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Sex-Based Analysis of Mathematics Performance and Non-Cognitive Factors of University Students

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Abstract: ***Mathematics education has long been a topic of interest due to perceived gender disparities, despite progress towards gender equality in other areas like employment and education. This paper aims to determine university students' differences in mathematics performance and non-cognitive factors based on sex. It focuses on analyzing the relationship between sex, mindset, and self-control. The study respondents were 150 Science, Technology, Engineering, and Mathematics (STEM) first-year university students. The descriptive correlational research design was utilized in this study, and the data were analyzed using frequency count, percentage, mean, standard deviation, and t-test. The study found that students have an average level of mathematics performance. Furthermore, most STEM students have a growth mindset with some fixed ideas in learning mathematics. In addition, results also reveal that they have an average level of self-control. Moreover, the study found no significant differences in mathematics performance, mindset, and self-control when groups based on sex. Thus, males and females are equally equipped with cognitive and non-cognitive domains to succeed in STEM courses.***

Keywords:STEM, sex, mathematics performance, mindset, self-control

1. Introduction

Mathematics serves as one of the critical instruments for academic and life success. Its importance cannot be underestimated since it significantly contributes to various fields of discipline and relevance, even daily life. The Mathematics Framework for Philippine Basic Education is recognized as a gateway for national progress; since our country's economic progress relies heavily on its progress in science and engineering, this demands a strong foundation in mathematics. In addition, it is also identified as a "gatekeeper" for employability and successful and productive citizenship (SEI-DOST & MATHTED, 2011). Therefore, the demand to produce quality mathematics education for all Filipinos is necessary.

However, it is generally accepted that mathematics is better suited for males. As observed, most Science, Technology, Engineering, and Mathematics (STEM) courses were dominated by male students. The study of Maccoby & Jacklin (1974) examining engineering, medicine, or any science-related career confirms that males dominate math-related occupations. Females were still underrepresented in science, technology, engineering, mathematics, and computer science. In the study of Cunningham & Hoyer 2009, one key finding reveals that female students have a lower interest in mathematics and science. They are less likely to pursue STEM courses as compared to male respondents. As shown in the study of Asante (2010), the results indicate a significant difference in mathematics performance between males and females. Male respondents outperformed female respondents. The findings suggest a clear-cut sex difference in mathematics performance. This concept has recently been challenged by the study of Kersey et al. (2018) concluded that across all stages of numerical development, analyses consistently revealed that boys and girls do not differ in early quantitative and mathematical ability. These findings indicate that boys and girls are equally equipped to reason about mathematics during early childhood. So far, as per the research literature review, there is a contrasting idea of how sex contributes to the differences in the students' mathematics performance.

Examining the intricate interplay between sex, mindset, and self-control among students reveals a fascinating realm of human behavior that has far-reaching implications for their overall well-being and academic success. As education institutions strive to create environments conducive to holistic development, understanding how these factors intertwine becomes crucial. Passion, as a strong desire or enthusiasm for something (Sigmundsson et al., 2020), plays a crucial role in shaping individuals' goals and achievements. It can be domain-specific, indicating that certain passions are more prevalent in specific areas of interest. Previous research has suggested that passion drives goal attainment (Duckworth et al., 2011). Therefore, it is important to investigate how different levels of passion might interact with sex to influence mindset and self-control among students.

The concept of mindset refers to the assumption that intelligence is a flexible attribute that can be enhanced via exertion or remains largely stable. According to Dweck (2006), it has been shown that individuals' self-awareness, self-esteem, inventiveness, capacity to confront obstacles, ability to recover from setbacks, degrees of depression, and inclination to engage in stereotyping are all impacted by this phenomenon. The Mindset Theory posits that beliefs can be classified into two distinct categories: a growing mindset and a fixed mindset. The concept of the growth mindset pertains to adopting incremental views, which are grounded in the understanding that intelligence and personal traits can be modified or nurtured via diligent exertion. Individuals with this mindset perceive problems as a chance to acquire knowledge and enhance their abilities. Even in the face of defeat, they approach it constructively. Conversely, a fixed mindset is characterized by the conviction that intelligence and aptitude remain unchanging. The emphasis is placed on enduring characteristics; individuals exhibit a rapid aversion to taking risks and tend to diminish the significance of the

exerted effort. According to Macnamara & Rupani (2017), individuals with a fixed mindset tend to shun difficulties and perceive failure as a result of inherent, unchangeable inadequacy. This notion engenders patterns of conduct characterized by helplessness and a diminished inclination to acquire knowledge.

Another non-cognitive factor hypothesized to be essential to a student's academic success is self-control. According to Baumeister et al. (2007), self-control is the capacity to modify individual responses following standards, including ideals, values, and moral and social expectations, to pursue long-term objectives. It allows one to override their interior thoughts to avoid undesirable behavioral tendencies and resist temptation. Baumeister noted that self-control may be associated with emotional issues, academic underachievement, a lack of persistence, various task performance failures, relationship issues, and others. Students require self-control to enhance academic achievement and performance as well as their well-being as a whole.

This study provides an excellent opportunity to advance our knowledge regarding sex differences and non-cognitive learning factors and their influence on performance in mathematics. Specifically, the study sought to determine the following:

1) To determine the respondents' level of
   a) Mathematics Performance
   b) Mindset
   c) Self-control
2) To determine if a significant difference exists in mathematics performance, mindset, and self-control when grouped according to sex.

2. Research Methods

This study used a descriptive-quantitative research design. According to Bhat (2018), descriptive research is a research method that involves observing behavior to objectively and meticulously describe attributes. A descriptive research endeavor seeks to understand phenomena or groups comprehensively. This research method best suits the objectives of this present research since its primary goal was to statistically describe the differences inmathematics performance, mindset, and self-control of the respondents based on sex.

This study's respondents are 150 1st-year students (107 male and 43 female) from the College of Engineering, College of Architecture, and College of Communication and Information Technology of Nueva Ecija University of Science and Technology. In addition, the respondents were selected using a purposive sampling technique. Hence, student-respondents must bein STEM courses and enrolled in a Mathematics Class.

This paper utilized a survey questionnaire as a primary tool for data gathering. It enables the researchers to gather information from large samples with minimal time and resources. The Mindset Questionnaire was adapted from the study of Diehl (2008). This instrument comprised 20-item questions aimed at the measured extent of growth mindset and fixed of students. 13-item Self-control Scale, this survey questionnaire was taken from the study by Stewart (2015).

The statistical tools used in this study were frequency count, percentage, weighted mean, standard deviation, and Independent T-test.

3. Results and Discussion

3.1 Determine the respondents' level of Mathematics Performance, Mindset in learning mathematics, and Extent of Self-control.

Table 1: Level of Mathematics Performance of the Students

Mathematics Performance	f	%	Mean	SD
Outstanding	8	5.33%	87.44	4.31
Very Satisfactory	45	30%		
Satisfactory	61	40.67%		
Unsatisfactory	31	20.67%		
Poor	5	3.33%		
Total	150	100%		

It can be observed that the respondents' Mathematics Performance has a general weighted mean of 87.44 with a standard deviation of 4.31. The table also shows that 61, or 40.67%, of the respondents, performed *satisfactorily*, 45, or 30%, performed *very satisfactorily*, and 31, or 20.67%, performed *unsatisfactorily*. It must be noted that only 5 or 3.33% performed *outstandingly* in Mathematics. The data reveals that students had *satisfactory* performance in mathematics. Thus, most students perform at an average level in mathematics.

The data indicate that a substantial portion of the student population accomplishes satisfactory or higher levels in mathematics, with room for improvement among the remaining students.Almerino et al. (2020) found similar results, concluding that most state university students performed very well academically, and their study orientation was generally above average. However, in the 2018 Programme for International Student Assessment (PISA) mathematics assessment, Filipino pupils exhibited subpar performance, as over 50% achieved scores below the minimum competency threshold. Hence, there is a difference in the local and international assessments of students' mathematics performance.

Table 2: Students' Mindset in Learning Mathematics

MINDSET	f	%	Mean	SD
Strong Growth Mindset	16	10.67%	2.84	0.28
Growth Mindset with some Fixed ideas	114	76%		
Fixed mindset with some Growth ideas	20	13.33%		
Strong Fixed Mindset	0	0.00%		
Total	150	100%		

Table 2 shows that the respondents' mindset in learning Mathematics garnered a general weighted mean is 2.84 with a standard deviation of 0.28. The table also displays that 114 out of 150 or 76% of respondents have a *growth mindset with some fixed ideas*, 20 or 13.33% have a *fixed mindset with some growth ideas*, while only 16 or 10.67% of the students hold a *strong growth mindset* in learning Mathematics. Note that the results show that no respondents were identified as having a *strong fixed mindset*. Hence,

most students have a "growth mindset with some fixed ideas" toward learning mathematics.

The research suggests that most students believe that their cognitive abilities and capacity to acquire knowledge in a given field may be enhanced and cultivated to a certain degree via diligent effort and commitment. Nevertheless, individuals may experience lingering uncertainties over their talents at a certain juncture. Dweck (2016) explains that individuals with a growth mindset believe their talents can be developed through hard work, good strategies, and input from others. They tend to achieve more than those with a more fixed mindset (those who believe their talents are innate gifts) because they worry less about looking smart and focus more on learning. Thus, these individuals are characterized by their diligent efforts and ability to maintain concentration in challenging circumstances. Individuals with a growth mindset exhibit a proclivity for actively pursuing challenges and flourishing in the face of such obstacles.

Table 3: The extent of Students' Self-Control

Self-Control	f	%	Mean	SD
Excellent	3	2%	2.34	0.33
Good	40	26.67%		
Average	97	64.67%		
Poor	10	6.6%		
TOTAL	150	100%		

Table 3 shows the extent of respondents' self-control, having 2.34 as the general weighted mean with a standard deviation of 0.33. The table shows that 97, or 64.67%, respondents hold *average* self-control, 40, or 26.67%, possess *good* self-control, and 10, or 6.6%, have *poor* self-control. However, only 2% of the respondents hold *excellent* self-control. Therefore, it can be noted that most of the student respondents hold *average* self-control.

Baumeister (2018) reveals that there exists a positive correlation between elevated levels of self-control and various desirable outcomes, including a higher grade point average, improved adjustment (as seen by reduced instances of psychopathology and greater levels of self-esteem), decreased occurrences of binge eating and alcohol abuse, enhanced interpersonal skills and relationships, stable attachment, and more favorable emotional reactions. The tests conducted to assess curvilinearity did not reveal any limitations associated with the concept of overcontrol. Furthermore, the beneficial impacts of overcontrol persisted even after accounting for the influence of social desirability. Therefore, low self-control is a noteworthy risk factor for a wide array of personal and interpersonal difficulties.

Moreover, the research conducted by Yang, Zhao, Chen, Simeng, and Zhao (2017) showed that students possessing moderate self-control could consciously modify or alter their internal reactions to attain their desired objectives in Mathematics education. Nevertheless, individuals may find themselves enticed to engage in activities that deviate from their intended objectives, perhaps diverting their attention away from the pursuit of studying Mathematics. Likewise, students with high self-control demonstrate enhanced capacity to resist temptations and successfully govern their learning processes.

3.2 Determine if a significant difference exists in mathematics performance, mindset, and self-control when grouped according to sex.

Table 4: The difference in Mathematics Performance when grouped based on sex

Sex	f	Mean	SD	t-value	p-value
Male	107	87.27	.63	1.053	.138
Female	43	86.87	.51		

To determine if there was a significant difference in mathematics performance when grouped according to sex, an independent T-test was utilized with a 5% level of significance. The analysis results show no significant difference in the mathematics performance of the student when grouped according to their sex (t = 1.053, p = .138). Therefore, male and female respondents have similar performance in mathematics. Sex is not a factor in the difference in mathematics performance.

The findings of the current study negate the previous research of Anjum (2015), wherein a significant difference in mathematics achievement and reading comprehension was found between males and females in the upper primary school stage.

Table 5: The difference in mindset when grouped based on sex

Sex	f	Mean	SD	t-value	p-value
Male	107	2.85	.29	.193	.856
Female	43	2.84	.25		

Table 5 shows the statistical analysis to determine the difference in mindset in learning mathematics based on sex. A T-test was used to test with a 5% level of significance. The analysis shows no significant difference in mindset in learning mathematics when grouped according to sex since the p-values are less than .05 or p = .856 (t = .193). As shown in the table, the mean mindset of the male is 2.85 while the females are 2.84. The results were reasonable since the difference was negligible. Consequently, male and female respondents have the same mindset in learning mathematics.

The analysis results do not match the earlier findings that males and females significantly differ in persistence. However, females are more likely to persist than males (Brown &Kanyongo, 2010).

Table 6: The difference in Self-Control when grouped based on sex

Sex	f	Mean	SD	t-value	p-value
Male	107	2.34	.34	.100	.921
Female	43	2.34	.30		

Table 6 displays the analysis to distinguish the difference in self-control when grouped according to sex. Again, an Independent T-test was utilized with a 5% significance level. The data analysis reveals no significant difference in the self-control of the student-respondents when grouped based on their sex since the p-value was less than .05 (t = .100, p = .921). The result was logical since both male and female respondents have exactly the weighted mean of 2.84. Thus,

male and female respondents demonstrate a similar level of self-control.

The study's findings are consistent with Gasco, Goni&Villaroel (2014), who found no sex difference in math motivation (value, cost, self-efficacy) of grade 9 students. Both men and women value the mathematical task similarly and perceive the effort to study this matter.

4. Conclusions

Based on the findings, the researcher drew the following conclusions. The study out that the respondents were primarily male. Most of the STEM students generally perform at an average level in mathematics. Most STEM students believe that their intelligence and ability to learn mathematics, to some extent, can be further improved and developed through hard work and dedication. It can be noted that the majority of the student respondents hold average self-control. Moreover, male and female STEM students have similar mathematics performance, mindset, and self-control. Thus, males and females are equally equipped with cognitive and non-cognitive domains to succeed in STEM courses.

5. Recommendations

This study's findings have several important implications for future practice. The researcher recommends that Guidance Counselors may encourage female students to enroll in STEM courses. Sex must not be the basis of their course selection. Everyone can become successful in the STEM field. School Administrators and Teachers must promote gender equality in school to provide a conducive learning environment for all. Furthermore, Parents should not discourage their daughters from taking STEM courses. Instead, they must be supportive and provide guidance.

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