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A Demographic Analysis of Mathematics Engagement among Mathematics Students

Mark Angelo I. Tugade*

School of Graduate Studies, Saint Mary's University, Bayombong, Nueva Vizcaya, Philippines
*Corresponding author: hed-matugade@smu.edu.ph

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Abstract This study examined the mathematics engagement of Bachelor of Secondary Education (BSEd) major in Mathematics students at Nueva Vizcaya State University, Bayombong Campus. A descriptive-comparative and correlational research design was employed, involving a total of 46 student-respondents who completed a survey questionnaire. Data were analyzed using descriptive statistics, Mann-Whitney U Test, Kruskal-Wallis Test, and Spearman's Rho. Findings revealed that students were engaged in mathematics across the behavioral, emotional, and cognitive dimensions. No significant differences in mathematics engagement were observed across age, year level, and socio-economic status; however, male students exhibited significantly higher emotional engagement than their female counterparts. Furthermore, age of the students showed no significant association with their engagement in mathematics. The study recommends that mathematics teachers adopt strategies that sustain student attentiveness, foster confidence in facing challenging tasks, and cultivate positive attitudes toward mathematics learning.

Keywords: *behavioral, cognitive, demographic factors, emotional engagement, student engagement*

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1. Introduction

Mathematics plays a vital role in everyday life as it helps every individual understand and make sense of the world. From simply budgeting money, making schedules, and organizing time to analyzing information and solving everyday problems, mathematics is needed. In short, mathematics is more than just a number, an equation, or a procedure. It is a powerful tool for developing critical thinking, problem-solving skills, and analytical skills that are crucial in today's knowledge-driven world [1]. Mangarin and Caballes [2] argue that mathematics is the backbone of many fields today, including science, technology, engineering, and mathematics, which are all essential for innovation. However, despite its significance, many students face mathematics with fear, anxiety, or disengagement, even just from simply hearing it.

Student disengagement, particularly in mathematics, is a global issue. Shabab [3] found that fear of failure or loss of aversion leads to disengagement in mathematics. Fitzmaurice et al. [4] emphasized that when students perceive mathematics as irrelevant, feel unappreciated or insufficiently knowledgeable, their interest and engagement decline. Akpalu et al. [5] further noted that students' positive perceptions toward mathematics, combined with engaging lessons, enhance motivation and performance, whereas negative attitudes because of anxiety, stereotypes, or limited resources result in disengagement and poor outcomes.

In the Philippines, Bonggo [6] pointed out that traditional methods of teaching mathematics can result in reduced motivation, disengagement, and poor grasp of key mathematical principles. Furthermore, in Cotabato, students recorded below-average performance, implying the need to develop students' engagement to achieve better learning outcomes [7]. The need to address these issues becomes more evident when looking at the results of international assessments, such as the Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS). According to the results of PISA 2022, Filipino students continue to perform poorly in mathematics, reading, and science, showing no significant progress since 2018 [8,9]. PISA 2022 also indicates worrying trends for the Philippines, including high levels of math anxiety, low self-efficacy, and only a small fraction of students attaining proficiency in mathematics [10]. Similarly, in the 2019 TIMSS, the Philippines ranked last among 58 participating countries, scoring 297 and 249 in Mathematics and Science, respectively [11,12]. These results suggest that there are still serious issues and challenges in the country's education system, not only in the mastery of content, but also possibly in teaching approaches, emotional experiences of students, lack of interest, motivation, and engagement.

Moreover, understanding how demographic factors relate to mathematics engagement is equally important. While prior studies have explored engagement broadly, findings on whether demographic variables such as age, sex, year level, and socio-economic status influence engagement remain inconsistent and inconclusive. Some studies suggest that sex differences [13] and year level [14] play a role in how students engage in mathematics, while others found no significant differences across age and sex [14]. Similarly, socio-economic status has been identified as a potential factor in mathematics learning, with evidence suggesting that students from different economic backgrounds differ in their mathematical competence and engagement [15]. However, these findings are largely context-dependent and may not generalize across different educational settings, particularly in the Philippine context, where cultural, institutional, and economic factors are unique. This inconsistency in the literature justifies the need to examine whether demographic profiles meaningfully differentiate engagement levels among mathematics students in a local university setting. Thus, this study sought to investigate mathematics engagement, particularly from behavioral, emotional, and cognitive perspectives, among college students. Identifying which demographic factors are associated with differences in engagement can help educators design more targeted and responsive instructional strategies to improve engagement and overall learning experiences.

1.1. Research Questions

This study aimed to determine the engagement in mathematics of Bachelor of Secondary Education major in Mathematics students. Specifically, this study sought to answer the following:

1. What is the level of engagement in mathematics of the respondents in terms of:
   1.1. behavioral engagement;
   1.2. emotional engagement; and
   1.3. cognitive engagement?
2. Is there a significant difference in the mean score of engagement in mathematics when grouped by the following profile variables:
   2.1. age;
   2.2. sex;
   2.3. year level; and
   2.4. socio-economic status?
3. Is there a significant relationship between the respondents' age and engagement in mathematics?

2. Research Methodology

2.1. Research Design and Sample

This study utilized a descriptive-comparative and correlational research design. Descriptive design was used to describe the respondents' level of engagement in mathematics. Comparative design was used to determine whether a significant difference existed in engagement in mathematics across the profile variables. Furthermore, correlational design was employed to determine the relationship between the respondents' age and their engagement in mathematics.

The targeted respondents of this study were the Bachelor of Secondary Education (BSED) major in Mathematics students from Nueva Vizcaya State University (NVSU), Bayombong Campus. NVSU, for the third consecutive year, earned global recognition by ranking 201-250 in the Top 400 of the 2025 World University Rankings for Innovation (WURI). The program had a total of 64 students: 15 first-year, 15 second-year, 13 third-year, and 21 fourth-year students. The study employed a combination of convenience and voluntary response sampling. Students were initially reached based on availability; however, participation was voluntary, and only those who willingly responded answered the questionnaire. As a result, 46 students participated in the study. The distribution of the respondents' profile is shown in the table below.

Table 1. Profile of the Respondents

Profile	Categories	Frequency	Percent
Age	18	7	15.2
	19	8	17.4
	20	9	19.6
	21	9	19.6
	22	7	15.2
	23	4	8.7
	24	2	4.3
Sex	Male	12	26.1
	Female	34	73.9
Year Level	1st Year	8	17.4
	2nd Year	11	23.9
	3rd Year	8	17.4
	4th Year	19	41.3
Socio-Economic Status (SES)	Low	16	34.8
	Middle	30	65.2
	High	0	0.0
Total		46	100.0

As shown in Table 1, most of the 46 respondents were 20 or 21 years old, with 9 (19.6%) in each age group. The remaining were 19 years old (8, 17.4%), 18 years old (7, 15.2%), 22 years old (7, 15.2%), 23 years old (4, 8.7%), and 24 years old (2, 4.3%). In terms of sex, there were more female (73.9%) than male respondents (26.1%). Most of the respondents were fourth-year students (41.3%), followed by second-year students (23.9%), and first-year and third-year students (17.4% each). Regarding socio-economic status, the majority considered middle class (65.2%), 30 (34.8%) identified as low status, while none identified as high status.

2.2. Data Collection and Instruments

This study utilized a two-part questionnaire. The first part gathered the profile of the respondents, including their name, age, sex, year level, and socio-economic status. The second part consisted of a 4-point Likert scale instrument that measured their behavioral, emotional, and cognitive engagement in mathematics. This engagement questionnaire was adopted from the study of Flores et al. [16] and was composed of a total of 33 statements: 11 measuring behavioral engagement, 10 assessing emotional engagement, and 12 evaluating cognitive engagement. The scale ranged from strongly agree to strongly disagree, scored from 4 to 1, respectively.

Data collection was conducted through social media platforms, specifically Facebook Messenger and Google Forms. The researcher communicated with the class advisers to obtain permission to gather data from the students. Afterward, a message was sent to the representatives of each year level, consisting of an introduction of the researcher, the purpose of the research, a request for consent to participate, and an assurance of the confidentiality of their responses. The respondents were then instructed to answer the questionnaire during their free time to avoid disruption of classes.

2.3. Data Analysis

After data collection, statistical analysis was performed using Microsoft Excel and IBM SPSS Statistics to achieve the objectives of the study. Descriptive statistics such as frequency count and percent distribution were used to describe the profile of the respondents and their level of engagement in mathematics. Mean and standard deviation were utilized to describe the level of engagement for each statement, and the mean was interpreted qualitatively as shown in Table 2. All negative statements in the questionnaire were reverse-scored before analysis to ensure that a higher score consistently indicated a higher level of engagement.

For inferential analysis, a preliminary analysis was conducted prior to selecting the appropriate tests to determine whether parametric or non-parametric tests were more appropriate. Since the study did not employ random sampling, the assumption of random selection required for parametric tests was not met. In addition, the Shapiro-Wilk test was performed to assess the normality of the data within each group. Results revealed that several subgroups violated the assumption of normality, including behavioral engagement among 22-year-old students ($W = .799$, $p = .040$), female students ($W = .904$, $p = .006$), first-year students ($W = .818$, $p = .045$), fourth-year students ($W = .878$, $p = .020$), and middle-SES students ($W = .889$, $p = .005$), as well as emotional engagement among male students ($W = .854$, $p = .041$) and fourth-year students ($W = .882$, $p = .023$). Given that normality was not consistently met across groups, combined with the non-random sampling design, non-parametric tests were deemed more appropriate. Thus, the Mann-Whitney U Test was used for comparing two independent groups, such as sex and socio-economic status, the Kruskal-Wallis Test for three or more independent groups, such as age and year level, and Spearman's Rho for the relationship between the respondents' age and their engagement in mathematics.

Table 2. Guide for Interpretation

Mean Range	Level of Engagement
1.00-1.75	Highly Not Engaged
1.76-2.50	Not Engaged
2.51-3.25	Engaged
3.26-4.00	Highly Engaged

3. Results and Discussion

Table 3 illustrates the level of engagement in mathematics of the students. In all three dimensions, the majority of the respondents were engaged. Specifically, 82.6% were engaged behaviorally, 78.3% emotionally, and 80.4% cognitively. The results also reveal that the level of engagement in mathematics varied among the students. Some were highly engaged behaviorally (8.7%), emotionally (10.9%), and cognitively (8.7%), while others were not engaged behaviorally (8.7%), emotionally (10.9%), and cognitively (10.9%).

Research shows that student engagement in mathematics has dimensions, which involve behavioral, emotional, cognitive, and every learner exhibits their engagement differently. For instance, some demonstrate higher cognitive engagement through tasks, while others vary in behavior by participation and emotional interest [17].

This implies that engagement is multifaceted, highlighting the need to maximize students' learning and positive experiences in mathematics through differentiated, meaningful, and relevant activities that target all dimensions.

Table 3. Level of Behavioral, Emotional, and Cognitive Engagement in Mathematics

Level	Behavioral		Emotional		Cognitive	
	f	%	f	%	f	%
Highly Not Engaged	0	0	0	0	0	0
Not Engaged	4	8.7	5	10.9	5	10.9
Engaged	38	82.6	36	78.3	37	80.4
Highly Engaged	4	8.7	5	10.9	4	8.7
Total	46	100.0	46	100.0	46	100.0

Table 4 portrays the level of behavioral, emotional, and cognitive engagement for each statement. All statements were rated by the respondents as either not engaged, engaged, or highly engaged. Behaviorally, the respondents engaged in mathematics through activities such as listening to the teacher, working hard, reviewing math problems, following directions, and asking for help when needed. However, the respondents were easily distracted, skipped difficult questions, and pretended to study, but they did not stop working on difficult math problems. Overall, a mean of 2.9328, indicates that the respondents were behaviorally engaged. Cevikbas and Kaiser [18] found that students' behavioral engagement improved and changed through instructional approaches that encourage active participation, such as flipped classrooms. This indicates that students are generally behaviorally engaged in mathematics; however, some distractions and task avoidance behaviors were observed that need to be addressed. Thus, engagement can be improved through strategies that encourage active participation.

The emotional engagement of the respondents is generally engaged with an overall mean of 2.9543. This indicates that the respondents tend to experience positive feelings and interest toward the subject. Furthermore, they considered learning mathematics enjoyable, as reflected in their willingness to attend class and their low levels of boredom. However, some students reported a preference for other subjects over mathematics. Students who are emotionally engaged tend to enjoy mathematics more and feel more confident in their ability to succeed. Moreover, providing relevant and real-life applications of mathematics can boost students' interest and motivation, which are essential components of emotional engagement [19].

The cognitive engagement of the respondents indicates that students are generally engaged, with a mean of 2.9511. This suggests that the students think about mathematical concepts and apply strategies to solve problems. Notably, they expressed a strong desire to get good grades in mathematics. They also reported engaging attitudes, including asking themselves questions to check their understanding, connecting math to real-life situations, trying different approaches, developing their own strategy for solving problems, setting goals, maintaining focus, and memorizing important concepts. On the contrary, some respondents relied on guessing answers and thought of other things while studying math. These findings align with the study of Jie et al. [20] about junior high school students' cognitive engagement, which strongly correlates with their mathematical achievement. This suggests that students who actively think and apply strategies tend to perform better academically.

Table 4. Level of Behavioral, Emotional, and Cognitive Engagement of Each Statement

Statements	Mean	Std. Deviation	Qualitative Description
Behavioral Engagement			
1. I listen to my teacher in my math class.	3.50	.658	Highly Engaged
2. I participate in the discussion in math class	3.20	.687	Engaged
3. I get easily distracted in math class	2.41	.805	Not Engaged*
4. I work hard in math class	3.22	.728	Engaged
5. At home I review math problems that I did not understand in school	2.76	.736	Engaged
6.When I see difficult math problems, I stop working on them.	2.78	.841	Engaged*
7. Sometimes I skip difficult math questions	2.35	.766	Not Engaged*
8.When I make mistakes in math, I work until I correct them.	3.13	.687	Engaged
9. I follow my teacher's directions in math class.	3.24	.603	Engaged
10. I sometimes act out as if I am studying in math class.	2.46	.721	Not Engaged*
11. I ask my friends or teachers for a help when I can't solve math problems.	3.22	.814	Engaged
Overall	2.9328	.39900	Engaged
Emotional Engagement			
1. I am interested in learning new things in math.	3.37	.679	Highly Engaged
2. I do not like attending math classes.	3.39	.649	Highly Engaged*
3. Learning math is fun.	3.33	.598	Highly Engaged
4. I feel excited when I study in math class.	3.07	.611	Engaged
5. I feel bored when I study in math.	3.02	.745	Engaged*
6. I am excited about solving difficult math problems.	2.83	.643	Engaged
7. I like to study other subjects rather than math.	2.35	.994	Not Engaged*
8.Time passes very quickly when I study math.	3.00	.667	Engaged
9. I forget where I am when I study math	2.39	.682	Not Engaged
10. I want to spend more time solving math problems.	2.80	.719	Engaged
Overall	2.9543	.40918	Engaged
Cognitive Engagement			
1. I want to get good grade in math class.	3.63	.741	Highly Engaged
2. Sometimes I follow my best guess when I do not the answer	1.80	.654	Not Engaged*
3.When I study math, I ask myself questions to make sure I understand it correctly	3.24	.673	Engaged
4. I try to connect math to real life situations.	3.15	.631	Engaged
5. I try to think different ways to solve math problems.	3.09	.590	Engaged
6. I try to develop my own strategy when I solve math problems	3.00	.632	Engaged
7. I set goal for myself when I study math.	3.11	.674	Engaged
8.When I can't solve a math problem, I try to change my strategy.	3.11	.567	Engaged
9. I often think about something else when I study math.	2.28	.720	Not Engaged*
10. At home I think about what I learned in math class.	2.83	.709	Engaged
11. I am focused when I study math.	3.04	.759	Engaged
12. I memorize important facts to understand math better.	3.13	.582	Engaged
Overall	2.9511	.35857	Engaged

Note: (*) indicates reverse-scored items. Values shown are already recoded.

Table 5 shows the comparison of the mean engagement in mathematics of the students when grouped by age. The Kruskal-Wallis test reveals that although 22-year-old students had the highest mean behavioral engagement (M=30.50), 23-year-old students had the highest mean emotional engagement (M=29.88), and 18-year-old students had the highest mean cognitive engagement (M=28.36), there was no significant difference in engagement across age groups. This is supported by the nonsignificant test results: H=4.881, p=.559 for behavioral engagement, H=3.429, p=.753 for emotional engagement, and H=1.712, p=.944 for cognitive engagement. This implies that, regardless of age, BSED major in Mathematics students had the same levels of engagement in mathematics. These findings support the study of Gutierrez and Doronio [14], who found no significant difference between students' age and their engagement in mathematics. In contrast, Maulana et al. [21] reported that older students tend to exhibit higher levels of perceived emotional engagement.

Table 5. Kruskal-Wallis Test Result of Engagement in Mathematics when Grouped by Age

Engagement in Mathematics	Age	N	Mean Rank	Test Statistics
Behavioral Engagement	18	7	25.93	H = 4.881, p = .559
	19	8	17.81	
	20	9	19.22	
	21	9	23.89	
	22	7	30.50	
	23	4	24.50	
	24	2	28.75	
Emotional Engagement	18	7	23.57	H = 3.429, p = .753
	19	8	25.50	
	20	9	18.00	
	21	9	21.17	
	22	7	26.21	
	23	4	29.88	
	24	2	28.25	
Cognitive Engagement	18	7	28.36	H = 1.712, p = .944
	19	8	24.25	
	20	9	21.67	
	21	9	20.67	
	22	7	23.36	
	23	4	25.63	
	24	2	20.75	

Table 6. Mann-Whitney U Test Result of Engagement in Mathematics when Grouped by Sex

Engagement in Mathematics	Sex	N	Mean Rank	Test Statistics
Behavioral Engagement	Male	12	25.04	U = 185.500, p = .641
	Female	34	22.96	
Emotional Engagement	Male	12	31.79	U = 104.500, p = .012*
	Female	34	20.57	
Cognitive Engagement	Male	12	25.58	U = 179.000, p = .530
	Female	34	22.76	

*Significant at 0.05

Table 6 shows the comparison of mean engagement in mathematics of male and female respondents. Male respondents had higher engagement in mathematics in terms of behavioral (M=25.04) and cognitive (M=25.58) aspects than female respondents. However, the Mann-Whitney U test indicated that these differences were not statistically significant. Male respondents also recorded higher emotional engagement (M=31.79) compared to female respondents (M=20.57). This difference was statistically significant at 0.05 level, as supported by the Mann–Whitney U test result: U=104.500, p=.012. This implies that male respondents exhibited significantly higher emotional engagement in mathematics than female respondents. These results align with the findings of Bearneza [13], who reported that male students exhibited significantly higher learning engagement in mathematics than female students, particularly in areas such as attentiveness during lessons, timely submission of assignments, effort to understand mathematical concepts, and feeling challenged in class.

Table 7 illustrates the comparison of mean engagement in mathematics when grouped by year level. As shown in the table, first-year students had the highest mean behavioral engagement (M=27.88), emotional engagement (M=25.25) and cognitive engagement (M=29.38) across all year level groups. However, the nonsignificant Kruskal-Wallis test results (H=5.124, p=.163, for behavioral engagement; H=.893, p=.827 for emotional engagement; and H=1.926, p=.588 for cognitive engagement) implies that the engagement of students in mathematics did not differ significantly across year levels. In contrast, Gutierrez and Doronio [14] found a statistically significant difference in the level of mathematical engagement across grade levels.

Table 7. Kruskal-Wallis Test Result of Engagement in Mathematics when Grouped by Year Level

Engagement in Mathematics	Age	N	Mean Rank	Test Statistics
Behavioral Engagement	1st Year	8	27.88	H = 5.124, p = .163
	2nd Year	11	16.41	
	3rd Year	8	21.63	
	4th Year	19	26.55	
Emotional Engagement	1st Year	8	25.25	H = .893, p = .827
	2nd Year	11	22.86	
	3rd Year	8	19.88	
	4th Year	19	24.66	
Cognitive Engagement	1st Year	8	29.38	H = 1.926, p = .588
	2nd Year	11	23.00	
	3rd Year	8	21.69	
	4th Year	19	22.08	

Table 8 shows the mean comparison of students' engagement in mathematics according to socio-economic status. As shown, students from the middle socio-economic status exhibited higher mean behavioral engagement (M=23.88) than those from low socio-economic status (M=22.78). Conversely, students from low socio-economic status exhibited higher mean emotional engagement (M=27.69) and cognitive engagement (M=27.09) as compared to the middle-status students. However, these differences were not statistically significant based on the Mann-Whitney U test results: U=228.500, p=.790 for behavioral engagement; U=173.000, p=.121 for emotional engagement; and U=182.500, p=.183 for cognitive engagement. These findings suggest that students' engagement in mathematics does not differ significantly based on socio-economic status. Haataja et al. [15] reported a significant correlation between students' socio-economic status and mathematics learning, suggesting that higher SES leads to better mathematics performance.

Table 9 presents the Spearman's Rho Correlation between students' age and their engagement in mathematics. As shown, there were weak positive correlations between students' age and both behavioral engagement (ρ=0.168, p-value=0.264) and emotional engagement (ρ=0.101, p-value=0.503). This suggests a direct relationship between the variables, meaning students' behavioral and emotional engagement tend to increase as students grow older. Meanwhile, a weak negative correlation was observed between age and cognitive engagement (ρ=-0.099, p-value=0.511), implying an inverse relationship where cognitive engagement decreases as students age. However, these relationships were not statistically significant, indicating that age does not have a meaningful effect on students' engagement in mathematics within this specific sample. In contrast to the nonsignificant relationship found in this study, Covas and Veiga [22] reported that, in higher education, older students had significantly higher engagement than the younger ones, especially in terms of agentic, behavioral, and cognitive engagement.

Table 8. Mann-Whitney U Test Result of Engagement in Mathematics when Grouped by Socio-Economic Status (SES)

Engagement in Mathematics	SES	N	Mean Rank	Test Statistics
Behavioral Engagement	Low	16	22.78	U = 228.500, p = .790
	Middle	30	23.88	
Emotional Engagement	Low	16	27.69	U = 173.000, p = .121
	Middle	30	21.27	
Cognitive Engagement	Low	16	27.09	U = 182.500, p = .183
	Middle	30	21.58	

Table 9. Spearman's Rho Correlation between Respondents' Age and Engagement in Mathematics

	Behavioral Engagement		Emotional Engagement		Cognitive Engagement	
	ρ	p-value	ρ	p-value	ρ	p-value
Age	0.168	0.264	0.101	0.503	-0.099	0.511

4. Conclusions and Recommendations

The study found that the Bachelor of Secondary Education (BSED) major in Mathematics students were generally engaged in mathematics across behavioral, emotional, and cognitive dimensions. Engagement levels did not vary significantly based on age, year level, or socio-economic status, indicating that these demographic factors do not meaningfully influence students' mathematical engagement. However, a significant difference was observed in emotional engagement regarding sex, with male students showing higher emotional engagement than their female counterparts. Correlation analysis further confirmed that age had no significant relationship with engagement in mathematics. Overall, these findings highlight that students' engagement is consistent regardless of demographic profiles, except for emotional differences by sex.

Based on the findings, it is recommended that mathematics teachers adopt strategies that keep them attentive, encourage them to face difficult tasks with confidence, and build positive emotions toward learning, particularly among female students since they showed lower emotional engagement. Teachers are also encouraged to evaluate the effectiveness of their instructional approaches and make adjustments based on student feedback. Given that demographic variables did not significantly influence engagement, educators should prioritize high-quality teaching, enhanced motivational practices, and a conducive learning environment over demographic considerations. This study, however, has limitations, including a small sample size, the use of Likert-scale questionnaire, and respondents from only one academic program. Thus, it is recommended that future researchers include larger samples, including those from other course/programs, and use qualitative methods, such as interviews, for more detailed and deeper insights.

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