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| RESEARCH ARTICLE

Effects of Heuristic Method on Students' Performance in Mathematics

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| ABSTRACT
This research determines the effects of the Heuristic method on students' performance in Mathematics 7 of a public national high school in the Philippines, school year 2022-2023. The quasi-experimental method used two sets of questionnaires (standardized Attitudes Towards Mathematics Inventory and standardized Algebra Test). The data were treated using frequency, mean, standard deviation, Chi-square test of independence, and paired t-test. The study revealed that student's profiles (age, gender, final grade in Grade 6 Math) do not have significant relationships with their level of mathematical attitudes and academic performance. However, a significant increase in test scores between the pretest and post-test results in a significant difference between the mean gained of both groups. Thus, teaching strategies could encourage students to increase their academic performance. It was concluded that the Heuristic teaching model helps students develop better mathematics learning. The researchers strongly recommend searching for more learning methods that could help elevate the learners' academic performance.

| KEYWORDS

Teaching Mathematics, Heuristic method, performance, descriptive study, Philippines.

| ARTICLE INFORMATION

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1. Introduction

Mathematics is a foundational part of human thought and logic that promotes mental discipline, logical reasoning, and critical thinking skills. According to the International Commission on Mathematical Instruction (2021), mathematical knowledge and skills play a crucial role in understanding the contexts of other subjects such as Science, Social Studies, and even music and art. Thus, teaching with different strategies in Mathematics content helps the transition between paper and pencil calculations and mental calculations, which is one of the modes that shape our thoughts, power of reasoning, creativity, and critical thinking skills, and increases students' problem-solving ability that led to improvement of student's academic performance and active engagements in Mathematics class (Hanna & Villiers, 2012). However, despite understanding the overall importance of Mathematics on students' academic performance and its application concerning other sciences and other fields, lies the idea that there are real existing problems related to teaching and learning Mathematics based on scientific research and hence propose a solution to alleviate the issues.

Moreover, Trends International Mathematics and Sciences Study (2015) revealed that the Philippines only scored 297 in Mathematics; 19% of Filipino students were on a low benchmark and had some basic mathematical knowledge, while 81% still needed to reach this level. The central perception that mathematics is a complicated subject to learn, together with mathematics being labeled negatively among students in schools, makes this study even more vital. These insights into which students were at risk of failing in mathematics subject and continuing to fall behind in achieving sufficient mathematical skills and academic

performance. Thus, teachers' teaching techniques and strategies may not be appropriate nor applicable to all topics for all students and at all times, but this calls for an improved approach to teaching mathematics. With the increasing development in the world, teachers are further challenged with the task of producing competent students, and this imposes great demand on mathematics teachers to devise appropriate instructional techniques and teaching strategies, specifically the use of the Heuristic method in teaching mathematics that led to the improvement of the student's performance and active learning engagement.

With the Heuristic method in teaching mathematics, students learn by self-experience and discovery, which helps them achieve cognitive, affective, and psychomotor skills. Also, it allows the student's mental and cognitive development, self-confidence, and self-reliance in answering mathematical problems. This demanded the Heuristic method to obtain varied information in the context of mathematics teaching and that teachers must possess much curiosity, observation, interest, and spirit of scientific investigation because these are the qualities that students must develop, resulting in improvement in the learning performance of the Grade 7 students in mathematics.

In this light, based on the researchers' observations on the problems encountered by students in learning Mathematics, they opted to study the effects of the Heuristic method in teaching Mathematics on the academic performance and learning engagements of the Grade 7 students.

2. Literature Review

This study is anchored on the following theories: Constructivist Learning Theory by Piaget (1964), Self-Regulated Learning Theory by Zimmerman (2003), Social Cognitive Theory (Bandura, 1986), and Self-Determination Theory by Ryan and Deci (2000). Also, this is supported by the following legal bases: DepEd Order No. 28, series 2020 entitled, "International Day of Mathematics," Regional Advisory No. 51, series 2017 entitled, "Nomination of Participants for the Regular Courses of SEAMEO Regional Centre for QITEP Mathematics," and DepEd Order No. 40, series 2009 entitled "National Workshops on International Trends in Mathematics Teaching and Assessment.

Piaget's (1964) Constructivist Learning Theory impacts the learning curriculum because teachers must create a curriculum plan that promotes logical and conceptual growth in their students (Handrianto & Rahman, 2019; Ghazi & Ullah, 2015; Gurses et al., 2015). The teacher must emphasize the importance of experiences—or connections with the surrounding environment—in student education (Ilechukwu & Usulor, 2019; Bada & Olusegun, 2015). Teachers, for example, must consider the role of fundamental concepts such as object permanence in establishing cognitive structures (Inhelder et al., 2014).

According to Piaget's Constructivism Theory, people produce knowledge and form meaning based on their experiences (Amineh & Asl, 2015). Piaget's theory encompassed learning theories, instructional methods, and educational reform (Illeris, 2018; Demetriou et al., 2016). Two critical components that construct an individual's new knowledge are accommodation and assimilation (Kimmerle et al., 2015)—assimilating causes an individual to incorporate new experiences into old ones (Bada & Olusegun, 2015). This causes the individual to develop new perspectives, reconsider previously held misconceptions, and assess what is essential, ultimately altering their perceptions (Mohammed et al., 2017; Lili, 2015).

Accommodation, conversely, is the process of incorporating new information and experiences into an already-existing mental capacity (Sarbah, 2020; Lili, 2015; Hu, 2014). Individuals envision a particular way for the world to function. When things do not work within that context, they must accommodate and reframe the outcomes' expectations (Bada & Olusegun, 2015). Apart from learning theories, Piaget's Constructivism Theory addresses how learning occurs rather than what influences learning (Schrader, 2015). Teachers play an essential role. Instead of lecturing, teachers in this theory are facilitators, assisting students with their understanding (Brookfield, 2017; Joshi, 2015). This shifts the emphasis away from the teacher and lecture and toward the student and their learning (McCallum et al., 2015). The resources and lesson plan that must be initiated for this learning theory take a different approach to traditional education. Instead of telling, the teacher should ask questions (Mitchell et al., 2020).

Instead of answering questions that only pertain to their curriculum, the facilitator, in this case, must ensure that the student comes to their conclusions rather than being told (Albanese & Dast, 2013). Furthermore, teachers constantly have conversations with students, creating a learning opportunity open to new directions as learning progresses based on students' needs (Motola et al., 2013). Teachers who follow Piaget's Constructivism Theory must challenge students by making them influential critical thinkers, not just "teachers" but also mentors, consultants, and coaches (Kumar & Singh, 2017; Joshi, 2015). Some strategies for the teacher include having students work together and aiding in answering one another's questions (Berrett, 2012). Another approach is to designate one student as the "expert" on a particular subject and have them teach the class. Finally, students should be allowed to work in groups or pairs on controversial research topics they must present to the class.

Self-Regulated Learning (SRL) Theory, developed by Zimmerman (2003), defines self-generated learning as learning that is systematically oriented toward the achievement of students' learning goals (Peteros et al., 2019; Schunk & Zimmerman, 2013). Self-regulated learning entails goal-directed activities that students initiate, modify, and sustain, such as attending to instruction, processing information, rehearsing and relating new learning to prior knowledge, believing in one's learning ability, and establishing productive social and work environments (Hamilton-Ekeke, 2015). SRL corresponds to the idea that rather than being passive recipients of information, students actively contribute to their learning goals and have control over goal attainment (Davis & Hadwin, 2021; Gan et al., 2021). With a solid theoretical background, Schunk and Greene (2017) discuss self-regulation research that identifies regulatory processes and examines how self-regulatory processes operate during learning. Research on self-regulation will enhance our understanding of achievement processes and have important implications for teaching and learning in and out of school (Fang et al., 2022; Josep et al., 2020). SRL encompasses cognitive, metacognitive, behavioral, motivational, and emotional/affective learning aspects (Limone et al., 2020; Verma et al., 2019). It is thus an exceptional umbrella under which many variables influencing learning (e.g., self-efficacy, volition, cognitive strategies) are studied comprehensively and holistically (Lan et al., 2020; Cerezo et al., 2019).

Bandura's (1986) Social Cognitive Theory (SCT) proposes that learning occurs in a social context, with the person, environment, and behavior interacting dynamically and reciprocally. SCT is distinguished by its emphasis on social influence and external and internal social reinforcement (Etcuban et al., 2019). Albert Bandura developed the SCT on the premise that cognitive, behavioral, and environmental factors influence learning (Bandura, 1991). Unlike traditional psychological theories emphasizing direct experience, Bandura proposed that virtually all learning phenomena could occur by observing other people's behavior and its consequences (Bandura, 1986). SCT considers how individuals acquire and maintain behavior and the social environment in which they behave. The theory finds that a person's previous experiences influence whether or not behavioral action will occur (Etcuban et al., 2019). These earlier experiences affect reinforcements, aspirations, and expectancies, all of which affect whether or not a person will interact with specific behavior and why that person does so (Sussman et al., 2011).

Ryan and Deci's (2000) Self-Determination Theory (SDT) is a method for studying human motivation, and character that employs both traditional empirical methods and an organismic metatheory that emphasizes the importance of students' evolved inner resources for personality development and changing behavior (Arcallana et al., 2018). Thus, its domain is the investigation of people's innate growth tendencies and psychological needs, which serve as the foundation for their self-motivation and personality integration and the conditions that promote those positive processes (Zyeşil, 2012; Beckmann, 2009). Much SDT-guided research has examined environmental factors that impede or undermine self-motivation, social functioning, and personal well-being (Ryan & Deci, 2017). Although many specific adverse effects have been investigated, research suggests that these disadvantages can be most succinctly described as thwarting the three basic psychological needs (Ryan & Deci, 2017; 2000).

DepEd Order No. 28, series 2020 entitled, "International Day of Mathematics," announces the Observance of the International Day of Mathematics (IDM), highlighting the essential role of mathematics and its application in all aspects of human activity. The International Mathematical Union (IMU), a nongovernment, non-profit scientific organization that promotes international cooperation in mathematics, leads the IDM.

The IDM seeks to contribute to achieving the Sustainable Development Goals (SDGs) by increasing awareness of the importance of mathematics in education among the general public, decision-makers, and schools (Hamdi et al., 2022). It also aims to help build capacity in mathematical and scientific education, particularly emphasizing girls and children from developing countries. It also strives to empower women and girls in mathematics. The organization aims to raise awareness of the importance of mathematics as a tool for development that leads to more prosperous economic circumstances among the general public, decision-makers, and students.

Regional Advisory No. 51, series 2017 entitled, "Nomination of Participants for the Regular Courses of SEAMEO Regional Centre for QITEP Mathematics" through the Southeast Asian Ministers of Education Organization (SEAMEO) Regional Centre for Quality Improvement of Teachers and Education Personnel (QITEP) in Mathematics announces its regular courses for SEAMEO member countries (Yth, 2012). The five regular courses are designed for teachers in mathematics to improve their pedagogical knowledge through attending classes on the utilization and development of IT-based learning, teacher-made teaching aids, developing lesson study in mathematics education, Southeast Asia realistic mathematics education, and joyful learning in mathematics education.

DepEd Order No. 40, series 2009, entitled "National Workshops on International Trends in Mathematics Teaching and Assessment" through the Center for Educational Measurement, announces the conduct of the National Workshops for Mathematics Coordinators and Teachers, which aims to develop an awareness of new trends on teaching mathematics as well as on posing test questions.

In addition, Sianturi et al. (2021) revealed that students had difficulty in achieving mathematical literacy, formulating, employing, and interpreting mathematics in a variety of context-based problems because the majority of teachers used the directive teaching approach in learning and the conventional teacher-led instruction, where the context problems given to students had been completed by the teacher's completion procedure, making the students less independent in resolving context-based issues. Integrating science and technology into educational practices has created a new avenue for learning new paradigms in teaching students. The availability of vast information on the Internet and technological advancement help teachers deliver lessons, making them enjoyable (Etcuban, 2013).

Using the Heuristic method in teaching Mathematics has stimulated several pedagogical effects on learning (Yaman, 2018; Abonyi & Umeh, 2014). It is based on discovery learning that enhances the mastery of the concept in Mathematics. Students were encouraged to propose any idea to solve the problems through critical thinking and reasoning (Kingir et al., 2012). Compared to the traditional teaching method, the Heuristic method is effective and suitable for improving students' ability to analyze and create solutions to mathematical problems.

Problem-solving is an essential aspect of students' mathematical activities. Heuristic learning strategies can help students practice this ability and promote metacognitive skills. However, teachers faced several challenges in implementing these strategies. Rosyada and Retnawati (2021) describe teachers' challenges in implementing learning with Heuristic strategies. The results revealed that some teachers have already implemented a Heuristic strategy in the learning process but need help to define it correctly. In implementing it, teachers experience several obstacles. These obstacles were found in providing non-routine problems to students, solving problems by students, and conducting discussions to solve problems.

The study of Abubakar et al. (2020) compared Heuristic and traditional methods of teaching mathematics at the junior secondary school level. The result showed that all four null hypotheses were accepted. The study set out to compare the mean performance between students taught using the traditional method and those taught using the Heuristic method. The result shows that students' performance in both methods is similar, resulting in a non-significant difference between their mean performances, as indicated in the tested hypotheses. Scafa (2014) introduces unique Heuristically oriented problem-solving systems that are an efficient tool of the "light hand" guiding the mathematical learning process. The Virtual Instruction Cloud empowers teachers with agile tools to develop and deliver vetted curricula while preserving academic intellectual property rights in innovative ways for both traditional and distance learners using teaching methods developed by new and exciting educational research.

Heuristic literacy is an individual's capacity to use Heuristic vocabulary in discourse and apply the selected Heuristics to the routine solution. In a controlled five-month classroom experiment with Israeli 8th-grade students, non-routine mathematical tasks were indirectly promoted. The study's novel finding is that students in the experimental group who were below the sample average at the start of the experiment benefited from the Heuristically oriented intervention. It is argued here that this is due, in part, to the intervention's communicational aspects (Koichu et al., 2007). Before introducing the K–12 Basic Education Program, intervention material was highly regarded as an instrument for improving students' subpar academic performance. After that, SIMs were incorporated into the teaching strategies to encourage student involvement and raise their comprehension level. It is carefully crafted and intended to teach remedial to those who struggle with the topic. Students who struggle to understand a subject matter are provided the same after receiving standard classroom teaching. SIM in Mathematics aids teachers in giving students who require assistance the tools they need to achieve better in arithmetic.

3. Methodology

This section presents the research design, environment, subjects, instrument, data gathering procedures, statistical treatment, and data analysis.

3.1 Design

This study employed the quasi-experimental method using a pretest-posttest design to gather data relating to the attitudes and performance of Grade 7 students in Algebraic expressions. Furthermore, this study aims to establish the cause-and-effect relationships among the variables (attitudes, mathematics performance) in the Heuristic method of teaching mathematics, particularly algebraic expressions. A quantitative quasi-experimental study determined whether implementing the Heuristic method resulted in a statistically significant difference in student scores for Grade 7 students.

3.2 Environment

The Province of Cebu is officially a Philippine province located in the Central Visayas (Region VII) region, with the main island and 167 surrounding islands and islets. Cebu City, known as "the Queen City of the South," is the country's capital and largest city. It is the Philippines' oldest city and first capital and is politically independent of the provincial government. This study was conducted at Pusok National High School, Lapu-Lapu City, Philippines. The school comprises two head teachers, eight master teachers from

different learning areas, and 57 teachers I-III. The school comprises junior and senior high school departments with a student population of 1,787. The Grade 7 level is composed of 343 students, wherein the sample population is derived from two sections.

3.3 Participants

The researchers chose the study samples in a classroom setting wherein the researchers were the mathematics teachers of the Grade 7 students. Forty-four Grade 7 students were selected by arranging their Final Grade in Grade 6 Mathematics in descending order. Then, the researchers renumbered the list based on their Final Grade in Grade 6 Mathematics. Then, they separated the list using even and odd numbers. The researchers then tossed a coin to identify which groups were assigned to the Control Group and Experimental Group. The Control Group received only the discussion of Algebraic Expressions, while the Experimental Group received the discussion of Algebraic Expressions using the Heuristic Method in teaching this group of subjects. These subjects were chosen based on their final grade in Grade 7 mathematics, and the two groups were checked to see if they were comparable based on their mean grade in Grade 6 mathematics.

3.4 Instrument

This study utilized two sets of questionnaires. The first set is a standardized Attitudes Towards Mathematics Inventory [ATMI] by Tapia and Marsh (2004). The second set is a standardized Algebra Test by Tobey and Slater (2009).

The first set of questionnaires has two parts: 1] profile of the research subject, and 2] students' attitudes toward mathematics. Part 1 of the questionnaire gathers the subjects' profiles, including age, gender, and final grade in Grade 6 mathematics. In this section, the students were advised to write their ages and genders in the space provided. For the final grade in Grade 6 mathematics, the researchers filled in the grades using the class records of teachers in the previous year. Part 2 gathers the subjects' attitudes toward mathematics, where the researchers utilized the standardized instrument, Attitudes Towards Mathematics Inventory [ATMI], by Tapia and Marsh (2004). The section consists of the 40-item attitudinal scale involving Self-confidence [13 items], Value [10 items], Enjoyment [9 items], and Motivation [8 items]. The respondents are advised to rate their attitudes toward mathematics using the 4-Likert scale: 4 points for Strongly Agree [Very Positive Attitude], 3 points for Agree [Positive Attitude], 2 points for Disagree [Negative Attitude], and 1 point for Strongly Disagree [Very Negative Attitude].

The second instrument is a 20-item standardized Algebra Performance Test by Tobey and Slater (2009), which will be used for the pretest and post-test administration to determine if the Heuristic Method affects the learning of the Grade 7 students in Algebra. In this instrument, the researchers advised the research subjects to write their answers in the space provided.

3.5 Data Analysis

The researchers used the following statistical tools to analyze and interpret the data being gathered. The data on the demographic profile of the research subjects were treated using frequency, simple percentage, mean, and standard deviation. The data about the students' attitudes toward mathematics in both groups were measured using weighted mean and standard deviation. The mean and standard deviation were used to compare the performance of both groups in the pretest and post-test. The Chi-square test of independence was used to examine the significant relationship between the subjects' profiles and their mathematics attitudes. T-test was used to determine whether there was a significant difference between the mean gain of both groups' pretest and post-test scores.

3.6 Credibility and Reliability

Formal consent was obtained from the school heads and the Grade 7 student subjects to ensure the confidentiality of collected data from the research subjects. The research subjects are guaranteed the confidentiality of the information gathered regarding the Grade 7 students' attitudes and performances in Algebraic Expressions. In this manner, the student's responses were used only for research purposes.

3.7 Ethical Considerations

The researchers ensured the students' confidentiality was respected and maintained during the study. The researchers advised the Grade 7 students to fill out the consent form before they began answering the attitudinal test and performance test in Algebraic Expressions. The consent form's concept is that the researchers provided the students with enough information regarding the study to inform them about their benefits when participating. Also, this assures the Grade 7 students that only authorized personnel have access to all the information acquired and retrieved from them. This research has ethical implications for addressing and promoting the search for knowledge and truth by preventing data fabrication or falsification. To avoid such hazards, the student subjects in this study are informed of everything they need to know about the study's purpose, duration, and process. It is entirely up to you whether or not you choose to participate in this study. They are not forced to participate in the study if they do not want to. If, for any reason, the students may withdraw from the investigation. There will be no pressure on the students to continue. There were no negative consequences if they declined or withdrew from the study. Throughout the gathering procedures, the

researchers complied with the ethical research considerations. The researchers kept all students' sensitive information and identities protected.

4. Results and Discussion

This section presents the data gathered regarding the effects of the Heuristic method on the academic performance of Grade 7 students in mathematics, particularly algebraic expressions, in a public junior high school.

4.1 Profile of the Participants

The students' profiles, which include their age, gender, and final grade in Grade 6, were essential sub-variables to consider in this study. Thus, it is treated to determine its influence on the students' mathematics performance and attitude toward using the Heuristic teaching model. Table 1 presents the demographic profile of the subjects. The profile of the students consists of the following sub-variables: age, gender, and final grade in Grade 6 Mathematics.

Table 1
Profile of the Participants

	Control Group (n = 22)		Experimental Group (n = 22)	
	f	**%**	**f**	**%**
A. Age [in years]				
12	17	77.27	15	68.18
13	3	13.64	6	27.27
14	1	4.55	1	4.55
15	1	4.55	0	0.00
Mean :	12.36		12.36	
StDev :	0.79		0.58	
B. Gender				
Female	9	40.91	8	36.36
Male	13	59.09	14	63.64
C. Final Grade in Grade 6 Mathematics				
90 - 100 [Outstanding]	0	0.00	1	4.55
85 - 89 [Very Satisfactory]	4	18.18	4	18.18
80 - 84 [Satisfactory]	15	68.18	15	68.18
75 - 79 [Fairly Satisfactory]	3	13.64	2	9.09
Mean :	82.59		82.96	
StDev :	2.82		3.08	

Age. The profile of the students in terms of age, gender, and final grades in previous years, which is in Grade 6, was shown in Table 1. The results revealed that in the Control Group, the most numbered students were from the age of 12, which has a total of 17 students and constitutes 77.27 in the total sample population. The second most age students were 13 years old, with a total of three students comprising 13.64 % of the students. At the same time, the least number of ages are 14 and 15 years old and above, with only one respondent (4.55%) in each level. Furthermore, the students of the Control Group have an average mean of 12.36 and a standard deviation of 0.79.

In the Experimental Group, the highest number of students was at the age of 12, comprising 15 students (68.78%). The second highest number is at the age of 13, consisting of six students (27.27%), and one student (4.55%) is at the age of 14. Furthermore, the students of the Experimental Group have an average mean of 12.36 and a standard deviation of 0.58.

Generally, Grade 7 students in many countries are around 12 years old. However, the specific age range can vary depending on the country and education system. For example, in some countries, Grade 7 students may be slightly older or younger, depending on the age at which students typically begin school and the structure of the education system. Remembering that age is just one factor that can affect a student's academic abilities and performance is crucial. Individual differences in prior knowledge, motivation, learning style, and socioeconomic background can also be essential in shaping a student's academic outcomes. The above-concurred ages of the students of both groups indicate that they came from the same age bracket. According to Balart and

Oosterveen (2019), male students frequently outperform female students on mathematics exams, but female students outperform male students in terms of sustained performance during test-taking.

Gender. The profile of the students found in Table 1 presents the different gender of the students in both groups. The Control Group comprises 13 males (59.09%) and nine females (40.91%), summed up into 22 high school students. In the experimental group, most students comprised 14 males (63.64%) and eight females (36.36%). The results revealed that both groups contained 22 students, with the majority being males rather than females.

According to Rossi et al. (2022), the student's gender and age can influence the student's level of understanding of mathematics lessons. Furthermore, Lundberg (2020) discovered that females had more sustained performance during exams due to non-cognitive skills. Non-cognitive skills are a broad category of metrics that include socioemotional ability, personality, motivations, and behavior, and they have recently gained prominence as essential aspects of human capital. Females have been found to have more self-discipline, fewer behavioral problems, less overconfidence, and more developed attitudes toward learning.

Final Grade in Grade 6 Mathematics. The respondent's final grades in Mathematics 6 in both groups are shown in Table 1. The table shows that in the Control Group, most of the students had satisfactory final grades in Mathematics 6, which comprises 15 students (68.18%) who got a range of grade of 80-84, four students (18.18%) acquired a grade of 85-89 which falls under "Very satisfactory," and three students (13.64%) got a grade of 75-79 range of grades which is under reasonably satisfactory level.

In the Experimental Group, most of the 15 students (68.18%) acquired a grade of 80-84, which means "Satisfactory" in nature. Some students achieved a "Very Satisfactory" level of performance in Mathematics 6, which comprises four students (18.18%), and one student (4.55%) attained a grade of 90-100, which is included in an "Outstanding" level of academic performance in Mathematics 6. What is considered "satisfactory" in terms of grades can also vary depending on the grading system and the expectations of the specific school or district.

In some scenarios, a passing grade may be considered satisfactory, while in others, a higher level of achievement may be expected. Additionally, it is essential to recognize that grades are just one way of measuring a student's learning and that other factors, such as problem-solving skills, critical thinking, and creativity, may also be important in evaluating mathematical proficiency. Based on the data presented, most students from both groups performed satisfactorily in Mathematics 6. This conforms to the study by Insorio and Olivarez (2021), which states that students struggle to learn mathematics lessons independently while implementing modular distance learning. In the Philippines, because of the pandemic, wherein students learn the classes through the help of self-learning modules, teachers implemented some interventions through the use of social media platforms preferred by most students to reach and help them continue to deliver essential and quality education (Pagaran et al., 2022).

4.2 Level of Mathematical Attitudes of the Participants

The results are the students' feedback on learning Mathematics 7. The mathematical attitude of the students was broken down into four areas: Self-confidence, Value, Enjoyment, and Motivation in learning Mathematics 7.

Self-Confidence. Table 2 shows the students' mathematical attitude regarding self-confidence in accomplishing tasks and making mathematics subjects engaging during classroom discussions.

Table 2
Responses on Self-Confidence

	Indicators	Control Group (n = 22)			Experimental Group (n = 22)		
		$\bar{x}$	σ	Int	$\bar{x}$	σ	Int
1.	Mathematics is one of my most dreaded subjects.	2.18	0.40	NA	2.09	0.68	NA
2.	My mind goes blank, and I need help to think clearly when working with mathematics.	2.59	1.01	PA	2.50	1.06	PA
3.	Studying mathematics makes me feel nervous.	2.32	0.72	NA	2.18	0.59	NA
4.	Mathematics makes me feel uncomfortable.	2.23	0.53	NA	1.96	0.79	NA
5.	When I hear the word mathematics, I have a feeling of dislike.	2.09	0.68	NA	1.91	0.53	NA
6.	Mathematics does not scare me at all.	2.86	0.77	PA	3.09	0.92	PA
7.	I have much self-confidence when it comes to mathematics.	2.82	0.91	PA	3.23	0.69	PA
8.	I can solve mathematics problems without too much difficulty.	2.55	0.67	PA	2.73	0.83	PA
9.	I expect to do well in any math class I take.	3.00	0.82	PA	3.09	0.97	PA
10.	I always need clarification in my mathematics class.	2.50	0.96	PA	2.23	0.69	NA
11.	I learn mathematics quickly.	2.68	0.57	PA	2.77	0.75	PA
12.	I am good at solving math problems.	2.73	0.83	PA	2.77	1.07	PA
13.	A strong math background could help me in my professional life.	3.05	0.90	PA	3.27	0.94	VPA
	Aggregate Mean :	**2.58**	**0.75**	**PA**	**2.60**	**0.81**	**PA**

Legend:
1.00-1.74 Very Negative Attitude [VNA]; 1.75-2.49 Negative Attitude [NA];
2.50-3.24 Positive Attitude [PA]; 3.25-4.00 Very Positive Attitude [VPA]

The data presented in Table 2 reveal that the respondent's mathematical attitude towards learning mathematics in terms of self-confidence affects the student's academic performance during class discussions. The data shown under the Control Group are based on the respondents' self-confidence scores in Mathematics 7. This points out that the highest mean score of 3.05 (Positive), which was under the indicator, A strong math background could help me in my Professional life, which implies that students had a strong belief and attitude that learning mathematics subjects can help students to achieve their desired professional life. The second highest mean score is the indicator, which got a mean score of 3.00 (Positive). In addition, based on the results, most Control Group students have a negative attitude toward learning mathematics. Thus, the minor indicators that were statistically low in mean scores, interpreted as negative indicators, were the indicators. When I hear the word mathematics, I feel dislike, with a mean score of 2.09 (Negative)**.** Mathematics is one of my most dreaded subjects, with a mean of 2.18 (Negative). Studying mathematics makes me feel nervous**,** with a mean score of 2.32 (Negative). Mathematics makes me uncomfortable, with a mean score of 2.23 (Negative).

Based on the data gathered, the average mean of the Control Group in students' self-confidence in learning Mathematics 7 is *2.58*, meaning a positive attitude. While in the Experimental Group, the results show that the respondent's self-confidence in learning Mathematics 7 was very optimistic based on the computed mean score of *3.27,* specifically in the indicator, A strong math background could help me in my Professional life. In addition, I have much self-confidence in mathematics (M=3.23), which is positive; I expect to do pretty well in any math class I take (M=3.09). Mathematics was statistically positive and did not scare me (M= 3.09). When I hear the word mathematics (M=1.91), the indicator gets the lowest mean score, and Mathematics makes me feel uncomfortable, which has a mean of 1.96, which also reveals it as negatively interpreted in learning mathematics. Thus, teachers should possess an image in which students feel at ease while knowing the subject and accommodate students' queries and doubts. Based on the results of the gathered data, the students in the Experimental Group acquired an average mean of 2.60 (Positive).

Self-confidence in mathematics can vary widely among Grade 7 students, as several factors influence it, including prior experiences with math, individual learning styles, and teaching approaches. Some students may feel confident in their mathematical abilities if they have had positive experiences in math class, received praise and encouragement from their teachers or parents, or have a natural inclination towards mathematical thinking. On the other hand, students who have struggled with math in the past, have received negative feedback or criticism, or have not had access to effective teaching and support may have lower self-confidence in their math abilities. Self-confidence in learning mathematics concepts is an essential determinant of an individual's feelings, thoughts, behaviors, and motivation for a task. Research (Capuno et al., 2019; Peteros et al., 2019; Arcallana et al., 2018) shows that individuals with low self-confidence may avoid complex tasks, perceiving them as threats and giving up quickly when encountering

difficulties. In contrast, highly self-confident individuals typically make greater efforts to complete a task and are more persistent in facing challenges.

Value. Table 3 shows the results of the students' mathematical attitude regarding the value of Mathematics subject, specifically in the content of Algebra during the 2nd quarter.

Table 3
Responses on Value

	Indicators	Control Group (n = 22)			Experimental Group (n = 22)		
		$\bar{x}$	σ	Int	$\bar{x}$	σ	Int
1.	Mathematics is a very worthwhile and necessary subject.	3.32	0.65	VPA	3.41	0.91	VPA
2.	I want to develop my mathematical skills.	3.46	0.60	VPA	3.64	0.58	VPA
3.	Mathematics helps develop the mind and teaches a person to think.	3.05	0.84	PA	3.36	0.85	VPA
4.	Mathematics is essential in everyday life.	3.32	0.57	VPA	3.32	0.78	VPA
5.	Mathematics is one of the most important subjects for people to study.	3.14	0.77	PA	3.32	0.78	VPA
6.	High school math courses would be beneficial no matter what I decide to study.	3.27	0.55	VPA	3.36	0.79	VPA
7.	I can think of many ways that I use math outside of school.	2.73	0.94	PA	3.05	0.58	PA
8.	Studying advanced mathematics is helpful.	2.36	0.58	NA	2.36	0.85	NA
9.	Studying math helps me with problem-solving in other areas.	3.32	0.65	VPA	3.27	0.63	VPA
10.	Mathematics helps me a lot in my day-to-day living	3.05	0.65	PA	3.18	0.66	PA
	Aggregate Mean :	**3.10**	**0.68**	**PA**	**3.23**	**0.74**	**PA**

Legend:
1.00-1.74 Very Negative Attitude [VNA]; 1.75-2.49 Negative Attitude [NA];
2.50-3.24 Positive Attitude [PA]; 3.25-4.00 Very Positive Attitude [VPA]

The results in Table 3 reveal that the students' mathematical attitude in the Control Group, precisely the value of learning mathematics, is very positive. Based on the table of results shows that the indicator, I want to develop my mathematical skills (M= 3.46) has the highest mean score, which manifests a very positive response from the students who wanted to learn more and develop some mathematical skills. Furthermore, the indicators, Mathematics is essential in everyday life (M=3.32), I believe studying math helps me with problem-solving in other areas, and Mathematics is a very worthwhile and necessary subject got a mean score of *3.32*, which was also interpreted as very positive in terms of the student's responses in giving value to learning mathematics as a subject. Then, indicators like studying advanced mathematics is useful got the lowest mean score of 2.36. In addition, based on students' responses, indicators, as I can think of many ways that I use math outside of school, got a mean score of 2.73, interpreted as a negative response from the students. Thus, students view mathematics as an essential and valuable subject, but they believe that in a real-life situation, mathematics skills and knowledge might not be as crucial as they are based on the responses tabulated above.

The responses of the students that belonged to the Experimental Group were very positive since the students' mathematical attitude in terms of value revealed that the indicator, I want to develop my mathematical skills, got the highest mean score of 3.64, which is a very positive response from the students as interpreted. The indicators like Mathematics is a very worthwhile and necessary subject (M=3.41*)* were interpreted as a very positive response in terms of mathematics' value in students' lives, and Mathematics helps develop the mind and teaches a person to think. High school math courses would be beneficial no matter what I decide to study**.** I got a mean score of 3.36 (Positive), which was the third to the highest indicator in terms of mean scores. The lowest mean score revealed in the results is a mean score of 2.36 (Negative), shown in the indicator that studying advanced mathematics is helpful. Overall, the Experimental Group got an average mean of 3.23 (Positive).

Thus, the results found in Table 3 revealed that though students believed that mathematics is an important subject, students were not ready yet to study and learn advanced mathematical concepts based on the results indicated. The results imply that the student's learning and performance in Mathematics are affected by their attitude and perception of the subject's importance. The importance of mathematics to Grade 7 students varies depending on various factors, including prior experiences with the subject, individual interests and learning styles, and classroom teaching approaches. Some students may consider mathematics a valuable

subject because they enjoy solving problems, find it interesting, or see it as a pathway to future academic or career opportunities. Others may find math challenging or uninteresting and need to consider it more valuable.

According to Mazana et al. (2019), the mathematical attitude and value of learning mathematics significantly predicted students' performance. Thus, factors influencing the students' liking or disliking of mathematics constituted students' aptitude attributes and instructional, social, psychological, and environmental factors. Furthermore, the results show that teachers should provide insights and changes in teaching-learning practices and strategies that would promote the value of mathematics and, subsequently, better performance in the subject.

Enjoyment. Table 4 presents the results of the student's mathematical attitude in terms of enjoyment while learning Algebra concepts in Mathematics 7.

Table 4
Responses on Enjoyment

	Indicators	Control Group (n = 22)			Experimental Group (n = 22)		
		$\bar{x}$	σ	Int	$\bar{x}$	σ	Int
1.	I usually enjoy studying mathematics in school.	3.09	0.81	PA	3.18	0.73	PA
2.	Mathematics is dull.	1.68	0.65	VNA	1.64	0.66	VNA
3.	I like to solve new problems in mathematics.	3.09	0.75	PA	3.09	0.75	PA
4.	I prefer to do an assignment in math than to write an essay.	2.96	0.79	PA	2.96	0.72	PA
5.	I like mathematics.	3.36	0.79	VPA	3.09	0.87	PA
6.	I am happier in a math class than in any other class.	2.82	0.85	PA	3.00	0.82	PA
7.	Mathematics is a fascinating subject.	3.00	0.69	PA	3.05	0.84	PA
8.	I am comfortable expressing my ideas on how to look for solutions to a complex problem in math.	2.77	0.61	PA	2.86	0.77	PA
9.	I am comfortable answering questions in math class	2.59	0.59	PA	2.77	0.75	PA
	Aggregate Mean :	**2.82**	**0.73**	**PA**	**2.85**	**0.77**	**PA**

Legend:
1.00-1.74 Very Negative Attitude [VNA]; 1.75-2.49 Negative Attitude [NA];
2.50-3.24 Positive Attitude [PA]; 3.25-4.00 Very Positive Attitude [VPA]

The results shown in Table 4 pointed out the students' mathematical attitude in terms of enjoyment in engaging in various activities to be accomplished during class discussion. The results revealed that there were indicators that the students in the Control Group responded positively to multiple statements, but some had a negative response. The indicator that has a very positive response from the students and has also concurred with the highest mean score of 3.36 *(*Very positive) is the indicator, I like mathematics, then followed by the indicator**,** I like to solve new problems in mathematics, and I have usually enjoyed studying mathematics in school which has a mean score of 3.09 (Positive). Then, the indicator that got the third highest mean score was the indicator**.** Mathematics is a fascinating subject, with a mean score of 3.00 (Positive). This manifests that students enjoyed the subject, which entails a lot of analysis and logic when solving mathematical problems. The indicator with the lowest mean score and a very negative interpretation based on students' responses was that Mathematics is dull, with a mean of 1.68 (Very negative) student reactions.

Furthermore, based on the results revealed in the responses of the students in the Control Group, the students enjoyed and liked mathematics but found it dull and boring when more time was spent on numbers. Thus, the average mean score of the Control Group based on the student's mathematical attitude regarding how they enjoyed the mathematics class is 2.82 (Positive).

On the other hand, the responses of the students in the Experimental Group imply that students are enjoying the different activities in mathematics, wherein the indicator that possesses the highest mean score was the indicator, I have usually enjoyed studying mathematics in school, which got a mean score of 3.18 (Positive) and followed by the indicator with a mean score of 3.09 (Positive) were the indicators**,** I like to solve new problems in mathematics, and I like mathematics.

Another indicator that has a positive impact on students in terms of enjoyment in learning mathematics were the indicators**:** Mathematics is a fascinating subject (M=3.05), I am happier in a math class than in any other class (M=3.00*)*, I would prefer to do an assignment in math than to write an essay (M=2.96*)***,** I am comfortable expressing my ideas on how to look for solutions to a complex problem in Math (M=2.86), and I am comfortable answering questions in math class (M=2.77). The indicator with the lowest mean score of 1.64 was the indicator, Mathematics is dull, which implies that mathematics teachers should choose activities

that enhance students' critical thinking as well as boost students' interest in learning mathematics concepts. Thus, the Experimental Group has an average mean of 2.85 (Positive), which denotes a positive mathematical attitude of students towards enjoyment in learning mathematics. The data imply that some Grade 7 students may enjoy mathematics while others may find it challenging or uninteresting. The enjoyment of mathematics can depend on various factors, such as prior experiences with the subject, individual interests and learning styles, and the teaching approaches used in the classroom.

Students who enjoy mathematics may find it interesting, engaging, and challenging and may enjoy solving problems, discovering patterns and relationships, and using math to understand the world around them. They may also be motivated by the sense of achievement from mastering complex concepts and skills. According to Putwain et al. (2018), higher enjoyment of the students while learning was predicted to lead to more extraordinary subsequent achievement and, in turn, more fantastic academic achievement, predicted subsequent greater pleasure and lowered boredom during the teaching and learning process. Furthermore, the relations between emotions over time were mediated by achievement. Thus, the study was built on the evidence base for understanding the relations between students' achievements, emotions, and academic achievement among learners.

Motivation. Table 5 presents the results of the student's mathematical attitude in terms of their motivation to learn the concepts of algebra in mathematics in Grade 7 students.

Table 5
Responses on Motivation

	Indicators	Control Group (n = 22)			Experimental Group (n = 22)		
		$\bar{x}$	σ	Int	$\bar{x}$	σ	Int
1.	I am confident that I could learn advanced mathematics.	2.23	0.61	NA	2.00	0.93	NA
2.	I want to avoid using mathematics in college.	2.18	0.59	NA	2.36	0.73	NA
3.	I am willing to take more than the required amount of mathematics.	2.32	0.78	NA	2.46	0.67	NA
4.	I plan to take as much mathematics as possible during my education.	2.77	0.75	PA	3.09	0.68	PA
5.	I get a great deal of satisfaction out of solving a mathematics problem.	3.14	0.71	PA	3.50	0.60	VPA
6.	It makes me nervous to even think about having to do a mathematics problem.	2.55	0.60	PA	2.46	0.60	NA
7.	I am always under a terrible strain in math class.	2.27	0.63	NA	2.36	0.73	NA
8.	The challenge of math appeals to me.	3.00	0.76	PA	2.96	0.84	PA
	Aggregate Mean :	**2.56**	**0.68**	**PA**	**2.65**	**0.72**	**PA**

Legend:
1.00-1.74 Very Negative Attitude [VNA]; 1.75-2.49 Negative Attitude [NA];
2.50-3.24 Positive Attitude [PA]; 3.25-4.00 Very Positive Attitude [VPA]

The highest mean score of 3.14 (Positive) found in Table 5 was the indicator, I get a great deal of satisfaction out of solving a mathematics problem, then followed by the indicator, The challenge of math appeals to me (M=3.00)**;** I plan to take as much mathematics as I can during my education (M=2.77)*;* and It makes me nervous to even think about having to do a mathematics problem (M=2.55). While the indicators with negative responses from the students indicated that I am willing to take more than the required amount of mathematics (M=2.32)**,** I am always under terrible strain in a math class (M=2.27). I am confident that I could learn advanced mathematics (M=2.23).

Based on the results, the indicator with the lowest mean score was that I would like to avoid using mathematics in college, which got a mean score of 2.18 (Negative). From the results found in Table 5, the average mean score of the Control Group was 2.56 (Positive). Thus, results revealed that even though the students felt nervous when thinking of Mathematics concepts, they were challenged to take subjects related to mathematics, avoided mathematics subjects in college, and felt terrible talking about concepts in mathematics. The students still attained satisfaction when they got correct answers in various mathematics activities, which increased their enjoyment while learning mathematics lessons in Grade 7.

The responses of the Grade 7 students in the Experimental Group revealed a very positive response. These indicators were as follows: I get great satisfaction from solving mathematics problems, with a very high mean score of 3.50 (Very positive). I plan to take as much mathematics as I can during my education, with a mean score of 3.09 (Positive). The indicator, The challenge of math appeals to me**,** has a mean score of 2.96 (Positive). The results revealed that students opted to challenge themselves by taking

many mathematics subjects to facilitate better learning in mathematics problems. There were also indicators wherein students responded negatively, such as the indicators**.** It makes me nervous to even think about having to do a mathematics problem, and I am willing to take more than the required amount of mathematics, which both indicators got a mean score of 2.46 (Negative).

In contrast, the indicator with the lowest mean score of 2.36 (Negative) was the indicator that I would like to avoid using mathematics in college, and I am always under a terrible strain in math class, which was interpreted as unfavorable. The average mean score of the Experimental Group was 2.65 (Positive). The results imply that teachers should promote the development of intrinsic motivation and enjoyment by encouraging students' autonomy, providing feedback and optimal challenges, and adopting a caring attitude toward students. If teachers in the classrooms have a strong average effect on students' motivation in Mathematics, one should expect twins in different classes to be less similar in their enjoyment of the subject than those in the same classes.

The study conducted by Khalaf and Mohammed Zin (2018) revealed that the principal element of a successful learning process is the student's motivation to learn concepts in mathematics and other subject areas. More motivation was required in the learning process than in any other activities. Students' motivation is needed to facilitate the process of increasing their interest in educational activities. In addition, according to Ainley and Hidi (2014), interest and motivation are among the most significant predictors of mathematical achievement and persistence. Like most motivation factors, interest has short-term and long-term manifestations (Poliquit et al., 2018).

Summary of the Level of Mathematical Attitudes. Table 6 presents the summary table on the level of mathematical attitudes of both groups.

Table 6
Summary Table on Level of Mathematical Attitudes of the Participants

Indicators	Control Group (n = 22)			Experimental Group (n = 22)		
	$\bar{x}$	σ	Int	$\bar{x}$	σ	Int
A. Self-Confidence	2.58	0.75	PA	2.60	0.81	PA
B. Value	3.10	0.68	PA	3.23	0.74	PA
C. Enjoyment	2.82	0.73	PA	2.85	0.77	PA
D. Motivation	2.56	0.68	PA	2.65	0.72	PA
Aggregate Mean :	**2.77**	**0.71**	**PA**	**2.83**	**0.76**	**PA**

Legend:
1.00-1.74 Very Negative Attitude [VNA]; 1.75-2.49 Negative Attitude [NA];
2.50-3.24 Positive Attitude [PA]; 3.25-4.00 Very Positive Attitude [VPA]

The table shows that the indicator Value got both groups' highest mean (3.26 and 3.24), respectively. At the same time, the indicators of Motivation and Self-Confidence got the lowest mean of 2.56 and 2.60 for both groups, respectively.

4.3 Performance of Both Groups in Algebra During the Pretest and Post-test

The data in Table 7 presents the difference between the pretest and post-test results of both groups using the traditional teaching method and the experimental group utilizing the Heuristic teaching model in teaching Mathematics in Grade 7.

Table 7
Pretest Performance of Both Groups in Algebra

Raw Scores	Verbal Description	Control Group (n = 22)		Experimental Group (n = 22)	
		f	%	f	%
16 - 17	Excellent	0	0.00	0	0.00
12 - 15	Very Good	0	0.00	0	0.00
8 - 11	Good	0	0.00	0	0.00
4 - 7	Fair	11	50.00	6	27.27
0 - 3	Poor	11	50.00	16	72.73
	Mean :	**3.55**		**2.50**	
	StDev :	**1.06**		**1.71**	

Pretest Performance of the Participants. The results show the student's academic performance level in both groups while administering the pretest among Grade 7 students. Results revealed that in the Control Group, students with poor performance comprised 11, constituting 50%, and can be interpreted as low academic performance. Furthermore, the results revealed that the 11 students got a percentage of scores from 0% to 15% during the conducted pretest. Eleven students got a correct answer of 20% to 35%, which got a "Fair" level of academic performance. In addition, the students in the Control Group got an average mean score of 3.55 and a standard deviation of 1.06. Furthermore, in administering the pretest in the experimental group, most students had a poor academic performance level of 72.73%, comprised of 16 students. At the same time, the six students (27.27%) garnered a "Fair" level of academic performance. In this light, the Experimental Group gained an average mean score of 2.50 and a standard deviation of 1.71.

Based on the results, it pointed out that the average mean score of the student's academic performance in the Control Group during the conduct of the pretest was *3.55* and a standard deviation of *1.06,* while the Experimental Group got an average mean score of 2.50 and a standard deviation of 1.71. Thus, the pretest results in both groups revealed that the control group had a higher academic performance during the pretest than the experimental group, which manifested that the students in the control group had a much higher knowledge of algebra than the experimental group. The results imply that teachers should use different pedagogical approaches in teaching mathematics to improve students' learning. Furthermore, it is essential because it gives teachers an insight into the best practices for a classroom setting and allows teachers to apply and understand how different students learn so they can tailor their lessons to suit these needs. As a result, this will improve the quality of their teaching as students will receive it well. There could be various reasons for Grade 7 students' poor performance in algebra. Factors contributing to this may include a weak foundation, lack of practice, poor understanding of concepts, limited resources, and ineffective teaching methods.

To address these issues, teachers can use various teaching methods to help students understand algebraic concepts. For example, they can use real-world applications of algebra to make it more exciting and relevant to students. Teachers can also provide additional resources such as online tutorials, practice exercises, and other support outside of class time to help students gain mastery over the subject. Overall, providing a supportive learning environment that caters to the different learning styles of students can be an effective way to help improve Grade 7 students' performance in algebra.

Table 7
Post-test Performance of Both Groups in Algebra

Raw Scores	Verbal Description	Control Group (n = 22)		Experimental Group (n = 22)	
		f	%	f	%
16 - 17	Excellent	0	0.00	0	0.00
12 - 15	Very Good	1	4.55	3	13.64
8 - 11	Good	16	72.73	11	50.00
4 - 7	Fair	5	22.73	6	27.27
0 - 3	Poor	0	0.00	2	9.09
	Mean :	**8.86**		**8.55**	
	StDev :	**2.10**		**3.07**	

Post-test Performance of the Participants. The results revealed that in the Control Group, one student (4.55%) got a "Very Good" level of performance, and 16 students (72.73%), which is the highest number of students who were categorized as "Good" in terms of academic performance. In addition, five students (22.73%) gained a "Fair" knowledge of Algebra.

In the Experimental Group, only three students (13.64%) who gained were labeled as "Very Good" in terms of their knowledge of Algebra, 11 students (50%) who had a "Good" post-test result, six students (27.27%) who gained a "Fair" level of academic performance, and unfortunately, there were two students (9.09%) who had a "Poor" level of academic performance during the post-test. The post-test results generally revealed that both Groups manifested a high average mean score. The Control Group got an average mean score of 8.86 and a standard deviation of 2.10, while the Experimental Group got an average mean score of 8.55 and 3.07. The results stressed that the traditional teaching method could significantly affect students' academic performance. In addition, using the Heuristic teaching model significantly affected students' learning but did not show a higher mean score than the traditional teaching method.

The data imply that when Grade 7 students perform well in algebra, it could be due to several factors. Good performance in algebra can be a reflection of a strong foundation in basic math concepts. Students who grasp fundamental math concepts well are better equipped to understand and apply algebraic concepts. Also, the use of the traditional method could be justified by the fact that students were accustomed to the traditional way of teaching, and initiating new teaching approaches that would not necessarily be more effective creates difficulty for both teachers and students.

4.4 Test of Significance of the Relationship

The study hypothesized that the respondent's profile could significantly relate to the level of mathematical attitude toward learning about the concepts in Algebra. Table 9 presents the results.

Table 9
Relationship Between the Participants' Profile and the Level of Mathematics Attitudes of Both Groups (alpha = 0.05)

Variables	Chi-Square	df	Critical Value	Significance	Result
Level of Mathematics Attitudes of the Control Group and					
Age	0.647	3	7.815	Not Significant	Ho Accepted
Gender	0.075	1	3.841	Not Significant	Ho Accepted
Final Grade in Grade 6 Math	2.640	2	5.991	Not Significant	Ho Accepted
Level of Mathematics Attitudes of the Experimental Group and					
Age	1.027	4	9.488	Not Significant	Ho Accepted
Gender	2.338	2	5.991	Not Significant	Ho Accepted
Final Grade in Grade 6 Math	15.125	2	5.991	Significant	Ho Rejected

Table 9 revealed that the respondents' profiles, based explicitly on the students' age, have no significant correlation with mathematical attitude since the computed Chi-square value of 0.647 is lower than the critical value of 7.815. The respondent's gender has no significant relationship with the students' mathematical aptitude since the computed Chi-square value of .075 is lower than the 3.841 critical value. Furthermore, the respondent's final grade in Grade 6 revealed no significant correlation to the respondent's mathematical attitude since the computed critical value of 2.640 is lower than the computed Chi-square value of 5.991. Thus, the results revealed that the student's age, gender, and the final grades the students acquired in Grade 6 had no significant relationship on students' self-confidence, value, enjoyment, and motivation in learning the concepts in Mathematics 7. The research study conducted by Else-Quest et al. (2010) revealed that based on the study's findings in mathematics, female students had an average lower self-efficacy in mathematics than male students. Similar gender differences also tend to be found in other affective variables. Thus, the results pointed out that in some other way, age and gender affect the students' mathematics performance.

Table 9 shows the significant relationship between the student's profile, which includes the age, gender, and the student's final grades at the Grade 6 level and the mathematical attitude of Grade 7 in the Experimental Group. Research has shown a positive correlation between the level of mathematics attitudes of Grade 7 students and their final grades in math. Students with positive

attitudes toward mathematics tend to perform better than those with negative attitudes. The data imply that positive attitudes towards mathematics can include a sense of enjoyment, interest, confidence, and motivation in the subject. These attitudes can contribute to students' engagement and persistence in mathematics, ultimately leading to better performance. Overall, there is a strong relationship between the level of mathematics attitudes of Grade 7 students and their final grade in math, highlighting the importance of promoting positive attitudes towards mathematics to support student success.

Table 10 presents the relationship between the profile of the subjects and their attitudes toward algebra.

Table 10
Relationship between the Participants' Profile and the Level of Mathematics Attitudes of Both Groups (alpha = 0.05)

Variables	Chi-Square	df	Critical Value	Significance	Result
Mathematics Performance in Algebraic Expressions of the Control Group and					
Age	4.982	6	12.592	Not Significant	Ho Accepted
Gender	1.523	2	5.991	Not Significant	Ho Accepted
Final Grade in Grade 6 Math	3.850	4	9.488	Not Significant	Ho Accepted
Mathematics Performance in Algebraic Expressions of the Experimental Group and					
Age	5.022	6	12.592	Not Significant	Ho Accepted
Gender	1.768	3	7.815	Not Significant	Ho Accepted
Final Grade in Grade 6 Math	7.806	9	16.919	Not Significant	Ho Accepted

Table 10 presents the results of the data gathered, which shows a significant relationship between the student's profile and the mathematics performance of the Control Group. The results show that the respondents' profiles are based explicitly on the students' age, which has no significant correlation with mathematics performance in algebraic expressions since the computed Chi-square value of 4.982 is lower than the critical value of 12.592. In addition, the respondents' gender profiles have no significant relationship with the students' mathematics performance since the computed Chi-square value of 1.523 is lower than the critical value of 5.991. Furthermore, the student's final grade in Grade 6 has no significant correlation to the respondent's mathematics performance based on the computed Chi-square value of 3.850, which is lower than the critical value of 9.488.

The results presented in Table 10 show the significant relationship between the student's profile and the mathematics performance of the Experimental Group. The results show that the respondent's profile is based explicitly on the students' age, which has no significant correlation with the mathematics performance in Algebraic expressions since the computed Chi-square value of 5.022 is lower than the critical value of 12.592. In addition, the respondent's gender profile has no significant relationship with the students' mathematics performance since the computed Chi-square value of 1.768 is lower than *the* critical value of 7.815. Furthermore, the student's final grade in Grade 6 has no significant correlation to the respondent's mathematics performance based on the computed Chi-square value of 7.806, which is lower than the critical value of 16.919.

4.5 Test of Significance of the Difference

The study hypothesized that when the students were grouped by their profiles, there was a significant difference in attitude towards mathematics. Table 11 presents the significance of the difference between both groups' pretest and post-test results.

Table 11
Difference Between the Mean Gained of Both Groups' Pretest and Posttest Scores (alpha = 0.05)

Variables	t-value	p-value	Significance	Result
Pretest and Posttest Scores of the Control Group	-11.74	0.000	Significant	Ho Rejected
Pretest and Posttest Scores of the Experimental Group	-8.41	0.000	Significant	Ho Rejected

Table 11 illustrates the students' results in the pretest and post-test in Algebraic expression lessons in Mathematics before and after exposure to the Heuristic learning model in the Experimental Group and traditional method in teaching Grade 7 students. The pretest and post-test results in Table 11 show the student's results in the Control Group, which has a t-value of 11.74. The results revealed that the students in the Control Group who were taught using the traditional method of teaching Mathematics 7 significantly learned during the allocated time. Thus, the results revealed a significant difference between the pretest and post-test scores of the students in the Control Group. Furthermore, the results showed that the use of traditional teaching in mathematics could enhance students' learning.

In the Experimental Group, students had a t-value of -8.41 during the pretest and post-test. Thus, the results revealed a significant difference between the pretest and post-test scores of the students in the Experimental Group. Furthermore, the results showed that using the Heuristic learning model in teaching mathematics can enhance students' learning, specifically in the lesson about Algebraic expressions. The results show that the students in both groups significantly increased their scores from the pretest to the post-test. There is a significant difference between the average mean scores of the students in both groups, which implies that the use of the traditional teaching method and the Heuristic learning model can enhance students' learning in Mathematics 7. According to Tularam (2018), traditional teaching is generally teacher-directed and where students are taught in a manner conducive to sitting and listening. Indeed, traditional expectations can often allow us to continue with the lecture-based model with some valuable results, as evidenced by the past accomplishments of research being conducted, and this cannot be disputed as much.

5. Conclusion

The study concluded that applying the Heuristic teaching model enhanced students' academic performance, which was crucial in improving students' active engagement in learning mathematics, specifically in Algebra. Still, the results also revealed that the traditional teaching method helps the students gain more knowledge in the subject. Thus, the results justify the claim that the Heuristic teaching model and the conventional way of teaching mathematics can help boost a meaningful teaching and learning process. Also, it is concluded that students who were taught in the Heuristic teaching model had a significant effect on their mathematics performance and had a comparable impact in terms of performance with the students trained in the traditional teaching method. The researchers recommend that future research explore alternative designs to raise students' mathematics performance. The explosion of the Heuristic teaching model in supporting learning has made it highly significant to investigate the crucial determinants enabling students to enhance their performances.

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