. Posttest Performance Level of the Respondents on Solving Quadratic Inequalities

Level	Range of Scores	Printed		Digitized		Total	
		f	%	*f*	%	*f*	%
High	10 – 13	2	5.00	7	17.50	9	22.50
Moderate	5 – 9	10	25.00	10	25.00	20	50.00
Low	0 – 4	8	20.00	3	7.50	11	27.50
Total		20	50.00	20	50.00	40	100.00

As seen in Table 11, the respondents had a high-level performance in their post-test in solving problems involving quadratic inequalities with an overall score of 5 or 12.50 percent, composed of 2 or 5.00 percent and 3 or 7.50 percent from the printed and digitized group, respectively. However, 26 or 65.00 percent of the respondents got overall moderate level, composed of 14 or 35 percent and 12 or 30.00 percent from a printed and digitized group, respectively. Lastly, 9 or 22.50 percent of respondents had a low level, and 4 or 10.00 percent was from the printed group, and 5 or 12.50 from the digitized group. Data reveals that the respondents have difficulties in solving word problems involving quadratic inequalities. In general, students struggle with word problem solving because of the lack of understanding of Math's basic concepts, such as translating phrases to mathematical symbols. It

ISSN: 2945-4190

was supported in the related study conducted by Mingke & Alegre (2019). Findings reveal that translating word problems into mathematical symbols is students' difficulties that lead them to low scores. Hence, it was suggested to conceptualize the said competency to relate this skill's usefulness even outside the school.

Table 12. Test of Significant Relationship between the Profile and the Respondents' Pretest Performance

Variables	Df	Computed χ^2	p - value	Decision	Remarks
Age and Pretest Performance	2	1.577	0.454	Do not Reject Ho	Not Significant
Gender and Pretest Performance	4	0.618	0.961	Do not Reject Ho	Not Significant
Income and Pretest Performance	4	1.657	0.799	Do not Reject Ho	Not Significant
Availability of Devices and Pretest Performance	6	5.314	0.504	Do not Reject Ho	Not Significant
Final Grade and Pretest Performance	4	8.243	0.083	Do not Reject Ho	Not Significant

Table 12 presents the results of the test for a significant relationship between the respondents' profiles and their pretest performance. The variables examined include age, gender, income, availability of devices, and final grade. For all variables, the computed p-values were greater than the standard significance level ($p > 0.05$), leading to the decision to "Do not Reject Ho," meaning no significant relationships were found between any of these profile factors and the pretest performance. Specifically, age ($p = 0.454$), gender ($p = 0.961$), income ($p = 0.799$), availability of devices ($p = 0.504$), and final grade ($p = 0.083$) all showed no statistically significant correlation with pretest scores. These results suggest that demographic factors and access to resources did not significantly influence the students' initial performance on the pretest.

According to Grissom (2004), age has no significant relationship with educational achievement. He suggested that both age and gender have a negative correlation with academic performance. However, Ghazvini & Khajehpour (2011) revealed that gender differences affect the students' academic performance, which contrary to this finding. Female students have a more adaptive approach to learning tasks than male students. This study was not considered the contextual variables which affect boys' and girls' motivation. Likewise, Baliyan (2012), Adzido et al. (2016), and Machebe et al. (2017) argued that the socio-economic status of the parents has significantly contributed to the performance of the students, which contradicts the result of this study. The family's financial income affects the students' performances, supporting and helping their students' needs. Also, Davis (2012) revealed in his study that the use of technology devices did not increase students' academic achievement. Like the finding of this study, the students' availability of devices at home does not significantly affect their performance. It means that students who have smartphones, laptops, or any technology devices that can support their learning have the same performance as those who have no devices at home. Furthermore, it can be observed that the previous grade of the respondents had no significant difference in their pre-test performances. Students grade in the previous school does not affect to their current performances. This finding is steady with the discoveries of Barbaranelli, Caprara, Rabasca, and Pastorelli (2003). There was a negative correlation between academic performance and the current questionnaire scores for children.

Table 13. Test of Significant Relationship between the Profile and the Respondents' Posttest Performance

Variables	Df	Computed χ^2	p - value	Decision	Remarks
Age and Posttest Performance	2	1.723	0.423	Do not Reject Ho	Not Significant
Gender and Posttest Performance	4	5.368	0.252	Do not Reject Ho	Not Significant
Income and Posttest Performance	4	2.377	0.667	Do not Reject Ho	Not Significant
Availability of Devices and Posttest Performance	6	1.165	0.979	Do not Reject Ho	Not Significant
Final Grade and Posttest Performance	4	5.953	0.203	Do not Reject Ho	Not Significant

Table 13 presents the test for a significant relationship between the respondents' profiles and their posttest performance. Similar to the pretest results, none of the variables—age, gender, income, availability of devices, and final grade—showed a statistically significant relationship with the posttest performance, as all computed p-values exceeded the threshold of 0.05. Specifically, age ($p = 0.423$), gender ($p = 0.252$), income ($p = 0.667$), availability of devices ($p = 0.979$), and final grade ($p = 0.203$) were found to have no significant effect on posttest

ISSN: 2945-4190

performance. These findings indicate that demographic factors and access to technology did not significantly influence the students' performance on the posttest, similar to the pretest results. This suggests that other factors not captured in the profile variables may have a greater impact on students' learning outcomes. Owolabi & Etuk-Iren (2014) supported the results of this study when they investigated the effect of the gender and age of the students on their performance in Algebra, which revealed that there is no significant difference in the achievement of the students to their ages and gender differences. A similar study conducted by Nt (2015) on the academic performance relationship with the age and gender in Nigeria revealed no significant difference between the age of the students; however, there was a significant relationship between the gender of the students to their performance. His study implied that age had no effect on the child's educational achievement, and gender affected pupil's performance. Based on the study of LV (2016), it shows that the level of family income in an urban area in China has no significant influence on the performance of the students, but in a rural area, the family's income plays a crucial role in the enhancement of the child's learning level. With this regard, he suggested the changes of the educational system of the said country.

However, this study's finding is contrary to Harris et al. (2016) finding, which investigated the effect of technology on the students' academic performance among American pupils. It revealed that technology devices such as laptops had a significant influence on the students' academic achievement. With the proper use of technology, students can do beyond their ability. However, technology must not be the replacement of the teachers but a tool that will enhance learning.

Table 14. Test of Significant Difference on the Pretest Performances of the Two Groups

Source of Difference	Mean	Standard Deviation	Mean Difference	Computed t- value	p-value	Decision
Digitized	17.85	8.86	1.00	0.423	0.674	Do not Reject Ho
Printed	16.85	5.75				

It can be seen in Table 14 that the two groups had no significant difference in the pre-test performances. The following are the results: digitized modality (μ=17.85, σ=8.86) and printed modality (μ=16.85, σ=5.75) which revealed that null hypothesis is not rejected with the mean difference of the two groups of 1.00, computed t-test 0f 0.423 and p-value 0f 0.674. The results signify that whatever modality the students choose, either printed or digitized, the pre-test performance does not differ. Even most of the teachers prefer digitized than printed because of their convenience, but the students' convenience matters. Hence, whatever modular distance learning modality they will utilize, the same performances of the students will prevail. This finding supports the studies of Carol & Burke (2010), who suggested neither modality is more effective than the other concerning students' performances.

Table 15. Test of Significant Difference on the Posttest Performances of the Two Groups

Source of Difference	Mean	Standard Deviation	Mean Difference	Computed t- value	p-value	Decision
Digitized	25.15	9.82	3.15	1.170	0.249	Do not Reject Ho
Printed	22.00	6.97				

As seen in table 15, the digitized group (μ=25.15.85, σ=0.82) and printed group (μ=22.00, σ=6.07) have the mean difference of 3.15 with the computed t-value of 1.170 and p-value of 0.249, which implies that the two groups have no significant difference. Like the respondents' pre-test performance, their post-test performance from the two modular learning modalities does not differ. Thus, the null hypothesis does not reject. Furthermore, it can be observed that the respondents' performances from pre-test to post-test with mean differences of 1.00 and 3.15 respectively have improved, which means that even in the physical absence of the teachers, students will still learn using modular distance learning. However, it can be observed that the students' post-test performances from the three learning competencies of quadratic inequalities are at a moderate level. Hence, Students need to enhance the pre-requisite skills of the quadratic inequalities and improve the self-learning module's delivery instruction by carefully giving students a thorough discussion that shows a step-by-step process of the learning competencies. A study by Rach and Ufer (2020) found that the pre-requisite skills contribute to the students' success. A similar study conducted by Paul and Jefferson (2019) revealed no significant relationship between distance learning and traditional classroom teaching in the students' performance.

Conclusion

Based on the findings, it can be concluded that there is no significant relationship between the respondents' profiles—such as age, gender, income, availability of devices, and final grade—and their pretest or posttest performance. The computed p-values for all variables were above the significance threshold, indicating that none of the profile factors had a statistically significant impact on the students' performance in both the pretest and posttest. Additionally, the comparison between the pretest and posttest performances of the printed and digitized groups revealed no significant difference, with both groups showing similar improvements. Although the digitized group had a slightly higher mean in the posttest, the difference was not statistically significant. These results suggest that both printed and digitized modular learning modalities were equally effective in improving the students' understanding of quadratic inequalities, regardless of their profile characteristics.

References

Adzido, R. Y. N., Dzogbenuku, R. K., & Ahiave, E. (2016). Influence of socio-economic status on academic performance of students in rural senior high schools in Ghana. *International Journal of Educational Research*, *2*(4), 101-112.

Baliyan, S. P. (2012). Socio-economic factors influencing secondary school pupils' performance in Botswana: A case study of selected schools. *European Journal of Social Sciences*, *2*(1), 23-32.

Barbaranelli, C., Caprara, G. V., Rabasca, A., & Pastorelli, C. (2003). A questionnaire for measuring the big five in late childhood. *Personality and Individual Differences*, *34*(4), 645-664.

Baring, R., & Alegre, H. (2019). Developing mathematical thinking through problem solving in secondary education: A framework. *Philippine Educational Research Journal*, *8*(1), 23-35.

Bosman, A. C., & Schulze, S. (2018). Learning style preferences and mathematics achievement among secondary school students. *Educational Psychology*, *38*(4), 431-446.

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design & analysis issues for field settings*. Rand McNally.

Davis, M. (2012). The use of technology in mathematics classrooms and its impact on student performance. *Journal of Educational Research*, *56*(2), 45-52.

Didis Kabar, M. G. (2023). A thematic review of quadratic equation studies in the field of mathematics education. *Participatory Educational Research*.

Donvito, A., & Otero, M. R. (2019). Utility of mathematical knowledge as a motivating factor in students' learning. *Educational Journal of the University of Patras UNESCO Chair*.

Garinganao, N. S., & Bearneza, F. J. D. (2021). Algebraic skills and academic achievement in mathematics of Grade 7 students in a Philippine Chinese school. *Philippine Social Science Journal*.

Ghazvini, S. D., & Khajehpour, M. (2011). Gender differences in factors affecting academic performance of high school students. *Procedia-Social and Behavioral Sciences*, *15*(1), 1040-1045.

Grissom, J. A. (2004). Age and gender differences in school achievement. *Educational Research Review*, *8*(3), 67-85.

Harris, A., Munoz, J., & Salinas, P. (2016). The impact of technology on the students' academic performance. *American Journal of Educational Research*, *4*(12), 934-939.

Kudaibergen, A. A. (2020). Word problems in the school mathematics course. *Proceedings of International Young Scholars Workshop*.

D., Ok, M., & Shin, M. (2020). A systematic review of interventions for algebraic concepts and skills of secondary students with learning disabilities. *Learning Disabilities Research & Practice*, *35*, 89-99.

LV, L. (2016). The relationship between family income and students' academic performance: Evidence from urban and rural China. *Education Economics*, *24*(5), 469-482.

Machebe, C. H., Ezegbe, B. N., & Onuoha, C. I. (2017). The influence of parental socioeconomic status on their involvement in their children's education in Nigeria. *International Journal of Educational Research*, *6*(1), 40-45.

Medová, J., Bulková, K., & Čeretková, S. (2020). Relations between generalization, reasoning and combinatorial thinking in solving mathematical open-ended problems within mathematical contest. *Mathematics*, *8*(12), 2257.

Mingke, S., & Alegre, H. (2019). Students' performance in solving word problems in quadratic inequalities. *Philippine Educational Research Journal*, *9*(2), 13-25.

Muchoko, C., Jupri, A., & Prabawanto, S. (2019). Algebraic visualization difficulties of students in junior high school. *Journal of Physics: Conference Series*, *1157*, 032108.

Ndlovu, Z. (2019). The use of graphing calculators in understanding quadratic inequalities. *Mathematics in School*, *6*(4), 45-57.

Nt, M. L. (2015). Age and gender influences on students' academic performance in Nigeria. *Journal of Education and Social Research*, *5*(2), 20-29.

Otoo, P. O., Antwi, D., & Asare, E. (2018). The effect of self-motivation on students' learning in mathematics. *International Journal of Educational Studies*, *4*(3), 34-45.

Owolabi, O. T., & Etuk-Iren, R. O. (2014). Age and gender as predictors of academic achievement in algebra among Nigerian secondary school students. *Journal of Education and Practice*, *5*(21), 57-62.

Paul, J., & Jefferson, F. (2019). A comparative analysis of student performance in distance learning versus traditional classroom environments. *International Journal of Distance Education Technologies*, *17*(2), 23-39.

Rach, S., & Ufer, S. (2020). The role of prerequisite knowledge for students' success in learning quadratic inequalities. *Journal of Mathematical Behavior*, *38*(5), 234-246.

Rupasinghe, D. D., Vitharana, P., & Amarasinghe, A. (2023). Professional development of mathematics teachers' pedagogical content knowledge in teaching basic algebra. *International Journal of Research and Innovation in Social Science*.

Sönnerhed, W. W. (2021). Quadratic equations in Swedish textbooks for upper-secondary school. *LUMAT: International Journal on Math, Science and Technology Education*.

Velychko, V., Stopkin, A., & Fedorenko, O. (2019). Use of computer algebra system Maxima in the process of teaching future mathematics teachers. *Information Technologies and Learning Tools*.

Wilkie, K. J. (2019). Investigating secondary students' generalization, graphing, and construction of figural patterns for making sense of quadratic functions. *The Journal of Mathematical Behavior*.