



## Evaluating the Relationship between Grit and Mathematics Academic Achievement among Senior High School Students

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### ABSTRACT

**Purpose of the study:** This study aimed to assess the grit level of senior high school students in a Philippine high school and to analyze its relationship with their academic achievement in Mathematics.

**Methodology:** This study employed a quantitative descriptive-correlational research design. Data were gathered from Grade 12 students in the Cordillera Administrative Region (CAR), Philippines. The “Grit-S” Scale (Duckworth & Quin, 2009) was utilized with its reliability tested using Cronbach’s alpha (0.754). Sample size of 225 students was determined through Cochran’s formula. Data were treated using weighted mean and Pearson’s Product Moment of Correlation.

**Main Findings:** Students exhibited moderate levels of grit (overall  $\bar{x} = 3.20$ ) and very satisfactory mathematics achievement ( $\bar{x} = 85$ ). Using Pearson’s Product-Moment Correlation, a weak but statistically significant positive relationship was found between grit and mathematics academic achievement ( $r = 0.20$ ,  $p < 0.01$ ), indicating that grit has a limited but measurable association with students’ performance.

**Novelty/Originality of this study:** This study is among the first to investigate grit as a non-cognitive factor influencing Mathematics achievement in the Philippine senior high school context. By localizing the application of the Grit-S scale, it expands global research to a new cultural setting and highlights the role of perseverance in shaping academic outcomes, offering evidence-based insights for curriculum and instructional improvement.

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## 1. INTRODUCTION

Mathematics has consistently been recognized as both a foundational discipline and a persistent challenge within formal education. Despite its critical role in developing analytical reasoning and problem-solving skills, many learners perceive mathematics as difficult, intimidating, and anxiety-provoking. Shakuntala emphasized that learners’ fear of mathematics often stems not from the subject itself but from the manner in which it is taught [1]. Similarly, Shanker noted that negative early learning experiences contribute significantly to learners’ avoidance of mathematics and the development of unfavorable perceptions toward the subject [2]. Previous studies have described mathematics learning as a stressful experience characterized by tension and anxiety, which may limit students’ participation, confidence, and performance [3]-[6]. These experiences often result in persistent negative attitudes that affect academic achievement and long-term engagement with mathematics.

Educational research highlights the importance of instructional practices in shaping students' mathematics learning experiences. Effective teaching requires not only strong content knowledge but also a deep understanding of how learners process information and construct meaning. Bransford, Brown, and Cocking emphasized that meaningful learning occurs when instruction aligns with learners' cognitive processes and experiences [7]. Likewise, scholars have argued that teachers' pedagogical understanding and instructional approaches significantly influence mathematics achievement [8], [9]. When learning environments fail to promote conceptual understanding, students may view mathematics as abstract and inaccessible, reinforcing anxiety and disengagement [10]. As a consequence, mathematics anxiety has been found to negatively influence academic performance by limiting students' ability to manipulate numbers and solve mathematical problems effectively [5], [6].

While cognitive ability has traditionally been viewed as the primary determinant of academic success, contemporary research increasingly recognizes the contribution of non-cognitive factors to educational outcomes. Variables such as motivation, personality traits, and perseverance have been identified as important influences on students' learning processes and achievement [11], [12]. Among these factors, grit has emerged as a significant construct in educational psychology. Duckworth et al. defined grit as perseverance and passion directed toward long-term goals, emphasizing sustained effort and commitment despite setbacks and challenges [13]. Research suggests that persistence and effort regulation mediate the relationship between personality characteristics and academic achievement [14]. Moreover, non-cognitive qualities such as grit have been proposed to predict academic success beyond traditional measures of cognitive ability [15].

Empirical studies further support the role of grit within educational contexts. Non-cognitive traits have been associated with persistence, engagement, and achievement across multiple academic settings [16]-[18]. Specifically, grit has been linked to improved academic outcomes, student retention, and sustained motivation [19], [20]. In mathematics learning, where students frequently encounter complex and cognitively demanding tasks, perseverance may serve as a critical factor enabling learners to persist through challenges and maintain consistent academic effort. Personality-related factors have likewise been shown to influence mathematics learning and achievement by shaping learners' responses to academic demands [21]. However, findings remain inconclusive, as some studies report significant relationships between attitudes and mathematics achievement while others report weak or non-significant associations [22], [23]. These inconsistencies indicate the need for further examination of specific non-cognitive constructs that may influence mathematics performance within varying educational contexts.

Mathematics remains indispensable in everyday life and educational development. Acharya emphasized that mathematics serves as a fundamental tool for understanding the world and developing logical thinking [24]. Similarly, Anthony and Walshaw described mathematics as essential for participation in personal, social, and civic spheres [25]. Within the Philippine educational system, mathematics is positioned as a core subject in both basic and senior high school curricula, highlighting its importance in preparing learners for higher education and future careers [26]. Despite this emphasis, many students continue to struggle with mathematics achievement, suggesting that factors beyond cognitive ability warrant closer investigation.

Given the increasing recognition of non-cognitive factors in educational research, examining the influence of grit on mathematics achievement represents an important scholarly inquiry. Previous studies have encouraged further exploration of non-cognitive predictors across diverse educational and cultural contexts [11], [27]. Although research has explored personality, motivation, and attitudes in relation to academic performance, studies focusing specifically on grit and mathematics academic achievement among Filipino senior high school students remain limited. Addressing this gap is essential in understanding how perseverance may contribute to academic success within local educational environments.

Despite the growing body of international research on grit, there remains a limited number of empirical studies that examine its role within the Philippine senior high school context, particularly in relation to educational assessment and subject-specific achievement, such as Mathematics. Existing local studies have largely focused on cognitive outcomes or general academic performance, with minimal attention given to how non-cognitive constructs like grit may be systematically measured and integrated into assessment practices. Moreover, current assessment frameworks in Philippine basic education predominantly emphasize cognitive competencies, often overlooking non-cognitive factors that may influence students' learning processes and performance outcomes [28]. This gap highlights the need to contextualize grit within local educational settings and to examine its measurable association with academic indicators using appropriate statistical methods. Addressing this gap is timely and necessary, as understanding the role of perseverance in Mathematics achievement may provide additional bases for improving learner assessment, informing instructional strategies, and supporting student development in the K to 12 system [29].

Therefore, this study examines the relationship between grit and senior high school students' mathematics academic achievement within the Philippine educational context. By employing a correlational approach, the study not only determines the association between these variables but also contributes to the assessment of non-cognitive factors as measurable indicators of academic performance. The novelty of the study

lies in its contextualization of grit within the senior high school level and its integration into educational assessment discourse, where such constructs are often underexplored. Given the continuing challenges in mathematics achievement and the evolving demands of learner-centered education, this study is both timely and necessary. Its findings are expected to provide empirical evidence that may inform assessment practices, instructional strategies, and intervention programs aimed at fostering persistence and improving mathematics learning outcomes among senior high school students.

## 2. RESEARCH METHOD

### 2.1. Research Design

This study utilized a quantitative descriptive-correlational research design to examine the relationship between grit and mathematics academic achievement among senior high school students. The descriptive component of the design enabled the researcher to determine and present the existing levels of grit and academic performance, while the correlational component allowed for the statistical examination of the association between these variables. This approach was selected because it provides an objective and systematic means of analyzing relationships without manipulating or controlling variables, thereby preserving the natural context of the participants' experiences [30]. Through the use of mean, standard deviation, and Pearson's Product-Moment Correlation, the study aimed to determine whether variations in students' grit levels are significantly related to differences in their mathematics academic achievement, providing empirical evidence on the role of non-cognitive factors in academic outcomes [31].

### 2.2. Research Procedure

The research process commenced with the formulation of the research problem, which centered on determining the association between grit and mathematics academic achievement among senior high school students. This initial stage was followed by a thorough review of related literature to establish the study's theoretical grounding and to guide the identification of relevant variables and the selection of an appropriate research design [30].

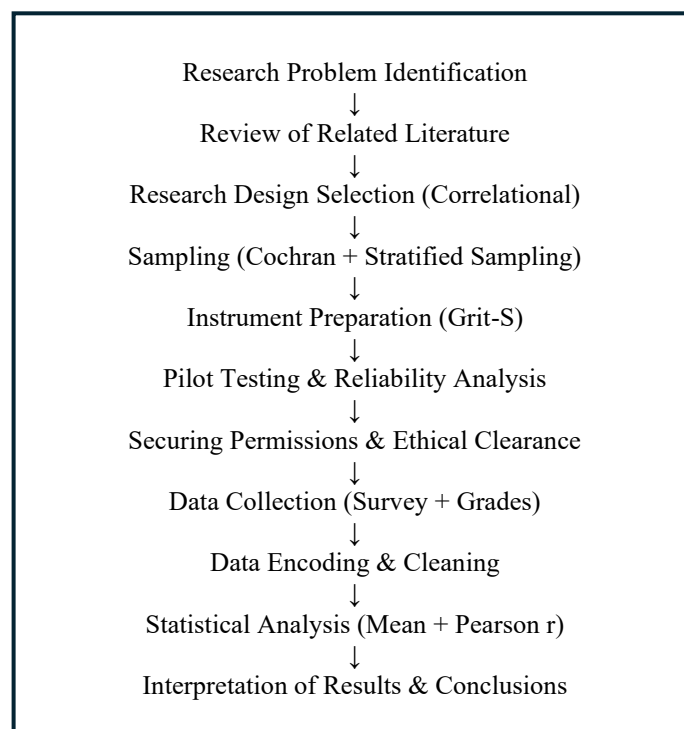


Figure 1. Research Procedure Flowchart

With the research framework in place, the study adopted a quantitative descriptive-correlational approach and identified the target population. The required sample size was calculated using Cochran's formula to ensure adequacy, while stratified sampling was employed to obtain proportional representation from the STEM, ABM, and HUMSS strands [32].

The data collection instrument was then prepared using the Short Grit Scale (Grit-S) developed by Angela Duckworth and Patrick Quinn [33]. Prior to its actual use, a pilot test was conducted among Grade 11 students to assess the instrument's reliability within the local context. The computed Cronbach's alpha value of

0.754 indicated that the instrument demonstrated acceptable internal consistency and was suitable for data collection [34].

Before administering the survey, the researcher obtained the necessary approvals from the Research Development Center, the school administration, and the data privacy committee. Once permission was granted, the questionnaires were distributed to the selected participants. Adequate time was provided for completion, and ethical principles such as voluntary participation, informed consent, and confidentiality were strictly upheld throughout the process [35].

In addition to the survey responses, the participants' mathematics grades were collected from the school registrar following proper authorization. The gathered data, including both grit scores and academic records, were carefully encoded, checked for accuracy, and compiled into a single dataset for analysis. After organizing the data, statistical treatments were applied. Descriptive measures, particularly the weighted mean, were used to describe the levels of grit and mathematics academic achievement. To determine the relationship between the variables, Pearson's Product-Moment Correlation was employed [36].

Finally, the findings were analyzed and interpreted based on the objectives of the study, leading to the development of conclusions and educational implications. The structured sequence of procedures ensured that the research was carried out in a systematic, transparent, and replicable manner.

### 2.3. Research Subjects and Sampling Procedure

The study was conducted in the Cordillera Administrative Region (CAR), Philippines. The respondents were Grade 12 senior high school students enrolled in the selected institution during the conduct of the study. A total sample size of 225 participants was determined using Cochran's formula to ensure statistical adequacy and to obtain a representative sample of the target population [32]. The use of this formula allowed the researcher to establish an appropriate sample size capable of producing reliable and generalizable results within the defined population [30].

To ensure proportional representation across the different academic strands, stratified sampling was employed as the sampling technique. This method enabled the researcher to divide the population into relevant subgroups based on academic strand and to select participants proportionately from each group. By applying stratified sampling, variations among strands were taken into consideration, ensuring that each subgroup was adequately represented in the study and minimizing sampling bias [31]. The distribution of respondents according to academic strand is presented in Table 1.

Table 1. Number of Respondents by Strand

Strand	Total Students	Sample Respondents
STEM	641	143
ABM	170	37
HUMSS	202	45
Overall	1,013	225

### 2.4. Research Instrument

The primary data gathering instrument employed in this study was a structured survey questionnaire designed to collect relevant information necessary to address the research objectives. The instrument consisted of two sections. The first section gathered the respondents' profile information, which provided the demographic background necessary for describing the study participants. The second section comprised the Short Grit Scale (Grit-S) developed by Angela Duckworth and Patrick Quinn [33], which was utilized to measure the level of grit among senior high school students.

The Grit-S is composed of eight items that assess two core dimensions of grit, namely consistency of interest and perseverance of effort. These dimensions capture the extent to which individuals maintain sustained effort and stable long-term goals despite challenges or setbacks. Responses were measured using a five-point Likert scale ranging from 1 (Not like me at all) to 5 (Very much like me), enabling the researcher to quantify students' grit levels and facilitate statistical analysis [31]. The overall structure and distribution of the instrument are presented in Table 2.

Table 2. Structure of the Short Grit Scale

Scale	Item Numbers	Total	Cronbach's Alpha Value
The consistency of interest	1,3,5,6	4	0.754
The perseverance of effort	2,4,7,8	4	

## 2.5. Data Collection Procedure

A pilot test was conducted among Grade 11 students to determine the reliability of the research instrument within the Philippine educational context prior to its full implementation. The pilot testing procedure allowed the researcher to evaluate the clarity, consistency, and suitability of the survey items for the target population. Reliability analysis was performed using Cronbach's alpha, which yielded a coefficient of 0.754. This result indicates an acceptable level of internal consistency, suggesting that the instrument was sufficiently reliable for measuring the construct of grit among senior high school students [34].

The research procedure commenced with the securing of the necessary approvals from the Research Development Center and the school principal before the conduct of data collection. Upon receiving authorization, the survey questionnaires were administered to student volunteers under the supervision of the researcher. Each participant was allotted approximately 25 minutes to complete the instrument to ensure adequate time for thoughtful responses. After completion, the questionnaires were collected by the researcher with the assistance of the assigned classroom teacher to ensure proper retrieval and organization of responses.

In compliance with ethical standards and data privacy regulations, a separate request for permission was submitted to the data privacy committee to access the academic records of the participants. Following approval, the researcher obtained the respondents' mathematics grades from the school registrar. The collected grit scores and corresponding academic records were then encoded, verified, and consolidated into a single dataset. This dataset served as the basis for the statistical analyses conducted to examine the relationship between grit level and mathematics academic achievement [35].

## 2.6. Data Analysis Techniques

The responses to the Short Grit Scale (Grit-S) were processed and scored in accordance with the standard scoring procedures established for the instrument [33]. The scale includes items that require direct scoring as well as reverse scoring to ensure accurate measurement of the construct and to minimize response bias. After assigning the appropriate numerical values to each item, an individual grit score was computed by obtaining the mean of the respondents' item scores. The resulting scores ranged from 1 to 5, where higher values reflected stronger levels of perseverance and consistency of interest, while lower values indicated minimal manifestation of grit characteristics.

Descriptive statistical techniques were employed to summarize and interpret the gathered data. Specifically, the weighted mean was used to determine the overall level of grit and the level of mathematics academic achievement among the respondents, allowing the researcher to describe the central tendencies of the variables and classify them according to predefined descriptive categories [31].

To determine the relationship between grit and mathematics academic achievement, Pearson's Product-Moment Correlation was utilized. This statistical test was selected because it measures the strength and direction of the linear relationship between two continuous variables [36]. The analysis enabled the researcher to establish whether variations in students' grit levels were significantly associated with differences in their mathematics grades, thereby providing empirical evidence regarding the role of grit as a potential factor related to academic achievement.

## 3. RESULTS AND DISCUSSION

### 3.1. Grit Level of Senior High School Students

Table 3 presents the grit level of the Grade 12 senior high school students. Specifically, the results indicate that STEM students ( $n = 143$ ) exhibit a moderate level of grit, while both ABM ( $n = 37$ ) and HUMSS ( $n = 45$ ) students are also classified as moderately gritty. The overall mean grit score of 3.20 further confirms that the respondents, as a whole, demonstrate a moderate level of perseverance and consistency of interest.

Table 3. Grit Level of the Students

Strand	N	Grit Level					Mean	DE
		NG	SG	MG	G	EG		
STEM	143	1	11	86	40	5	3.1	MG
ABM	37	0	6	24	7		3.2	MG
HUMSS	45	0	5	23	16	1	3.2	MG
Overall	225	1	22	133	63	6	3.2	MG

#### Legend

Numerical Scale	Descriptive Equivalent
1.00-1.79	Not Gritty at all (NG)
1.80-2.59	Slightly Gritty (SG)
2.60-3.39	Moderately Gritty (MG)
3.40-4.19	Gritty (G)
4.20-5.00	Extremely Gritty (EG)

Moderate grit refers to an average level of passion and perseverance toward long-term goals, although students may still be affected by setbacks and challenges [13]. This suggests that students may become distracted by competing tasks and may experience difficulty maintaining consistent effort when encountering challenges. When faced with demanding academic requirements such as long-term projects, performance tasks, or examinations, students may become discouraged, which could lead to reduced participation and lower academic performance. Persistence and sustained commitment have been identified as important factors influencing student success [37].

The results indicate that students across all strands generally exhibit a moderate level of perseverance, which is consistent with existing conceptualizations of grit [13]. This level may reflect students' ability to persist while still encountering difficulties in maintaining effort when faced with competing demands. These tendencies may influence students' academic engagement and performance, particularly when dealing with complex or extended academic tasks. Sustained commitment has likewise been recognized as essential in achieving long-term academic success [37].

Additional studies indicate that individuals with lower levels of persistence may experience greater difficulty when confronted with demanding tasks, affecting their ability to sustain effort [38], [39]. Similarly, individuals with moderate levels of grit may encounter challenges in maintaining perseverance across academic or career pathways [13].

The findings also align with developmental research suggesting that grit tends to increase with age and educational attainment. Previous studies have reported positive associations between grit, age, and academic level [40]–[42]. Likewise, higher levels of grit have been associated with greater educational attainment and persistence across academic stages [13], [33]. These findings suggest that the moderate grit level observed among senior high school students may be influenced by their developmental stage, with perseverance potentially strengthening as they progress through higher levels of education.

Notably, the relatively similar mean scores across the three strands suggest that grit may not be strongly differentiated by academic track at the senior high school level. This implies that perseverance and sustained effort are general learner characteristics rather than strand-specific attributes. Such a pattern supports the view that non-cognitive traits, including grit, are broadly distributed across student populations and are not solely shaped by academic specialization [11], [27]. This finding is important in the context of educational assessment, as it indicates that interventions aimed at improving grit should be implemented across all strands rather than targeted to a specific group.

Furthermore, the predominance of students within the “moderately gritty” category, as reflected in the frequency distribution, suggests that while students possess a baseline level of perseverance, there remains considerable room for development. This has implications for instructional practice, as educators may need to incorporate strategies that explicitly foster long-term goal setting, resilience, and sustained engagement in learning tasks. As emphasized in previous studies, non-cognitive factors such as grit can complement cognitive abilities in predicting academic success, particularly when learners are exposed to challenging and complex tasks [16], [20].

In addition, the moderate level of grit observed may be influenced by contextual and environmental factors within the educational setting. Instructional approaches, classroom climate, and assessment practices may either support or hinder the development of perseverance among learners. Research suggests that meaningful learning experiences, aligned with students' cognitive processes and supported by effective pedagogy, can enhance student engagement and persistence [7], [25]. Conversely, learning environments that do not adequately support conceptual understanding may contribute to disengagement and reduced effort [10].

Moreover, considering that senior high school students are in a transitional phase between basic and higher education, their level of grit may still be developing. At this stage, students are often adjusting to increased academic demands and expectations, which may challenge their ability to sustain long-term effort. This transitional nature may explain why grit levels are moderate rather than high, as students are still in the process of building resilience and long-term academic commitment [15], [27].

Overall, the findings highlight that while students demonstrate a foundational level of perseverance, there is a need for educational interventions that strengthen grit as a non-cognitive skill. Enhancing students' ability to sustain effort and remain committed to long-term goals may contribute to improved academic engagement and performance, particularly in cognitively demanding subjects such as mathematics.

### 3.2. Mathematics Academic Achievement of Senior High School Students

Table 4 presents the level of academic achievement of the senior high school students in General Mathematics. The overall mean score of 85 corresponds to the descriptive rating *Very Satisfactory*, indicating that students generally demonstrate adequate mastery of fundamental mathematical concepts and are capable of applying these skills independently in performance-based tasks [26].

Table 4. The level of Mathematics Academic Achievement of the Grade 12 Students

Strand	n	Mathematics Academic Achievement					Mean	DE
		D	FA	S	VS	O		
STEM	143	2	33	32	46	30	85	VS
ABM	37	1	17	5	11	3	83	S
HUMSS	45	0	2	12	20	11	86	VS
Overall	225	3	52	49	77	44	85	VS

*Legend**Numerical Scale*

90 and above

85-89

80-84

75-79

74 and below

*Descriptive Equivalent**Outstanding (O)**Very Satisfactory (VS)**Satisfactory (S)**Fairly Satisfactory (FA)**Did not meet expectation (D)*

The strand-specific results show that both STEM ( $\bar{x} = 85$ ) and HUMSS ( $\bar{x} = 86$ ) students attained a Very Satisfactory level of performance, reflecting a relatively strong level of mathematical proficiency. This suggests that learners are able to solve problems, apply mathematical concepts with minimal guidance, and transfer their knowledge to real-life contexts [43]. In contrast, ABM students ( $\bar{x} = 83$ ) achieved a Satisfactory level, indicating that while they possess foundational knowledge and skills, they may still require structured support and guided instruction to fully grasp more complex mathematical concepts. Learners at this level benefit from scaffolded instruction and collaborative learning strategies to enhance their conceptual understanding [43].

The observed differences across strands may be attributed to variations in curriculum exposure and academic orientation. STEM students are more frequently engaged in mathematically intensive subjects, which may contribute to stronger conceptual understanding and problem-solving skills. Similarly, HUMSS students, despite having less emphasis on mathematics compared to STEM, may benefit from analytical and critical thinking tasks that support mathematical reasoning. In contrast, ABM students may have less frequent engagement with advanced mathematical concepts, which may influence their level of proficiency.

The findings are consistent with previous research highlighting persistent challenges in mathematics education within the Philippine context. Studies have shown that students often demonstrate difficulty in mastering prerequisite competencies, particularly during the early implementation of the K to 12 curriculum [44]–[46]. These challenges have been linked to factors such as limited conceptual understanding, negative attitudes toward mathematics, reduced concentration, and instructional constraints [45]. Moreover, difficulties in mathematical problem-solving have been associated with weaknesses in procedural skills and the inability to verify solutions effectively [46].

Beyond these factors, non-cognitive variables may also influence mathematics achievement. Research suggests that academic performance is shaped not only by cognitive ability but also by learners' motivation, attitudes, and study behaviors [11], [27]. Mathematics anxiety, for instance, has been found to negatively affect performance by limiting students' confidence and ability to engage with numerical tasks [3]–[5]. These findings imply that the observed performance levels may reflect the combined influence of both cognitive and non-cognitive factors.

The results highlight the importance of adopting teaching strategies that promote conceptual understanding and active engagement in mathematics learning. Effective teaching practices, including the use of meaningful tasks, real-life applications, and student-centered approaches, have been shown to enhance mathematical understanding and performance [7], [25]. Providing differentiated instruction, particularly for students performing at the satisfactory level, may help address learning gaps and support the development of higher-order thinking skills.

Furthermore, the overall Very Satisfactory performance suggests that students are meeting expected learning standards; however, it also indicates room for improvement toward higher levels of achievement. Educational interventions that focus on strengthening problem-solving skills, conceptual clarity, and independent learning may further enhance students' mathematical proficiency. Continuous assessment and feedback, aligned with curriculum standards, may also play a critical role in improving learning outcomes [26], [28].

Overall, the results suggest that while students demonstrate a generally strong level of mathematical competence, variations across strands indicate the need for targeted instructional support. Enhancing both cognitive and non-cognitive aspects of learning may contribute to improved mathematics achievement and better preparation for higher education.

### 3.3. Correlation Between Grit and Mathematics Academic Achievement

Table 5 presents the correlation between grit and mathematics academic achievement among Grade 12 senior high school students. Using Pearson's Product-Moment Correlation, the analysis yielded a correlation coefficient of  $r = 0.20$  ( $p < 0.01$ ), indicating a statistically significant but weak positive relationship between the variables. This result suggests that although grit is significantly associated with mathematics achievement, the

magnitude of its influence is small, implying that it explains only a limited portion of the variance in students' academic performance.

Table 5. Correlation Between Grit and Mathematics Academic Achievement

Variable	Mean	Pearson's R	P-Value
General Mathematics Grade	85	0.20**	<0.01
Grit Level	3.20		

*Legend*

Ranges of <i>r</i>	Strength of Relationship
1.00	Perfect
0.80 to 0.99	Very Strong
0.60 to 0.79	Strong
0.40 to 0.59	Moderate
0.20 to 0.39	Weak
0.01 to 0.19	Very Weak
0.00	No correlation

\*\*Coefficient is significantly different from zero ( $p < 0.01$ )

The findings indicate that higher levels of grit are associated with slightly higher mathematics academic achievement. However, the weak correlation suggests that grit contributes only minimally to students' performance. While perseverance may support sustained effort in learning, academic achievement in mathematics appears to be influenced by multiple interacting factors beyond grit alone. Thus, grit should be considered a supporting rather than a primary determinant of academic success.

These results are consistent with previous studies reporting positive associations between grit and educational outcomes. Prior research has shown that grit is positively related to academic achievement and persistence in educational settings [13], [33], [47]. Similarly, grit has been found to be positively correlated with mathematics and science achievement [48]. In addition, grit has been shown to explain variance in academic performance beyond measures of intelligence, highlighting its role as a non-cognitive factor contributing to educational outcomes [13], [29].

Further evidence indicates that the relationship between grit and academic performance is generally weak but positive. Studies have reported small correlations between grit and academic achievement among adolescent learners [49], while meta-analytic findings suggest that such relationships are typically weak to moderate in magnitude [18]. This implies that grit operates alongside other influential variables rather than functioning as a dominant predictor of academic success. Factors such as motivation, self-regulation, attitudes toward mathematics, and learning strategies have been identified as important contributors to academic performance [11], [14], [17]. In particular, mathematics anxiety has been shown to negatively affect performance by reducing students' confidence and engagement with mathematical tasks [3]–[5].

The weak magnitude of the correlation in this study aligns with the broader literature, which emphasizes that non-cognitive traits, while important, have limited explanatory power when considered in isolation [18]. Similarly, previous studies have reported only small associations between grit and academic performance among adolescents [50]. This suggests that while perseverance may enhance students' ability to persist in challenging tasks, it does not necessarily guarantee higher academic achievement without the support of cognitive skills and effective instructional practices.

In contrast, some studies have questioned the predictive power of grit, reporting that it is not a significant predictor of academic achievement [51]–[53]. These inconsistencies suggest that the influence of grit may vary depending on contextual factors such as subject area, instructional environment, and learner characteristics. In mathematics, where conceptual understanding and procedural competence are critical, cognitive abilities and prior knowledge may play a more substantial role than non-cognitive traits alone [7], [25].

From an educational perspective, the findings highlight the importance of adopting a holistic approach to student development. While fostering grit and perseverance remains valuable, educators should also emphasize the development of cognitive skills, effective learning strategies, and supportive learning environments. Instructional practices that promote engagement, conceptual understanding, and active problem-solving have been shown to enhance academic performance in mathematics [7], [25]. Additionally, integrating non-cognitive skill development into classroom instruction may help students manage challenges and sustain effort in demanding academic tasks [19], [20].

Despite its contributions, this study has several limitations. The use of a correlational design limits the ability to establish causal relationships between grit and academic achievement [30], [31]. The reliance on self-reported measures of grit may also introduce response bias, potentially affecting the accuracy of the results. Furthermore, the study was conducted within a specific regional and institutional context, which may limit the generalizability of the findings to other populations.

Future research may consider employing longitudinal or experimental designs to better understand the causal mechanisms underlying the relationship between grit and academic achievement. Additionally,

incorporating other relevant variables such as self-efficacy, motivation, and instructional factors may provide a more comprehensive understanding of the determinants of mathematics performance. Expanding the study across diverse educational settings may also enhance the generalizability of the findings and contribute to a more nuanced understanding of the role of grit in academic success.

#### 4. CONCLUSION

This study addressed the objectives of determining the level of grit, the level of mathematics academic achievement, and the relationship between these variables among Grade 12 senior high school students. The findings revealed that students exhibit a moderate level of grit ( $\bar{x} = 3.20$ ) and a very satisfactory level of mathematics achievement ( $\bar{x} = 85$ ). Furthermore, Pearson's correlation analysis showed a statistically significant but weak positive relationship ( $r = 0.20$ ,  $p < 0.01$ ), indicating that grit is associated with mathematics performance, although its influence is limited.

Based on the findings of the study, it is recommended that educators incorporate strategies that promote students' perseverance and sustained effort alongside effective instructional practices in mathematics. Schools may also consider integrating non-cognitive skill development into learning activities to support students' overall academic performance. For future research, it is recommended to examine additional variables such as motivation, self-efficacy, and instructional practices, and to employ longitudinal or experimental designs to further explore the role of grit in academic achievement across different educational contexts.

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