Correlational Analysis on Mathematical Disposition and Mathematical Achievement Among Selected Senior High School Students at San Jose City National High School

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This study explored the relationship between mathematical disposition and achievement among senior high school students. It examined the influence of socio-demographic factors and students' perceived mathematical disposition, including self-efficacy, perseverance, and the perception of math as sensible, on their mathematical performance. Guided by Mikaguchi's Theory of Value, Disposition, and Identity, and the National Council of Teachers of Mathematics Evaluation Standard and Identity, the study utilized a descriptive-correlational research approach with a stratified random sample of 306 students from San Jose City High School. Data were collected through an online survey and analyzed using JAMOVI. The findings revealed a significant positive correlation between mathematical disposition and achievement. Furthermore, mother's educational attainment, occupation, and monthly income exhibited negative but significant relationships with mathematics achievement. The study emphasizes the importance of students' beliefs in their mathematical abilities and the influence of socio-economic factors on their performance. Recommendations are provided to further strengthen the understanding of these relationships and inform educational practices.

Keywords: mathematical disposition, self-efficacy, math as sensible component, mathematical perseverance, mathematical achievement

INTRODUCTION

In the constantly increasing body of knowledge on correlations of mathematical disposition and learners' achievement, mathematical creative thinking skill is believed to becoming the most significant orientation of mathematical disposition among learners which aims to enhance student attitude towards learning mathematics. Recognizing that creative mathematical disposition encompasses the capability for creative thinking and positive disposition is very much essential. Mathematical disposition viewed as creative skill in solving mathematical problems plays pivotal role in determining the problem's central idea, linking its essential elements, and enabling the exploration of different solutions for problem-solving (de Vink et al., 2022; Schindler & Lilienthal, 2022; Utemov et al., 2020). This study's results convey that mathematical disposition may assist individuals to creating a space to analyze mathematical problems and be able to capacitate one's skills in reaching a higher level of mathematical problem-solving ability (Sinniah et al., 2022). In the context of mathematical disposition, students' involvement in solving numerical problems characterized by various solutions contributes substantively to nurturing and refining their creativity (Ibrahim & Widodo, 2020; Shaw et al., 2022), for instance, students' flexibility powered by positive mathematical disposition (Bevan & Capraro, 2021). One element of the pedagogical approach to mathematics education instruction is the necessity of considering traditional classroom practices involving repetitive restatements, formulaic usage, and practical adherence. These habits' limitations become dominant for uplifting students' creative and positive disposition (Andrade et al., 2020). Entrenching students in mathematical learning experiences that cultivate creative thinking augments their positive disposition and capacity that would help improve their overall academic achievement in general, and mathematical performance in particular (Jonsson et al., 2022; Niu et al., 2022).

In the perspective of updating knowledge generation regarding mathematics disposition, it would be imperative to prompt learners to keep learning even after completing school to be steadfast to face the problems and challenges of advanced education. In this regard, mathematics would play the most pivotal role, emphasizing logical thinking and problem-solving skills. Mathematics is believed to be the foundation of science, technology, and engineering courses. Thus, this study focuses on exploring the positive mathematical disposition and how this practice guides learners with their mathematics achievement. Ozkal (2019) emphasized that mathematics has always been valued in the general mandatory system of education. By increasing one's disposition to learning numeracy, mathematics education would assist individuals to focusing on learning cognitive mathematics knowledge and skills. As such, this is gradually realized the essence of mathematics disposition, like that of perception, attitudes, emotions, motivations, goal orientation of mathematics learning that would positively or negatively impact students' performance in mathematics (de Vink et. Al, 2022; Schindler & Lilienthal, 2022; Johnsson et. Al, 2022).

This research in essential to understanding the significant correlation between mathematical positive disposition and mathematical achievement within relations and functions. Mikaguchi's Theory of Value, Disposition, and Identity (Mikaguchi, 1930; Bethel, 1989) and along with the Mathematical Dispositions outlined by the National Council of Teachers of Mathematics (1989) Evaluation Standard, and Identity, can provide a detailed and comprehensive insight into the structure of this relational model. This theoretical frame identified the elements of value with the observable evidences of mathematical disposition and identity. It attempts to fill in the gaps in empirical data regarding the relationship between mathematical disposition and mathematical achievement as regards to its impact on mathematic performance, as well as the initial stride in enhancing learners' mathematical capability thru creative disposition. Thus, potential recommendation can be proposed by implementing a specific approach to classroom instruction based on the insights from the study.

The general objective of this article is to examine the perceived mathematical disposition among teacher-education students of the College of Education, Central Luzon State University in the context of self-efficacy, perseverance, and math as sensible components to mathematical achievements. Specifically, it sought to: 1) describe the socio-demographic profile of the respondents in terms of age, sex, strands, educational attainment of parents, occupation of parents, and monthly gross family income; 2) determine the mathematical dispositions of the respondents in terms of three components: self-efficacy, perseverance, and math as sensible; 3) determine the mathematics achievement of the respondents; 4) find out the relationship between the respondents' socio-demographic profile and mathematics achievement; and, 5) find out the relationship between the respondents' mathematical disposition and mathematics achievement. The study likewise hypothesized that there are no significant correlations between sociodemographic characteristics and mathematical disposition to mathematical achievements among senior high school respondents.

Furthermore, the results of this study the potential to refine mathematics education regarding the mathematical disposition and achievement of learners, fostering the growth of students' numerical creativity. This enhancement is envisioned through articulating mathematics instructional approaches, which is informed by the established correlation model format that represents the relationship between learners' mathematical creative thinking and disposition with their creative outlook at mathematics in general, thereby optimizing the meaningful learning experience.

THEORETICAL AND CONCEPTUAL FRAMEWORK

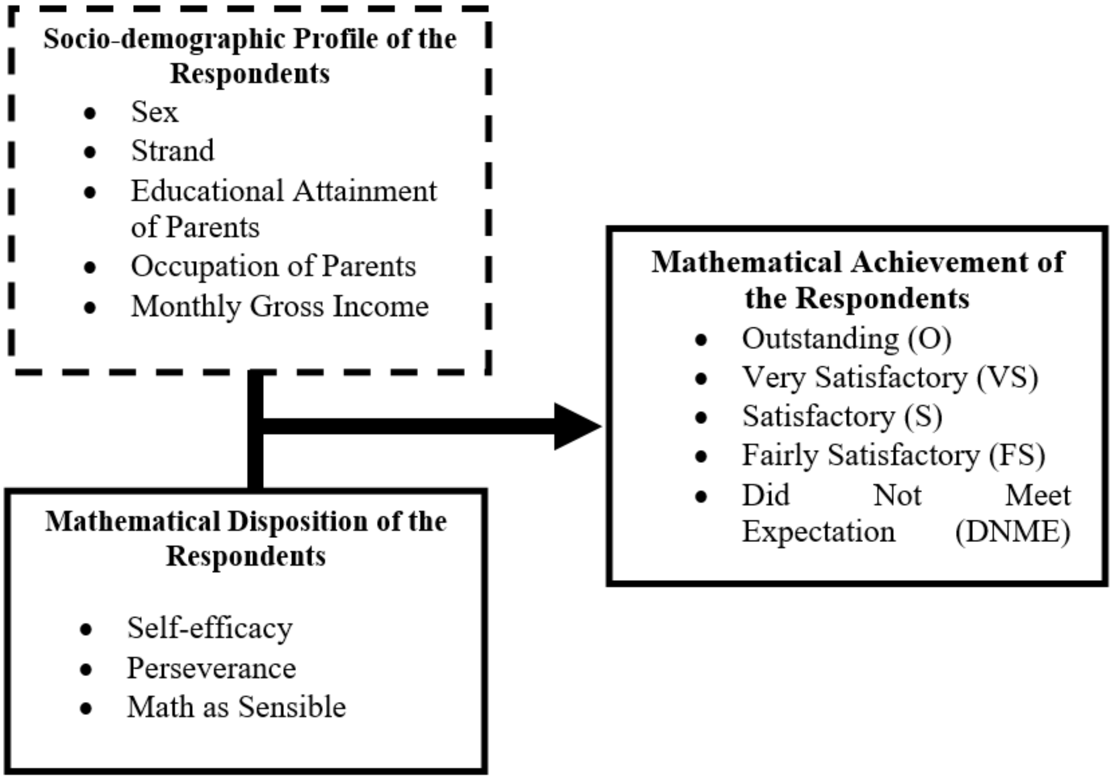
This study was anchored on a unified theoretical framework of Mikaguchi's Theory of Value, Disposition, and Identity (Mikaguchi, 1930; Bethel, 1989) and along with the Mathematical Dispositions outlined by the National Council of Teachers of Mathematics (1989) Evaluation Standard, and Identity. This theoretical frame identified the elements of value with the observable evidence of mathematical disposition and identity.

The idea of *value* in the context of Makiguchi (1930; Bethel, 1989) takes into account a particular subject and the object relationship, and in this case, it is the student relationship with mathematics, which reflects human action and creativeness. In the context of value creation, it would be imperative for students tofeel happiness or enjoyment in their own learning processes of investigating or understanding mathematical concepts. As a result, students would become meaning-makers and construct connotations in which the concept of *value* is created. In Makiguchi's concept of *value*, three fundamental elements are identified: *beauty*, *gain*, and *social good*. *Beauty* is perceived to be an emotional and impermanent value.

Conversely, the value of *Gain* would be an individual value comprised of self-development, self-achievement and beneficial aspects which is attached to the totality of man's life. Social good, on the other hand, is a distinct social value connected to the group's life. Lastly, the value of good is the expression given to the assessment of each individual's voluntary action, which contributes to the growth of a unified community composed of individual.

In the context of the conceptual framework, the concept of beauty can be associated with students' interest, curiosity, and inventiveness in doing mathematics tasks. The value of gain could be attributed to mathematical disposition that offers confidence in using mathematics to solve problems and communicate ideas. This value of gain can likewise enhance student's willingness, flexibility, appreciation, inclination and valuing: willingness to persevere and become persistent in mathematics tasks, flexibility in exploring mathematical concepts and try alternative methods in solving problems, appreciation on the role of mathematics in one's culture and its significant value as a tool and as a language, inclination to monitor and reflect on their own critical thinking and math achievement, and valuing the application of mathematics to various situations arising in other discipline and everyday experience. Furthermore, identity and social value can assist the student in seeing themselves as a learner, and doer of mathematics, thus the sense of belongingness in the learning community as a global citizen will likewise be strengthened.

FIGURE 1
THE RESEARCH PARADIGM SHOWING THE RELATIONSHIP OF INDEPENDENT AND DEPENDENT VARIABLES



Moreso, the study determined primarily the significant difference in mathematical disposition and mathematics achievements of students when grouped according to socio-demographic characteristics and their mathematical disposition. The mathematical disposition comprised self-efficacy, perseverance, and math as sensible. The mathematics achievement of the students was their final grade in general mathematics course that were categorized in terms of five (5) levels of proficiency with corresponding grade brackets. The study was conducted at San Jose City National High School-Senior High School, San Jose City, Nueva Ecija for the School Year 2023-2024. Figure 2.1 above depicts the relationships of the variables on mathematical disposition and achievement.

RELATED LITERATURE

The impact of self-efficacy on student achievement defines its definitive role in one's academic performance in general. Bandura's social cognitive theory (Bandura, 2011) assumes the idea of self-efficacy as focal part. In the Social Cognitive Theory (SCT) neither individuals are constrained by their current circumstances nor totally independent. In its place, the link could be seen as being mutual, where the domain can confine the alternatives that are accessible to an individual, and yet, the individual can figure out what piece of the potential environment will be capable (Callaman & Itaas, 2020). Furthermore, Callaman and Itaas (2020) conveyed that academic self-efficacy harmonized with scholastic achievement in the mathematics assessments. The understanding that learners have about their academic capabilities aids to forecast what they do with the skills they possess which eventually determines the individuals' mathematical achievement. Studies regarding gender differences in mathematics performance and mathematics self-efficacy ratings have also been chronicled (Betz & Hackett, 1983; Mutodi & Ngirande, 2014; Toropova et. al, 2019). While some reports have suggested that males are normally obtain higher as far as mathematics self-efficacy questionnaires is concerned than females (Betz & Hackett, 1983). According to Mutodi and Ngirande, anybody who usually got low mathematical self-efficacy will avoid mathematical problems. Several studies have also revealed a strong connection between mathematics self-efficacy and Mathematics achievement (Bonne & Lawes, 2016; Toropova et. al, 2019). In their decisions, they guarantee that as an individual is being rated high on the mathematics self-efficacy scale, the better this individual performs on problems pertaining to mathematics. As indicated by Toropova et al., the higher the degree of students' self-efficacy, the greater they were bound to communicate good inclinations towards academics than their friends. Schunk (1999) discovered that more high levels of self-efficacy also brought about more noteworthy utilization of learning and metacognitive techniques. Student advancement of self-efficacy was related to four components: prior experience, vicarious experience, verbal persuasion, and physiological state (Bandura, 2002). Prior experience deals with the essential activities the individual build upon when entering a new environment. Vicarious experiences, also known as social models, are models adults and peers use when attempting a problem. Verbal persuasion refers to the information obtained as a result of influence of others while working on a task. Physiological and affective states are when a person becomes emotionally and physically cues, when attempting to execute a new learning. The development of these factors is complex within the classroom setting.

On the other hand, various research efforts have sought to provide explicit instructional classroom practices that back up student perseverance with challenging mathematics tasks, yet very limited resources are known relative to how such practices can best assist student to enhancing perseverance in specific way throughout certain period. Studies aiming to define the nature of productive struggling (DiNapoli & Marzocchi, 2017; DiNapoli, 2023) largely have found that providing consistent opportunities for learners to get engaged with unfamiliar mathematical problem-solving tasks tend to encourage more variability in specific problem-solving strategies with greater learning gains, as compared to offering consistent opportunities to be involved in a more procedural mathematical task. Conversely, other chronicled studies (Bass & Ball, 2015; Freeburn & Arbaugh, 2017; Kress, 2017; Sengupta-Irving & Agarwal, 2017) have investigated the nature of perseverance by examining the impacts of implementing classroom activities using familiar entry points yet structured in complex format. Generally, there had been an empirical support for students leveraging opportunities within the challenging tasks to persevere in their efforts despite difficulty and seemingly create positive mathematical progress. Furthermore, some research had focused on teacher feedback's role in encouraging the context of "in-moment-perseverance" (Freeburn & Arbaugh, 2017; Kress, 2017; Sengupta-Irving & Agarwal, 2017). A synthesis of the results from these inquiries suggests non-leading teacher questioning that encourage student metacognition can facilitate more independent thinking and creative problem-solving skill during time of challenging tasks. In reference to the previous mentioned literature (e.g. Freeburn & Arbaugh, 2017; Kress, 2017; Sengupta-Irving & Agarwal, 2017), a recent study (DiNapoli, 2023) established an operationalized perseverance known as the three-phase perseverance framework (3PP) defining an analytical perspective wherein perseverance can be qualitatively described and gauged. These include the concept of self-regulation, making, and recognizing individuals' mathematical progress (e.g. Gresalfi & Barnes, 2015).

By utilizing the 3PP, Dinapoli (2023) examined how prompting students in algebraic equations to create an artifact of the personal conceptualization of mathematical tasks could support perseverance at times of impasse. The findings suggest how scaffolding tasks in this context encouraged an additional attempt to solve thru re-initiating and re-sustaining mathematically productive effort in the moment of challenge significantly more so than on task without any scaffolding. Dinapoli emphasized that participants in the study articulated that the conceptual thinking recorded after engaging with the scaffold prompt acted as an organizational toolbox from which to draw a fresh mathematical idea, or a new connection between ideas, to use to re-engage with the task upon impasse and to continue to productively struggle to make sense of the mathematical situation. Participants were persevering in problem-solving cyclically, with each additional attempt as a new opportunity to productively struggle with a given task scaffolded by their own conceptual ideas. Without recording their conceptual thinking on non-scaffolded tasks, participants felt frustrated after a setback and often gave up without making an additional attempt at solving. Despite the recent research on ways to support student perseverance in the moment, questions remain about whether these practices help nurture student perseverance to improve over time. There exists some work that shows evidence of student improvement in measures of grit (Polirstok, 2017) and time-on-task, however such work relies heavily on summative outcome variables that reveal little about how learners were challenged, overcame setbacks, and developed mathematical understanding.

Research on perseverance (DiNapoli, 2023; Freeburn & Arbaugh, 2017; Kress, 2017; Sengupta-Irving & Agarwal, 2017) can produce insights into effective practices by which to learn mathematics with understanding, yet much of the empirical evidence of student perseverance have been situated in single points of time with little or no exploration of how those perseverance experiences may be related or demonstrate signs of specific improvement. Thus, the study aimed to address these lingering concerns about whether and how student perseverance, when supported properly, can improve over time.

METHODOLOGY

Study Site and Participants of the Study

This study was conducted at San Jose City National High School – Senior High School compound in San Jose City, Nueva Ecija during the third quarter of school year 2023-2024. It is the largest secondary school offering both junior and senior high school levels. At the senior high school level it offers STEM, ABM, HUMSS, GAS, and Technical-Vocational Strands. The respondents of this study were Grade 12 students of San Jose City National High School-Senior High School during the school year 2023-2024 at the Division of San Jose City, Nueva Ecija. Grade 12 was a perfect level to examine how dispositions develop and change, and how the subject builds the character values for students. It can be seen from these students' confidence in answering mathematics problems, and their persistence and resilience in mathematics tasks. In addition, Grade 12 students have a curiosity in mathematics and appreciate the usefulness of mathematics.

As presented in Table 1, out of seven (7) high schools in the Division, the researcher chose only the biggest high school with the highest population of Grade 12 students. Stratified random sampling with proportional allocation was used to allocate the samples per strand of the study.

TABLE 1
DISTRIBUTION OF RESPONDENTS OF THE STUDY

Strand	Population	Sample
Accountancy, Business, and Management (ABM)	178	42
General Academic Strand (GAS)	136	32
Humanities and Social Sciences (HUMSS)	557	131
Science and Technology, Engineering, and Math (STEM)	240	56
Technology, Vocational, and Livelihood (TVL)	190	45
Total	**1301**	**n=306**

Stratified random sampling is a kind of probability sampling procedure or methodology that included divining a respondent-population into subgroupings or strata based on specific characteristics that the study focus requires (Bernard, 2006). After which, the researcher selected random samples from each stratum. The sampling technique was very useful in this study since the population being studies was divided into distinct subgroups or strata, each representing a unique characteristic or attribute such as various strands in the senior high school program.

Research Design

The study used a descriptive and correlational research design employing a questionnaire to describe the respondents' socio-demographic profile, mathematical disposition, and mathematics performance of senior high school students in San Jose City National High School-Senior High School. Descriptive research design is a process of gathering, analyzing, classifying, and tabulating data about prevailing conditions, practices, beliefs, processes, trends, and relationships and then making adequate and accurate interpretations about such data with or without statistical methods (Creswell, 2009). In addition, the study utilized a correlational research design that examined the significant relationships in mathematics achievements when grouped according to respondents' socio-demographic characteristics and mathematical disposition. A research design that seeks to find the correlation between independent and dependent variables and the researcher's goal is to determine whether the independent variable could influence the outcome, or the dependent variable, by examining two or more groups of individuals (Bernard, 2006).

Instrumentation

The study utilized a survey questionnaire composed of three parts: socio-demographic profile, mathematical achievement, and mathematical disposition. Part I identified the socio-demographic profile of the respondents in terms of sex, strand, educational attainment of parents, occupation of parents, and monthly gross family income. Part II described their mathematics achievement in terms of their final Mathematics 9 grade under K-12 curriculum that was measured in five (5) levels of proficiency with corresponding grade brackets that were: Did Not Meet Expectation (DNME-74% and below); Fairly Satisfactory (FS-75% to 79%); Satisfactory (S -80% to 84%); Very Satisfactory (VS -85% to 89%; and Outstanding (O -90% and above). Part III measured their mathematical disposition thru survey, a list of thirty-eight statements aimed at measuring the Self-Efficacy, Perseverance, and Math as Sensible components of a mathematical disposition and was accessed through a five-point, "Likert-type scale". These statements were mainly taken or adopted from surveys created by other researchers. For the Self-Efficacy component, statements were gathered from the Fennema-Sherman Confidence in Learning Mathematics Scale (Fennema & Sherman, 2007), studied by Usher and Pajares (2009) and Berger and Karabenick (2011). For the Math as Sensible component, statements were collected from the Fennema-Sherman Usefulness of Mathematics Scale (Fennema & Sherman, 2007), and the Indiana Mathematics Belief Scales (Kloosterman & Stage, 1992). For the Perseverance component, statements were pulled directly from the Indiana Mathematics Belief Scales (Kloosterman & Stage, 1992). Questions were pulled directly from the above resources, giving the mixed parity of the statements, with about one-fourth of the statements worded negatively and the rest worded positively. Lastly, the researcher consulted experts in the field regarding the validity of the instrument and pilot tested to twenty (20) senior high school students of Munoz, National High School, Science City of Munoz, Nueva Ecija which yielded its Cronbach alpha's reliability and validity of the instrument in an accepted standard.

Methods of Data Gathering and Analysis

The survey instrument was administered by the requested faculty who acted as the facilitator to the senior high school student-respondents at San Jose City High School and administered it to the dates set by the researcher. Letters of courtesy and permission were addressed to the office mentioned above. Before answering the questionnaire, the research facilitator and the assigned enumerators explained the instructions to the respondents and allowed them to work independently for one (1) hour and thirty (30) minutes. Prior to data gathering, the researcher sought for the approval of the ethics review committee. To protect the privacy of the respondents, their real names were not revealed and all data being gathered were kept with utmost confidentiality and used only for this study.

Responses to survey questionnaires were consolidated and analyzed by descriptive and inferential analyses using Statistical Package for Social Sciences (SPSS) and MS Excel Worksheet to make the computations easier in treating the data collected. The researcher tabulated and summarized the collected data using Microsoft Excel. Then, the researcher, with the help of a statistician, used Statistical Package for Social Sciences (SPSS) to treat data.

JAMOVI was used in frequency distribution, percentage, means, and standard deviation that describe the socio-demographic characteristics of the respondents, as well as their mathematical achievement and dispositions. Moreover, to find out the significant correlations in their mathematical achievement when grouped according to socio-demographic characteristics and mathematical dispositions, inferential statistics, series of Pearson r moment correlation (for continuous data) and chi-square analysis were utilized in examining the significant correlations in variables being evaluated.

RESULTS AND DISCUSSION

Responses were gathered from 306 senior high school students of the San Jose City National High School – Senior High School compound in San Jose City. Included in the socio-demographic variables were the following: strands, sex, parents' educational attainment, parents' occupation, and monthly family income. Data on these variables are presented in Table 1.

TABLE 1
RESPONDENTS' PROFILES

SOCIO-DEMOGRAPHIC PROFILE	FREQUENCY n = 306	PERCENTAGE %
Strand		
ABM	42	13.73
GAS	32	10.46
HUMSS	131	42.81
STEM	56	18.30
TVL	45	14.71
Sex		
Male	151	49.35
Female	155	50.65
Parents' Educational Attainment		
Father		
Elementary	40	13.07
Secondary	186	60.78
Tertiary	80	26.14
Mother		
Elementary	50	16.34
Secondary	195	63.73
Tertiary	61	19.93
Parents' Occupation		
Father		
Without Occupation	56	18.30
With Occupation	250	81.70
Mother		
Without Occupation	101	33.01
With Occupation	205	66.99
Monthly Family Income		
Less than 25,000	106	34.64
25,000-50,000	76	24.84
Greater than 50,000	24	7.84
Mean = 27,350 Min = 9,000		
SD = 21,200 Max = 89,500		

Strand

Academic strand of senior high school respondents presents categories where each belongs. Based on the table shown above, fewer than half (131 or 42.81%) of the respondents belongs to Humanities and Social Sciences (HUMSS), whereas 56 (18.30%) respondents belong to Science and Technology, Engineering and Mathematics (STEM). Furthermore, 45 (14.71%) and 42 (13.73%) belong to Accountancy-Business and Management (ABM) and Technical-Vocational-Livelihood (TVL), respectively. Lastly, the General Academic Strand comprises the least respondents (32 or 10.46%). Results show that most of the senior high school respondents dominated the strand of Humanities and Social Sciences (HUMSS) and this inclination HUMSS strand can be observed in various public and private institutions.

Sex

Table 1 shows the distribution of the senior high school respondents as to the variable Sex. As shown in the table, 159 or 50.65 percent of the student respondents were females, while 151 or 49.35 percent of them were males. The findings imply that the population of students in the senior high school education program was dominated mostly by females. It has constantly been observed that female students were intensively inclined with humanities and social sciences program including teacher education at this modern generation. Findings coincided with the result of the study conducted by Eremeeva (2010) that there had been a decreasing number of males who entered into humanities and social sciences such as teaching profession. Similarly, results also aligned with the findings of Galeyeva and Morgacheva (2015) about perspective in teaching career that female students were more likely interested in the humanities and social science professions than males.

Parents' Educational Attainment:

Mother's Educational Attainment

Mother's or father's educational attainment plays a crucial part in their children's academic performance of their children not to mention the extra-curricular activities they are involved in. As illustrated in the table above, the teacher-education respondents revealed the mother's educational attainment. There were 195 mothers (63.73%) obtained their secondary education, 61 (19.93%) earned their tertiary education, while 50 (16.34%) finished their elementary education. To support this findings, Lazarides and Buchholz (2019) found out that college students mathematics performance is related to their mother's educational attainment. In connection with Masingila et. al (2017), the amount of education mothers possess could likewise influence their children's success in reading and mathematics.

Father's Educational Attainment

In terms of father's educational attainment, 186 (60.78%) of the respondents' fathers earned their secondary education, fewer than half or 80 (26.14%) were tertiary education graduates, while 40 (13.07%) of them obtained elementary education. Based on the findings of this study about parents' highest educational attainment among students enrolled at public schools, results conformed with Chen (2022) that parents were either have secondary or college education. It has also been noted that parents having advanced degree or post graduate degree most likely preferred their children to enroll in the private school as there were many concerns with the public school system. Kitsantas, et. al (2021) noted that parents with higher degree of educational attainment could be role model for their children to perform well in mathematics. Conversely, parents who attained low level of education may not consider the significant influence to their children's future career, hence they may not that supportive as those parents with high level of educational attainment.

Parents' Occupation

Parents' occupation of the teacher-education respondents had likewise been presented in Table 1. Regarding father's occupation, most of them (250 or 81.70%) were affiliated with their respective employers while 56 (18.30%) had been coined as unemployed fathers. Furthermore, mothers' occupation was similarly categorized in two distinct groups: employed and unemployed. The data suggest that most of the mothers (206 or 66.99%) were employed while 101 (33.01%) were considered unemployed. This information conformed with the result of Mardiana (2018) that students having parents affiliated with employers especially in the private sector tended to perform better in any various forms of numeracy and technology compared to those in public schools as manifested in students' attitude towards mathematics and technology.

Monthly Family Income

Based on the results, fewer than half of the respondents (106 or 34.64%) had a family monthly income of less than Php25,000.00. This was followed by 76 respondents (24.84%) having a family monthly income between Php26,000.00 – 50,000.00 while 24 respondents (7.84%) declared their family monthly income of greater than Php50,000.00 per month. Overall, the mean average of family monthly income is Php27,350 with a standard deviation of 21,200, which suggests that a minimum monthly income would range from Php9,000 to a maximum of Php89,500. This confirms the Philippine Statistics Authority's recent findings that only three out of every twenty households belong to the middle-class population (Albert et. al, 2018). In addition, two-thirds of the middle-class population lives in cities. Because most of the respondents' families have a low income and a low socioeconomic status, more than half of their household expenses would be allocated to food, with only a small portion allocated to education. According to a study by the Philippine Statistics Authority, only 2.1 percent of the total household would be allocated to education, including learning materials and tools (Adrian, 2021). Furthermore, these results could also be related to the parents' educational attainment. Based on the results in Table 1.1, it could be analyzed that only a few of the respondents' parents achieved higher education, which could be a factor of their low socio-economic standing.

RESPONDENTS PERCEIVED MATHEMATICAL DISPOSITIONS

Table 2 below depicts the mathematical dispositions of the respondents in terms of three components: self-efficacy, perseverance, and math as sensible. Overall, respondents of senior high school program rated their perceived mathematical disposition domain with an overall mean ($\bar{x}$=3.58 interpreted as Agree. This most likely suggests that respondents in the senior high school program concur with the indicators of mathematics disposition that define their self-efficacy component, perseverance component, and math as sensible component reflected in the individual's inherent qualities of mind and character.

TABLE 2
RESPONDENTS PERCEIVED MATHEMATICAL DISPOSITIONS

MATHEMATICAL DISPOSITION	MEAN	SD	DESCRIPTION
Self-efficacy Component			
1. I am sure I could do advanced work on Mathematics.	3.41	0.86	Agree/(LMD)
2. I am sure that I can learn mathematics	4.10	0.76	Agree/(HMD)
3. I think I could handle more difficult mathematics	3.29	0.74	Uncertain/(LMD)
4. I can get good grades in mathematics	3.90	0.75	Agree/(HMD)
5. I don’t think I could do advanced mathematics	3.86	0.95	Agree/(HMD)
6. I can imagine myself working through challenging math problems successfully	3.58	0.85	Agree/(LMD)
7. I am confident I can learn the basic concepts taught in math	3.94	0.87	Agree/(HMD)
8. I believe I can do well on a mathematics test	3.70	0.81	Agree/(HMD)
9. I believe I can complete all of the assignments in a mathematics course	3.58	0.88	Agree/(LMD)
10. I believe I will be able to use mathematics in my future career when needed	2.91	0.95	Uncertain/(LMD)
11. I believe I can learn well in a mathematics course	3.62	0.89	Agree/(HMD)
12. I believe I am the type of person who can do well in mathematics	3.39	0.78	Uncertain/(LMD)
Pooled Mean	**3.61**	**0.80**	**Agree**
Perseverance Component			
1. Math problems that take a long time don’t bother me	3.41	0.86	Agree/(LMD)
2. I feel I can do math problems that take a long time to complete	3.47	0.80	Agree/(LMD)
3. I find I can do hard math problems if I just hang in there	3.14	0.98	Uncertain/(LMD)
4. If I can’t do a math problem in a few minutes, I probably can’t do it at all	3.21	0.99	Uncertain/(LMD)
5. If I can’t solve a math problem quickly, I quit trying	3.40	1.11	Uncertain/(LMD)
6. I’m not very good at solving math problems that take a while to figure out	2.85	0.88	Uncertain/(LMD)
7. By trying hard, one can become smarter in math	4.16	0.84	Agree/(HMD)
8. Working hard in a math class can improve one’s ability in mathematics	4.06	0.87	Agree/(HMD)
9. I can get smarter in math by trying hard	4.02	0.79	Agree/(HMD)
10. Ability in math increases when one studies hard	3.96	0.87	Agree/(HMD)
11. Hard work can increase one’s ability to do math	4.00	0.92	Agree/(HMD)
12. I can get smarter in math if I try hard	3.96	0.93	Agree/(HMD)
Pooled Mean	**3.64**	**0.90**	**Agree**

MATHEMATICAL DISPOSITION	MEAN	SD	DESCRIPTION
Math as Sensible Component			
1. I will need mathematics for my future work	3.91	0.98	Agree/(HMD)
2. I study mathematics because I know how useful it is	4.10	0.81	Agree/(HMD)
3. Mathematics is a worthwhile and necessary subject	3.78	0.83	Agree/(HMD)
4. I will use mathematics in many ways as an adult	3.74	0.78	Agree/(HMD)
5. Mathematics will not be important to me in my life's work	3.60	1.21	Agree/(HMD)
6. I see mathematics as a subject I will rarely use in my daily life as an adult	2.46	1.08	Disagree/(LMD)
7. Studying mathematics is a waste of time	3.82	1.14	Agree/(HMD)
8. Time used to investigate why a solution to a math problem works is time well spent	3.65	0.81	Agree/(HMD)
9. A person who doesn't understand why an answer to a math problem is correct hasn't really solved the problem	3.65	1.02	Agree/(HMD)
10. In addition to getting a right answer in mathematics, it is important to understand why the answer is correct	4.12	0.87	Agree/(HMD)
11. It's not important to understand why a mathematical procedure works as long as it gives a correct answer	3.10	1.06	Uncertain/(LMD)
12. Getting a right answer in math is more important than understanding why the answer works	2.74	1.17	Uncertain/(LMD)
13. It doesn't really matter if you understand a math problem if you can get the right answer	3.17	1.09	Uncertain/(LMD)
Pooled Mean	**3.51**	**0.98**	**Agree**
Over-all Mean	**3.58**	**0.91**	**Agree**

* reversely coded

Legend:		Level	
1.00 – 1.80	Strongly Disagree	< Mean	Low Mathematical Disposition (LMD)
1.81 – 2.60	Disagree	> Mean	High Mathematical Disposition (HMD)
2.61 – 3.40	Uncertain		
3.41 – 4.20	Agree		
4.21 – 5.00	Strongly Agree		

Self-Efficacy Component

Self-efficacy component comprised twelve statements or indicators to measure respondents perceived mathematical disposition with a pooled mean of 3.61 verbally interpreted as Agree. As depicted on the table, six items (2, 4, 5, 7, 8, & 11) were considered high mathematical dispositions. Specifically, items 2 and 7 which state "I am sure that I can learn mathematics" and "I am confident I can learn the basic concepts taught in math" obtained the highest weighted means ($\bar{x}$=4.10; $\bar{x}$=3.94) respectively. Conversely, three statements (1, 6, & 9) had been perceived as low mathematical disposition. Among the three, statement 1 which says "I am sure I could do advanced work on Mathematics" got the lowest mean ($\bar{x}$=3.41) with verbal interpretation Agree. Furthermore, there were indicators that had been perceived as Uncertain/Low Mathematical Disposition (3, 10, & 12). Among these three statements, item 10 that says "I believe I will be able to use mathematics in my future career when needed" got the lowest of all means ($\bar{x}$=3.41) interpreted as Uncertain. Based on the results, senior high school student-respondents on Self-efficacy component more likely suggest that positive disposition of learning mathematics would likewise give them confidence to numerical learning process. With the individual's belief about his or her ability to perform the task, they would have control and ownership of their own learning pace and strategies specially when tasks require problem solving abilities.

In the study by Gurler (2022) on critical thinking on mathematical disposition, one strategy for students to get into a more mathematical frame of mindset is dependent on one's self-efficacy on numeracy. According to the findings of Gurler, enjoying some interesting aspects of mathematics is fully engaging in numerical activities based on mathematical concepts, including puzzles, number patterns, everyday mathematics, dominoes, and the like. In this sense, Gurler accentuated what teacher dispositions could be critical to promoting student learning in mathematics. In her findings, a keen personal interest in learning and growing are important coupled with reflective teaching ang learning process. As an individual learner, one must believe that all students can learn, a high expectation but feasible through flexibility in adapting instruction, materials and assessment to various contexts. Most importantly, one's ability to creating an optimistic yet goal-oriented learning environment. Specifically, Gurler emphasized some dispositions are more detailed to self-efficacy contexts such as genuine interest and connections to math concepts and persistence with finding solutions to problems, as well as an appreciation for mathematics-related applications such as those in other related fields.

Perseverance Component

Respondents' domain on perseverance component was measured through an opinionnaire instrument with twelve distinct benchmark statements having a pooled mean of 3.64 interpreted as *Agree*. As presented on the table, six statements (7, 8, 9, 10, 11, & 12) had been perceived as high mathematical dispositions. Explicitly, items 7 and 8 which state "*By trying hard, one can become smarter in math*" obtained the highest mean ($\bar{x}$=4.16) and "*Working hard in a math class can improve one's ability in mathematics*" ($\bar{x}$=4.06) construed as *High Mathematical Disposition*. On the other hand, items 1 and 2 that state "*Math problems that take a long time don't bother me*" and "*I feel I can do math problems that take a long time to complete*" with means of 3.41 and 3.47 were perceived to be *low mathematical dispositions* respectively. Four items (3, 4, 5, & 6) had been considered uncertain/low mathematical disposition. As clearly stated, item 6 which says "*I'm not very good at solving math problems that take a while to figure out" got the lowest mean of all ($\bar{x}$=2.85) with verbal interpretation of *Uncertain*. Based on the table covering the twelve key statements in identifying the senior high school student respondents' perseverance component, it was interesting to note that positivity coupled with hard work plays a pivotal role in enhancing mathematical disposition. The findings on the perseverance component could likewise be attributed to asserting one's capability to assert additional efforts coming from within oneself, and being persistent in doing something despite challenges or difficulties or delays in achieving his or her goals.

In the study of DiNapoli (2023), perseverance and persistence are distinct dispositional factors that afford different insights into how an individual learner learns mathematics with the context of full understanding. Although these constructs generally face challenges, perseverance digs more deeply into how learners spend their time navigating math obstacles. As such, DiNapoli found out that how students persevere with challenging situations can reveal how they overcome setbacks and provide their own mathematical connections in the "moment". This revelation by DiNapoli can pragmatically inform teachers in setting up mathematical activities and encourage students to necessitate and nurture such practices. Furthermore, this is not to say that research incorporating grit and persistence versus perseverance would not be useful in mathematics education. Research on grit and persistence more likely to establish associations between achievements and consistency of interest and efforts, which can then posit the construct as a predictor of general mathematical achievements in the long term. In addition, DiNapoli accentuated the idea that research incorporating persistence and perseverance can efficiently describe the duration students get involved and spend engaging with specific challenges, thus the opportunity they had learn from such challenges. Yet, in the scope of learning more about how students learn mathematics with understanding, evaluating student perseverance with challenging tasks has the most potential ground to come up with the most substantive and fine-grained insights.

Math as a Sensible Component

Math as a sensible component comprised thirteen benchmark statements with a pooled mean of 3.58 descriptively interpreted as *Agree*. Among these thirteen items, nine statements (1, 2, 3, 4, 5, 7, 8, 9 & 10) were perceived as high mathematical dispositions. It can likewise be noted that statements 10 and 2 which state "*In addition to getting a right answer in mathematics, it is important to understand why the answer is correct"* and "*I study mathematics because I know how useful it is*" attained the highest means of 4.12 and 4.10 interpreted as *High Mathematical Dispositions* respectively. Conversely, three items (11, 12 & 13) were considered uncertain/low mathematical dispositions. Of all these three indicators, item 12 that says "*Getting a right answer in math is more important than understanding why the answer works" attained the lowest mean (($\bar{x}$=2.74) interpreted as *Uncertain/Low Mathematical Disposition*. Regarding low mathematical dispositions, item 6 which says "I see mathematics as a subject I will rarely use in my daily life as an adult" gained the lowest mean of all ($\bar{x}$=2.46), descriptively interpreted as *Disagree/Low Mathematical Disposition*.

In the third component of mathematical disposition, namely math as a sensible component, the respondents highlighted the value of knowing the right procedures and answers to specific numerical tasks and recognizing its usefulness in their day-to-day lives, which more likely tends to require muscle memory. Math as a sensible element necessitates the practicality of tasks, workability of activities, and functionality of various numerical concepts. Their being independent learners likewise demand the application of motor skills, coordination of physical movements, and problem-solving activities. These findings were in consonance with Pekrun et. al (2017). In the study of Pekrun, math as a sensible component might also suggestive of activating the muscle memory coupled with teaching approaches. As such, this could deepen students' conceptual understanding from the higher learning domains and contribute to their value perceptions, resulting in active emotional engagements during mathematics learning. This finding supports the premise of value-theory showing the connections of multiple mediators in cognitive domains to activation-emotion-motion relationships. To aptly put, students in mathematics possess different abilities, their academic domains including muscle memory as tool for problem-solving skill, enhanced their positive learning experiences by enhancing their competence beliefs and academic values.

RESPONDENTS' MATHEMATICS ACHIEVEMENT

Table 3 illustrates the respondents' mathematics achievements with descriptive interpretations as outstanding, very satisfactory, satisfactory, fairly satisfactory, and did not meet expectations. Overall, the average mean score of this study's total population of respondents is 87.33 with the standard deviation of 5.84, which can be described in the context of *Very Satisfactory* ($\bar{x}$=87.33).

TABLE 3
RESPONDENTS' MATHEMATICS ACHIEVEMENT

PARAMETERS	F	%	DESCRIPTION
90 – 100	97	31.70	Outstanding (O)
85 – 89	123	40.20	Very Satisfactory (VS)
80 – 84	60	19.61	Satisfactory (S)
75 – 79	20	6.54	Fairly Satisfactory (FS)
Below 74	6	1.96	Did Not Meet Expectation (NME)
Mean = 87.33 SD = 5.84			

Among the respondents' mathematics achievement presented above, their achievement with verbal description of *Very Satisfactory* obtained the highest percentile rank (40.20%). This comprised 123 over 306 respondents. An *Outstanding* achievement ranked second comprising of 97 respondents (31.70%). More so, mathematics achievements with verbal descriptions of *Satisfactory* (19.61%) and Fairly *Satisfactory* (6.54%) ranked third and fourth while others that *Did Not Meet Expectation* (1.96%) ranked the least respectively.

The findings on respondents' mathematics achievement coincided with the study conducted by Bacsal et. al (2022) who found out that students in general and pre-service teacher-students showed more or less sufficient understanding of mathematical concepts that defines their mathematical achievement. However, the study likewise showed insufficient understanding in most logical operations, specifically classification, seriation, compensation, and correlational thinking (Bacsal et.al, 2022; Baking et. al, 2023). These insufficient understanding of numerical concepts that negatively impacts their mathematical achievement were more likely attributed to their inadequate knowledge of mathematical terms as the official language of discourse, including misinterpretation of the math problems, poor comprehension skills, and poor problem-solving skills (Baking, et. al, 2023).

RELATIONSHIP BETWEEN THE RESPONDENTS' SOCIO-DEMOGRAPHIC PROFILE AND MATHEMATICS ACHIEVEMENT

TABLE 4
RELATIONSHIP BETWEEN THE RESPONDENTS' SOCIO-DEMOGRAPHIC PROFILE AND MATHEMATICS ACHIEVEMENT

SOCIO-DEMOGRAPHIC PROFILE	MATHEMATICS ACHIEVEMENT		
	χ^2/r	p-value	Interpretation
Strand	37.04	0.053	Not Significant
Sex	0.221	0.128	Not Significant
Fathers' Educational Attainment	0.101	0.276	Not Significant
Mothers' Educational Attainment	-0.598*	0.045	*Significant*
Fathers' Occupation	0.129	0.106	Not Significant
Mothers' Occupation	-0.511*	0.037	*Significant*
Monthly Family Income	-0.465*	0.015	*Significant*

Legend:
** Correlation is **significant** at 0.05 level (2-tailed)*

To determine whether there is a relationship between the respondents' socio-demographic profile and mathematics achievement, correlation using Pearson-r (for continuous data) and Chi-square (for categorical data) were used. Results showed that mother's educational attainment, mothers' occupation, and monthly family income show negative correlations to mathematics achievement. Conversely, some of the socio-demographic profiles of respondents as to strand, sex, father's educational attainment and father's occupation were found to have no established links with the mathematical achievement. This might be associated with the limited representation of the general population of the study

Mother's Educational Attainment and Mathematics Achievement

In the result of the correlation on mother's educational attainment and mathematics achievement presented on the table above, the data yielded a negative but significant relationship between the two variables being examined (r= -0.598*, p <0.05). The result more likely suggests that educational achievement of parents specifically mothers serve as a strong indicator for students' academic success. Students with mothers with high educational attainment would have less supervision of their children as they tend to emulate their parents' professional status. This is supported by many studies (Azhar et al., 2014; Kaya, 2013; Khan et al., 2015; Rafiq et al., 2013) that have indicated a significant relationship between parents' educational level and their children's achievement. In addition, there were other studies (e.g. Carneiro et al., 2012; Faize & Dahar, 2011) that confirmed the positive relationship of the mothers' educational level specifically and their children's math-achievement, that parents' educational level is significantly positively related to student mathematics achievement and this specific element is evidently observed to be significantly differs across various populations. As an empirical evidence, for instance, Amuda and Ali (2016) pointed out that on average, students whose parents' educational attainment is high tend to perform higher compared to students in the same school whose parents' educational attainment are low. However, this was only seen around six percent with the school variation in mathematics achievement. As such, these results are common in the traditional mathematics achievement literature (Alibraheim, 2023). Likewise, results of student level model showed significant variability across populations of schools. This indicates that in some schools parents educational level specifically mothers was found to have weak relationship with mathematics achievement (Carneiro, et.al, 2012). This chronicled variation could have been due to factors like school and class size, school type, and students. Conversely, the study of Baking et. al (2023) generated a contradicting result as regard to mother's educational attainment and mathematics achievement. Baking et. al (2023) found out that both mothers' and fathers' educational attainment seemed to have insignificant relationships with the mathematical achievement. Thus, recommendation to further study by including wider scopes of respondents' representative of various sectors and institutions had been highly encouraged to future researchers with similar topic of interest in research.

Mother's Occupation and Mathematics Achievement

As shown in the correlation between mother's occupation and mathematical achievement, a negative relationship was significantly established ($r = -0.511^*$, $p < 0.05$). The finding tends to suggest that students with mothers with stable occupations are less likely to achieve low mathematical performance since parents would have the capability and means for hiring math tutors who frequently guide and nurture their children's numerical skills. This context had been studied (e.g. Alibraheim, 2023; Bakar, et.al, 2019; Bora & Amed, 2018; Carneiro, et.al, 2012) relative to parents' socio-economic status and mathematics achievement. The researchers tried to study the effect of mothers' socio-economic status on their child performance and concluded that that students whose mothers are educated with permanent occupations tend to have high grades in science courses than students whose mothers are uneducated. With similar context, Carneiro et al. (2012) studied the effect of mother's socio-economic status on student learning outcomes, including cognitive development as well as their health and behavioral problems at school. The findings confirmed that socio-economic status including educational level strongly influences the academic performance of their children in mathematics and reading comprehension at an early age. However, this observed effect tends to decrease when children reach adolescence.

Monthly Family Income and Mathematics Achievement

Another construct in the socio-demographic profile of respondents that established a negative yet significant relationship was the parents' monthly income and mathematics achievement ($r= -0.465^*$, $p < 0.05$). The result may seem to suggest that parents with low monthly income tend to neglect their children's need for tutorial support due to economic instability. Thus, this situation might likewise put their children at high risk of not performing well in mathematical achievement. As accentuated in the research studies (e.g. Alibraheim, 2023; Bora & Amed, 2018; Carneiro, et.al, 2012) on the positive correlation of socio-economic status of parents in relation to student mathematics achievement, parents whose educational level and socio-economic status are considered low would likewise have negative impact on their children's mathematics performance. Thus, the null hypothesis stating that there is no significant relationship between socio-demographic characteristics and mathematical achievement is at this moment rejected. Based on this study's results, significant correlations were being chronicled, though some literature offered contradicting results.

RELATIONSHIP BETWEEN THE RESPONDENTS' MATHEMATICAL DISPOSITION AND MATHEMATICS ACHIEVEMENT

The relationship between respondents' mathematical disposition on self-efficacy, perseverance, and math as sensible components had been carried out to provide basis of its significant contribution to student learning specifically to mathematics achievement.

TABLE 5
RELATIONSHIP BETWEEN THE RESPONDENTS' MATHEMATICAL DISPOSITION AND MATHEMATICS ACHIEVEMENT

MATHEMATICAL DISPOSITION	MATHEMATICS ACHIEVEMENT		
	r	**p-value**	**Interpretation**
	0.507*	0.028	*Significant*

Legend:
* *Correlation is significant at 0.05 level (2-tailed)*

To determine whether there is a relationship between the respondents' mathematical disposition and mathematics achievement, correlation using Pearson-r was used. Result shows that the respondent's mathematical disposition on self-efficacy, perseverance, and math as a sensible component is positively correlated to mathematics achievement (r= -0.507*, p <0.05). This implies that respondents with high mathematical dispositions are more likely to have high mathematics achievement than those with low mathematical disposition. Concurred with the study of Crick and Goldspink (2014) on learners' disposition, the findings stated that learning disposition is an important part of the learning process. As defined in research, learner's disposition pertains to the general and relatively stable inclination or propensity to approach new learning tasks in either in language or numeracy and a specific situation in various ways. Further, Lin and Tai (2016) pointed that disposition would be very different compared to learning from skills and knowledge, but, this can be learned through the habit of mind, tendencies to respond to situations in certain ways that would come up with positive outputs that defines individual's productivity. Here in, productive disposition can mean to a habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's efficacy. Thus, mathematics learning disposition can be considered as cultivated habit of the mind or behavioral mind patterns during the mathematical learning process. These would include but not limited to the individual's affectionate characteristic, cognitive ability, and the action tendency to problem situation. In this study, mathematics disposition delineates its role to the individual in the context of mathematics learning, with specific type of behavioral pattern coupled with mathematical cognitive habits.

CONCLUSION

In determining whether there is a relationship between the respondents' socio-demographic profile and mathematics achievement, correlation using Pearson-r (for continuous data) and Chi-square (for categorical data) were used. Results showed that mothers' educational attainment, occupation, and monthly family income show negative correlations to mathematics achievement. In the result of the correlation on mother's educational attainment and mathematics achievement presented on the table above, the data yielded a negative but significant relationship between the two variables being examined. The result more likely suggests that educational achievement of parents specifically mothers serve as a strong indicator for students' academic success. Students with mothers with high educational attainment would have less supervision of their children as they tend to emulate their parents' professional status. Findings on correlation between mother's occupation and mathematical achievement significantly established a negative relationship. The finding tends to suggest that students with mothers with stable occupations are less likely to achieve low mathematical performance since parents would have the capability and means for hiring math tutors who frequently guide and nurture their children's numerical skills. Another construct in the socio-demographic profile of respondents that established a negative yet significant relationship was the parents' monthly income and mathematics achievement. The result may seem to suggest that parents with low monthly income tend to neglect their children's need for tutorial support due to economic instability. Thus, this situation might likewise bring their children at high risk of not performing well in their mathematical achievement.

Learning disposition is regarded as an important part of learning process. As defined in research, learner's disposition pertains to the general and relatively stable inclination or proclivity to approach new learning tasks in either in language or numeracy and a specific situation in various ways mathematics disposition delineates its role to the individual in the context of mathematics learning, with specific type of behavioral pattern coupled with mathematical cognitive habits.

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REFERENCES

Adrian, M. (2021). *Who Are The Middle Class In The Philippines?* iMoney Learning Center. Retrieved from https://www.imoney.ph/articles/middle-class-sector-philippines/

Alibraheim E.A., & Taifour, E.A. (2023). The Relationship between Mothers' Educational Levels and their Children's Academic Performance. *Pegem Journal of Education and Instruction*, *13*(3), 36–40. https://doi.org/10.47750/pegegog.13.03.04

Albert, J.R.G., Santos, A.G.F., & Vizmanos, J.F.V. (2018). *Profile and determinants of the middle-income class in the Philippines (No. 2018–20)*. PIDS Discussion Paper Series.

Amuda, B., & Ali, D. (2016). Parents' level of education as predictors of academic performance of NCE student s of colleges of education in the north-eastern states of Nigeria. *IOSR Journal of Humanities and Social Science*, *21*(2), 41–47. https://doi.org/10.9790/0837-2122414

Appiah, J.B., Korkor, S., Arthur, Y.D., & Obeng, B.A. (2022). Mathematics achievement in high schools, the role of the teacher-student relationship, students' self-efficacy, and students' perception of mathematics. *International Electronic Journal of Mathematics Education*, *17*(3), em0688. https://doi.org/10.29333/iejme/12056

Azhar, M., Nadeem, S., Naz, F., Perveen, F., & Sameen, A. (2014). Impact of parental education and socio-economic status on academic achievements of university students. *European Journal of Psychological Research*, *1*(1), 1–9.

Bacsal, E.D., Ibanez, E.D., & Pentang, J.T. (2022). Jigsaw strategy: Strengthening achievement and interest in mathematics among elementary pre-service teachers. *The Palawan Scientist*, *14*(1), 35–42.

Bakar, S.A., Ayub, A.F.M., Gopal, K., & Salim, N.R. (2019). The influence of students' beliefs on mathematical problem solving towards mathematics achievement among Malaysian matriculation students. *Universal Journal of Educational Research*, *7*(10), 2243–2247.

Baking, R.D., Ibarra, F.P., & Mukminin, A. (2023). Predictive analysis of cognitive skills achievement in mathematics along seven logical operations among elementary pre-service teachers. *Edelweiss Applied Science and Technology*, *4*(2), 41–45. https://doi.org/10.55214/25768484.v7i1.332

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, *52*, 1–26. https://doi.org/10.1146/annurev.psych.52.1.1

Bandura, A. (2002). Social cognitive theory in cultural context. *Applied Psychology: An International Review*, *51*(2), 269–290. https://doi.org/10.1111/1464-0597.00092

Bass, H., & Ball, D.L. (2015). *Beyond you can do it! Developing mathematical perspective in elementary school.* Retrieved from http://www.spencer.org/collected-papers-april-2015

Berger, J.L., & Karabenick, S.A. (2011). Motivation and students' use of learning strategies: Evidence of unidirectional effects in mathematics classrooms. *Learning and Instruction*, *21*(3), 416–428.
Bernard, R.H. (2006). *Research Method in Anthropology*. New York, NY: Altamira Press.
Bethel, D. (Ed.). (1989). Education for creative living: Ideas and proposals of Tsunesaburo Makiguchi (A. Birnbaum, Trans.). Ames, Iowa: Iowa State University Press. (Original work published 1930).
Betz, N.E., & Hackett, G. (1983). The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Behaviour*, *23*(3), 329–345. https://doi.org/10.1016/0001-8791(83)90046-5
Bonne, L., & Lawes, E. (2016). Assessing students' maths self-efficacy and achievement. *Set: Research Information for Teachers*, *2*, 60–64. https://doi.org/10.18296/set.0048
Bora, A., & Amed, S. (2018). Parents' socioeconomic status and pupils' mathematics achievement: Stepwise multiple regression analysis approach. *International Journal of Technical Innovation in Modern Engineering and Science*, *4*(11), 316–322. Retrieved from https://files.eric.ed.gov/fulltext/ED590537.pdf
Callaman, R.A., & Itaas, E.C. (2020). Students' mathematics achievement in Mindanao context: A meta-analysis. *Journal of Research and Advances in Mathematics Education*, *5*(2), 148–159. https://doi.org/10.23917/jramathedu.v5i2.10282
Carneiro, P., Meghir, C., & Parey, M. (2012). Maternal education, home environments and the development of children and adolescents. *Journal of European Economic Association*, *11*(1), 123–160. https://doi.org /10.1111/j.15 42-4774.2012.01096.x
Chen, X. (2022, July 3–7). Mathematical confluences and journeys. In N. Fitzallen, C. Murphy, V. Hatisaru, & N. Maher (Eds.), *Proceedings of the 44th Annual Conference of the Mathematics Education Research Group of Australasia* (pp. 106–113). Launceston: MERGA.
Creswell, J.W. (2009). *Journal of Mixed Method Research*, *3*(2), 95–108.
Crick, R.D., & Goldspink, C. (2014). Learner dispositions, self-theories and student engagement. *British Journal of Educational Studies*, *62*(1), 19–35. https://doi.org/10.1080/00071005.2014.904038
DiNapoli, J., & Marzocchi, A.S. (2017). Productive struggle: What we can learn from working with pre-service teachers. *The ComMuniCator*, *41*(4), 10–13.
DiNapoli, J. (2023). Distinguishing between grit, persistence, and perseverance for learning mathematics with understanding. *Education Science*, *13*(4), 402–412. https://doi.org/10.3390/educsci13040402
Faize, F., & Dahar, M. (2011). Effect of mother's level of education on secondary grade science students in Pakistan. *Research Journal of International Studies*, *19*, 13–19.
Fennema, E., & Sherman, J.A. (2007). Fennema-Sherman mathematics attitude scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education*, *7*, 324–326.
Freeburn, B., & Arbaugh, F. (2017). Supporting productive struggle with communication moves. *Mathematics Teacher*, *111*(3), 176–181.
Galeyeva, N.L., & Morgacheva E.V. (2015). Features of the maintenance of competences of the elementary school teacher realizing the individual approach in training pedagogics. *Psychology: Selected papers of the international scientific school "paradigma".* Yelm, pp. 20–33.
Gresalfi, M.S., & Barnes, J. (2015). Designing feedback in an immersive videogame: Supporting student mathematical engagement. *Educational Technology Research and Development*, *64*(1), 1–22.
Gurler, A. (2022). State of prediction of the critical thinking dispositions of primary school teacher candidates through their self-efficacy for STEM practices. *Participatory Educational Research*, *9*(3), 61–81. Retrieved from http://www.perjournal.com
Kaya, F. (2013). *The relationship between age, gender and parents' education level and science attitudes in middle school students.* (Unpublished Master's thesis). Spalding University.
Khan, R., Iqbal, N., & Tasneem, S. (2015). The influence of parents educational level on secondary school students academic achievements in District Rajanpur. *Journal of Education and Practice*, *6*(16), 76 –79.

Kitsantas, A., Cleary, T.J., Whitehead, A., & Cheema, J. (2021). Relations among classroom context, student motivation, and mathematics literacy: A social cognitive perspective. *Metacognition and Learning*, *16*(2), 255–273.
Kloosterman, P., & Stage, F.K. (1992). Measuring beliefs about mathematical problem solving. *School of Science and Mathematics*, *92*(3), 109–115.
Kodippili, A. (2011). Parents educational level in students' mathematics achievement: Do school factors matter? *Academic Leadership Online Journal*, *9*(2), 1–7.
Kress, N.E. (2017). 6 essential questions for problem solving. *Mathematics Teacher*, *111*(3), 190–196.
Mardiana, H. (2018). Lecturer's attitude towards advance technology and its impact to the learning process: Case study in Tangerang city campuses. *Journal of Educational Science and Technology*, *4*(1), 12–25.
Masingila, J.O., Olanoff, D., & Kimani, P.M., (2017). Mathematical knowledge for teaching teachers: Knowledge used and developed by mathematics teacher educators in learning to teach via problem solving. *Journal of Mathematics Teacher Education*, *21*, 429–450. https://doi.org/10.1007/s10857-017-9389-8
Mutodi, P., & Ngirande, H. (2014). The influence of students' perceptions on mathematics performance. A case of a selected high school in South Africa. *Mediterranean Journal of Social Sciences*, *5*(3), 431–445. https://doi.org/10.5901/mjss.2014.v5n3p431
National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA: NCTM.
Pekrun, R., Lichtenfeld, S., Marsh, H.W., Murayama, K., & Goetz, T. (2017). Achievement emotions and academic performance: Longitudinal models of reciprocal effects. *Child Development*, *88*(5), 1653–1670. https://doi.org/10.1111/cdev.12704
Polirstok, S. (2017). Strategies to improve academic achievement in secondary school students: Perspectives on grit and mindset. *SAGE Open*, *7*(4), 1–9.
Rafiq, H., Fatima, T., Sohail, M., Saleem, M., & Khan, M. (2013). Parental involvement and academic achievement; a study on secondary school students of Lahore, Pakistan. *International Journal of Humanities and Social Science*, *3*(8), 209–223.
Sengupta-Irving, T., & Agarwal, P. (2017). Conceptualizing perseverance in problem-solving as collective enterprise. *Mathematical Thinking and Learning*, *19*(2), 115–138.
Toropova, A., Johansson, S., & Myrberg, E. (2019). The role of teacher characteristics for student achievement in mathematics and student perceptions of instructional quality. *Education Inquiry*, *10*(4), 275–299. https://doi.org/10.1080/20004508.2019.1591844
Usher, E.L., & Pajares, F. (2009). Sources of self-efficacy in mathematics: A validation study. *Contemporary Educational Psychology*, *34*(1), 89–101.