ISA Journal of Multidisciplinary (ISAJM)

Homepage: https://isapublisher.com/isajm/

Volume 3, Issue 2, March-April, 2026 ISSN: 3049-1851

Mathematics Grit and Performance of Senior High School Students: Basis for Pedagogical Intervention

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Received: 11.03.2026 | **Accepted:** 13.04.2026 | **Published:** 13.04.2026

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DOI: *10.5281/zenodo.19558303*

Abstract **Review Article**

Achievement in statistics and probability mathematics is one of the issues that many senior high school learners are facing, and thus there is a need to investigate the factors that affect learning, not only cognitive but also non-cognitive. This study sought to determine the effect of mathematics grit on performance in mathematics among Grade 11 learners enrolled in public senior high schools in Cordon, Isabela for the second semester in School Year 2025-2026. This study used theories such as Grit Theory, Social Cognitive Theory, and Growth Mindset Theory. The research design used was quantitative correlation design involving 196 respondents sampled using stratified systematic sampling. The findings showed that the students exhibited very high mathematics grit levels in all the domains, but in terms of performance, the proficiency level was low. Differences in selected domains of grit were also found among the groupings based on sex and academic strands. According to the results obtained from the Pearson correlation test, there is a significant but weak positive correlation between mathematics grit and performance. The finding implies that even though perseverance plays an important role in engagement, it is not enough in achieving high performance on its own.

Keywords: Mathematics Grit, Performance, Descriptive-Correlational Design, Senior High Students, Statistics and Probability.

Introduction

Mathematics has an important role in developing learners' logical reasoning, analytical thinking, and decision-making skills needed in both academic and real-life situations. One essential component of senior high school mathematics is Statistics and Probability, which enables students to interpret data, analyze uncertainty, and make evidence-based conclusions (DepEd, 2020). Despite its importance, difficulty in mastering concepts is evident to many learners (OECD, 2023). Students' academic performance is influenced not only by cognitive ability but also by non-cognitive factors.

One non-cognitive factor that has gained increasing attention in mathematics education is grit. It refers to sustained perseverance and effort of an individual despite challenges and difficulties for a long period of time. These characteristics support

students in working through difficult learning situations; however, persistence alone does not always guarantee improved performance without appropriate instructional support. Learners with higher levels of grit tend to remain engaged in challenging mathematical tasks and persist in solving problems despite difficulties (DiNapoli, 2023). Understanding how grit relates to students' performance may therefore provide meaningful insights to improve classroom instruction. With a growing interest in persistence-related variables in mathematics learning, limited local research has examined the relationship between mathematics grit and students' performance among senior high school learners. In response to this gap, this study grounded on Grit Theory (Duckworth et al., 2007), Social Cognitive Theory (Bandura, 1997), and Growth Mindset Theory (Dweck, 2006). It determined the mathematics grit and mathematical performance of Grade 11 students in public senior high schools in Cordon, Isabela during the School Year 2025–2026, second semester. The findings served as a basis for proposing pedagogical interventions to strengthen students' conceptual understanding while sustaining their persistence in learning Statistics and Probability.

Methodology

This study employed a quantitative correlational research design to examine the relationship between mathematics grit and performance in Statistics and Probability. The participants consisted of 196 grade 11 students from four public senior high schools in Cordon, Isabela during the second semester of School Year 2025–2026. Stratified systematic sampling was used to ensure proportional representation across schools and sex.

Two instruments were used in the study. Mathematics grit was measured using the Academic Grit Scale adapted from Clark and Malecki (2019) which was contextualized for mathematics learning and pilot tested. The instrument consisted of 20 items distributed across four domains: task persistence ($\alpha = 0.710$), effort investment ($\alpha = 0.703$), goal commitment ($\alpha = 0.712$), and resilience after failure ($\alpha = 0.758$), indicating acceptable internal consistency. To measure performance, Division of Isabela Standardized Diagnostic Test in Statistics and Probability was used, consisting of 40 items. Prior to data collection, permission was secured from the Schools Division Office and participating school principals. Respondents were properly oriented regarding the purpose of the study. Collected data were encoded, checked for completeness, and prepared for statistical analysis. Ethical standards were strictly observed through voluntary participation and confidentiality.

Descriptive statistics were used to describe respondents' profile and levels of mathematics grit and performance including frequency, percentage, mean, and standard deviation. To determine significant differences and relationships among variables, inferential statistics such as the independent samples t-test, one-way analysis of variance (ANOVA), and Pearson product–moment correlation coefficient was applied.

Results and Discussions

Table 1. Demographic Profile of the Respondents

Profile	Particulars	Frequency	Percent
Sex	Male	101	51.53
	Female	95	48.47
Age	15 - 16 years old	101	51.53
Mean = 16.55	17 years old or older	95	48.47
Academic Strand	HUMMS	132	67.35

TVL	24	12.24
GAS or ABM	40	20.41

$n = 196$

Table 1 presents the demographic profile of the respondents. As shown in table, there were 196 respondents. It reveals that 101 or 51.53% of the respondents are male, while 95 or 48.47% are female, showing proportional distribution of respondents by sex, suggesting that both male and female perspectives are adequately represented in the study to minimize bias.

The learners have a mean age of 16.55 years. A total of 101 or 51.53% belong to the 15–16 age group, while 95 or 48.47% are 17 years old or older. This means that the respondents are generally within the typical age range of senior high school students, indicating developmental appropriateness for the study.

For the academic strand, the majority of the respondents were from the HUMSS strand, comprising 132 or 67.35%. This is followed by GAS/ABM with 40 or 20.41%, and TVL with 24 or 12.24%. It is important to note that these strands represent the available offerings across the four schools included in the study, and there are no STEM students in the sample.

Table 2. Mathematical Performance of the Respondents

Mean Percentage Score	SD	Performance Level
31.64	11.076	Low Proficient

The table above revealed the mathematical performance of the respondents. The computed mean percentage score of 31.64 with a standard deviation of 11.076 is interpreted as *Low Proficient* when it comes in performance level. This result indicates that the students demonstrated limited mastery of mathematical concepts and skills. The relatively high standard deviation suggests variability in student performance. This means that while some performed better, a considerable number still struggled with the subject. This highlights the need for improved instructional support in the said subject.

Table 3. Level of Mathematics Grit of the Respondents by Domain

Domain	Mean	SD	Interpretation
Task Persistence	3.00	.442	High
Effort Investment	2.88	.483	High
Goal Commitment	2.86	.493	High
Resilience After Failure	3.08	.454	High

The table above shows that the level of mathematics grit of the respondents, it can be gleaned that students demonstrated a high level of mathematics grit across all four domains. Among the domains, resilience after failure obtained the highest mean score (M = 3.08, SD = .454), indicating that students were able to remain engaged in solving mathematical tasks despite encountering difficulties. Meanwhile, goal commitment obtained the lowest mean score (M = 2.86, SD = .493), although it remained within the high-level range. The results suggest that the respondents possessed strong persistence-related characteristics in learning Statistics and Probability**.**

Table 4. Significant Differences in Mathematics Grit When Grouped According to Demographic Profile

Domain	Profile Variable	Test Used	Computed Value	p-value	Decision
Task Persistence	Sex	Independent samples t-test	2.158	.032	Reject Ho
Task Persistence	Academic Strand	One-way ANOVA	5.243	.008	Reject Ho
Goal Commitment	Academic Strand	One-way ANOVA	3.300	.045	Reject Ho
Resilience After Failure	Academic Strand	One-way ANOVA	5.240	.008	Reject Ho

Significant differences in mathematics grit when grouped according to demographic profile is shown in Table 4. The results above revealed a significant difference in task persistence when grouped according to sex (t = 2.158, p = .032), indicating that persistence in mathematics tasks varies between male and female learners. This finding supports previous studies showing differences in students' motivation and engagement patterns in mathematics across sex (Jeong et al., 2025; Rodríguez et al., 2020; Reschke et al., 2023). The result suggests the need for gender-responsive instructional strategies that promote sustained persistence and engagement among learners in mathematics.

Meanwhile, a significant difference also is observed in task persistence when grouped according to academic strand (t = 5.243, p = .008), indicating that students' persistence in mathematics varies across learning specializations. This may be explained by differences in strand-related learning experiences, as students in academically oriented strands such as ABM are more frequently exposed to analytical tasks that support sustained engagement in mathematics. Similar strand-based differences in motivation and learning engagement among senior high school learners have been reported in the studies of Bayocot et al. (2023) and Co & Dela Cruz (2025).

Similarly, differences in goal commitment were also evident across academic strands (t = 3.300, p = .045), indicating that students' level of commitment to mathematics learning may be shaped by their academic orientation and classroom experiences. This finding is consistent with studies suggesting that strand-specific learning environments influence students' engagement and persistence in subject-related tasks (Albiez, 2025; Cedantes et al., 2026), although some research suggests that persistence may remain relatively consistent regardless of academic grouping (Liang et al., 2025; Postigo et al., 2020). These results highlight the importance of implementing strand-responsive instructional strategies to sustain students' interest in mathematics learning.

In the same way, resilience after failure also differed significantly across academic strands ($t = 5.240$, $p = .008$), indicating that students' responses to challenges in mathematics may vary depending on their learning specialization. This supports previous findings showing that academic orientation and learning experiences influence how learners respond to setbacks and maintain persistence in academic tasks (Segal & Kalfon-Hakhmigari, 2025; DiNapoli, 2023). Providing strand-responsive instructional support may therefore help strengthen students' confidence and persistence when facing challenging mathematical tasks.

Table 5. Relationship between Mathematics Grit and Mathematical Performance of the Respondents

Domains	r - value	p-value	Decision	Interpretation
1. Task Persistence	0.238	< .001	Reject Ho	Weak correlation
2. Effort Investment	0.201	.005	Reject Ho	Weak correlation
3. Goal Commitment	0.248	< .001	Reject Ho	Weak correlation
4. Resilience After Failure	0.199	.005	Reject Ho	Very weak correlation

Table 5 shows relationship between mathematics performance and the different domains of mathematics grit among the respondents. The data reveals that all domains of mathematics grit have statistically significant relationships with mathematics performance, resulting to the rejection of the null hypothesis. Goal Commitment exhibits the highest correlation, suggesting that students who remain focused on their mathematical goals tend to perform slightly better. On the other hand, Resilience After Failure ($r = 0.199$) shows a very weak positive relationship, indicating that although the ability to recover from setbacks is important, its direct association with performance is relatively limited compared to the other domains. Nonetheless, the significant relationships suggest that mathematics grit plays an important factor in supporting students' learning engagement and performance in mathematics.

This align to the findings of Lam and Zhou (2021), Li and Li (2021), and Zhang and Mao (2022) who found that grit contributes positively to students' academic performance and engagement, although the relationship tends to be relatively weak. This suggests that strengthening students' persistence, effort investment, and goal commitment through appropriate classroom strategies may help support improvements in their mathematics performance.

Based on the results of this study, it can be concluded that the Grade 11 students demonstrated a generally high level of mathematics grit but achieved a low proficient level of performance in Statistics and Probability. Meanwhile, significant differences in selected grit domains were observed when grouped according to sex and academic strand, indicating that learners' persistence and engagement in mathematics may vary depending on their learning characteristics and academic orientation. On the other hand, no differences were found when grouped by age. In addition, mathematics grit also showed a significant but weak positive relationship with mathematical performance, indicating that persistence and resilience contribute to learning but does not strongly influence achievement. These findings suggest that improving students' mathematics performance should not rely solely on developing grit but must also be supported by effective instruction, appropriate learning materials, and meaningful classroom experiences that address both students' persistence and their learning needs.

Align with the findings of the study, several recommendations are proposed. Mathematics

teachers may provide structured guided practice, collaborative problem-solving activities, timely instructional feedback, and error-analysis discussions to strengthen students' understanding and persistence in Statistics and Probability (Wisniewski et al., 2020; Fitzsimons & Ní Fhloinn, 2024; Zhang & Fiorella, 2023; Ceballos et al., 2025; Dorner & Krammer, 2026). Since significant differences were observed across sex and academic strand, gender-responsive and strand-appropriate learning activities may further support students' participation and motivation in mathematics learning. Moreover, school administrators may support the implementation of intervention plans that promote positive learning behaviors and confidence in mathematics. Future studies may also explore additional variables such as mathematics anxiety, study habits, and instructional strategies to further explain students' performance in Statistics and Probability.

Acknowledgment:

The researcher would like to express her sincere gratitude and appreciation to those who generously shared their time, support, and expertise in making this study possible. The researcher would like to acknowledge and give special thanks to Dr. Nelson D. Guray, thesis adviser and statistician, for his valuable guidance, technical assistance, and encouragement throughout the completion of this research. The researcher also give credit to the Schools Division of Isabela for granting permission to conduct the study, as well as the school principals and Grade 11 students of the participating public senior high schools in Cordon, Isabela, for their cooperation and support during the conduct of the study.

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