

## Research Article

### MODELLING STUDENT'S ACADEMIC ACHIEVEMENT IN ABSTRACT ALGEBRA

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Received 02<sup>th</sup> January 2023; Accepted 04<sup>th</sup> February 2023; Published online 30<sup>th</sup> March 2023

#### ABSTRACT

This undertaking analyzed the level of academic achievement in Abstract Algebra of BSE-Mathematics students at Central Bicol State University of Agriculture, AY 2020-2021 and create a structural equation model (SEM). Specifically, it answers to the following questions: 1). What is the profile along Age and Sex, Grit Mindset, Attitude towards success and Level of Academic Achievement in Abstract Algebra of the respondents? 2). Is there a significant relationship between profile, Grit Mindset, Attitude towards success and Level of Academic Achievement in Abstract Algebra of the respondents? 3). What mathematical expression could be crafted to represent the relationship between the profile of the respondents, Grit Mindset, Attitude towards success in Abstract Algebra and Academic Achievement in Abstract Algebra? This study utilized quantitative method. Descriptive correlational design was used in the conduct of this study. Validated questionnaire was used to gather data. Majority of the respondents are female and young, have high level of Grit Mindset, have positive attitude towards success in Abstract Algebra and got highly outstanding level of Academic Achievement in Abstract Algebra. There exists significant relationship between the profile of the respondents to their Grit Mindset, Attitude towards success in Abstract Algebra and Level of Academic Achievement in Abstract Algebra. Structural Equation Model (SEM) could be used to represent the relationship between the profile of the respondents, Grit Mindset, Attitude towards success in Abstract Algebra and Academic Achievement in Abstract Algebra.

**Keywords:** Grit Mindset, Attitude, Academic Achievement.

#### INTRODUCTION

UNESCO, through Sustainable Development Goal 4 (SDG 4), emphasized commitment to quality education and to improving learning outcomes, which requires strengthening inputs, processes and evaluation of outcomes and mechanisms to measure progress. Additionally, as stipulated in Target 4.6 (Literacy and Numeracy) by 2030, UNESCO ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy. According to Global Education Monitoring Report (GEM 2020) of UNESCO, globally, 86% of adults aged 15 and above and 92% of youth aged 15 to 24 are literate. This report sounds good and admirable. However, the report on 2019 results on Trends for International Mathematics and Science Survey (TIMSS) was on the contrary. Filipinos fared worst among 58 countries in an assessment for mathematics and science for Grade 4 students, according to a study by a Netherlands-based research institution.

Mathematics teaching and learning had been subjected for investigation even before the advent of pandemic. Up to this moment, teaching and learning mathematics was still examined. Teaching and learning mathematics were subjected for analysis in general context. Many researchers and educators went through series of investigation relative to teaching and learning mathematics on the side of applied mathematics. Very few educators ventured on analyzing mathematics on the side of pure mathematics. So, Abstract Algebra, as a course in pure mathematics and a newly discovered field was still an unexplored area. Aside from the fact that Abstract Algebra (Modern Algebra) was a newly discovered field, it is also an active agent for numerous advancement and innovations in technology. Artificial Intelligence (AI), advanced computer programming and the likes,

were made possible with the aid of Abstract Algebra. As an element in the revised teacher education curriculum, Abstract Algebra would be an essential subject for analysis in relation to students' learning. And, as an inherent function of every institution in the higher learning echelon, it was an utmost duty to maintain and deliver high quality education. Going back to the very nature of mathematics as basis in making decisions in daily life of humanity, it was therefore a must for every educational institution to maintain and establish a mechanism to ensure smooth delivery of mathematics instructions.

#### OBJECTIVES OF THE STUDY

This study analyzed the level of academic achievement in Abstract Algebra of BSE-Mathematics students at Central Bicol State University of Agriculture, AY 2020-2021 and create a structural equation model (SEM). Specifically, it was anchored on the following objectives:

1. Determine the profile along Age and Sex, Grit Mindset, Attitude towards success and Level of Academic Achievement in Abstract Algebra of the respondents.
2. Verify if there is a significant relationship between profile, Grit Mindset, Attitude towards success and Level of Academic Achievement in Abstract Algebra of the respondents.
3. Create a mathematical expression that could represent the relationship between the profile of the respondents, Grit Mindset, Attitude towards success in Abstract Algebra and Academic Achievement in Abstract Algebra.

#### REVIEW OF RELATED LITERATURE

This section presented some of the related literature and studies relative to academic achievement in Abstract Algebra of the respondents arranged thematically.

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## GRIT MINDSET

This part presents literature about Grit Mindset structured in sub-themes as patterned in the research problem to be examined.

Mayr H. L. *et al.*, (2020) conducted an intervention program for children and adolescents. At the end of their undertakings, they had found out that both children and adolescents had significantly improved their self – concept. On the same vein, Fernández-Martín F. D. *et al.*, (2020) had conducted a study about “*Grit as a Predictor and Outcome of Educational, Professional, and Personal Success*”. The results of their study revealed that age and sex predict grit level among students and general population. Older students and women showed higher level of Grit. They further added that educational variables predict Grit. On the other side of the coin, Bowman (2019) conducted a meta-analysis on how to create an enduring academic legacy. In his paper he pointed out that GRIT was the engine for human accomplishments. He further stipulated that if students are inspired to pursue the right goals in the right way, they will surely succeed.

In addition, Cosgrove J. M. *et al.*, (2018) had conducted study about “*Physical Fitness, Grit, School Attendance, and Academic Performance among Adolescents*”. They found out that adolescents have high grit score. They further added that GRIT and total number of attendances to class are significant contributors to academic success.

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Lechner C. M. *et al.*, (2019) investigated about Grit in relation to socio-demographic profile, career success and career engagement. At the end, they found out that Grit level is related to attitude towards studies. In addition, they found out that Grit is related to gender. Female is grittier than male. Age was also found related to Grit. In addition, Wills G. and Hofmeyr H. (2018) had conducted a study about academic resilience in primary schools of South Africa. They had found out that girls tend to be more academic resilient than boys. They further identified a significant relationship between academic resiliency, Grit level and attitude towards school.

## ATTITUDE TOWARDS SUCCESS IN ABSTRACT ALGEBRA

This part presented literature about Attitudes towards success in Abstract Algebra structured in sub-themes as patterned in the research problem to be examined. Silao (2018) had examined the Factors Affecting the Mathematics Problem Solving Skills of Filipino Pupils. Based on his findings, there is a significant relationship between pupil factor and attitude towards mathematics. He further added that pupil factor and performance in mathematics had significant relationship. On the same contentions, Luttenberger *et al.*, (2018), conducted study on math anxiety in US. They found out that age difference affects the attitude towards mathematics. They further emphasized that math anxiety affects individuals of all ages in academic situations as well as in their academic success and well-being. In addition, Fabian K., *et al.*, (2018) examined the effect of using mobile technologies for teaching mathematics. Based on their findings, they found out that all of the participants, regardless of age have positive attitude towards mathematics. They generally label the respondents as having relatively high level of enjoyment towards mathematics.

Mazana M. Y *et al.*, (2020) assessed student's performance in mathematics based on teachers' perspectives. They found out that there is a higher failure rates in primary and secondary schools' particularly lower secondary school. Gender differences exist at all levels of education with girls underperforming in primary, lower secondary, and college examinations due to cultural factors impacting female students' learning. On the other hand, Ganesan P. *et al.*, (2020) examined factors and interventions influencing children's attitudes towards mathematics. They found out that there is only a weak correlation between attitude towards mathematics and their performance in mathematics. Meanwhile, Fabian K. *et al.*, (2018) had examined the effect of mobile technologies in students' attitudes and achievement in mathematics. They found out that the use of mobile technologies elicits positive responses from students both in terms of how they perceive the mobile activities and how it improved their performance but its' effect on students' attitudes towards mathematics will need to be further investigated.

## ACADEMIC ACHIEVEMENT IN ABSTRACT ALGEBRA

This part presents literature about Academic Achievement in Abstract Algebra structured in sub-themes as patterned in the research problem to be examined.

Abramovich S. *et al.*, (2019) conducted a study about “*Teaching Mathematics through Concept Motivation and Action Learning*”. They had found out that action learning could be used in teaching mathematics across k-12 curriculum. Age factor relative to performance in mathematics could be minimized using action learning.

In addition, Koponen T. *et al.*, (2018) examined the prevalence of comorbidity of dysfluent reading and math skills. They found out that children who showed very low performance in one skill also evidenced low or very low performance in the other. They further emphasize that difficulties had somewhat higher prevalence in third and fourth graders than in first and second graders. Furthermore, H. M. Costa *et al.*, (2018) had examined the performance of pre-schoolers in mathematics. They had found out that preschool low achievers constitute a heterogeneous group, and they stress the importance of domain-general factors for the development of mathematical abilities during the preschool years. Anders J. *et al.*, (2018) examined the variation of subject choices relative to their previous school attended. They found out that young students studying core subjects performed the same as those who are not studying the core subjects' combination. They further noted a statistically significant association between an individual's gender and the academic selectivity of the subjects they study.

Rodríguez S. *et al.*, (2020) had investigated about the effects of motivation in mathematics performance of students in primary education. They found out that girls tend to exhibit fewer positive attitudes towards mathematics than boys. And they further explained that motivation towards mathematics was significantly related to academic performance.

Hinojo-Lucena FJ. *et al.*, (2020) had examined the status of STEM in the web of science. They had found out that there are differences at the level of gender in its use in teaching and learning process.

## METHODOLOGY

This study utilized quantitative method. Descriptive-Evaluative-Correlational design was utilized in this study. Descriptive components deal with the profile of the respondents. Evaluative will focus on determining the Grit Mindset, Attitudes towards success in Abstract Algebra and Academic Achievement in Abstract Algebra.

Correlation aspect entails determining the extent of correlation of the profile to Grit Mindset, Attitude towards success in Abstract Algebra and Academic Achievement in Abstract Algebra, degree of correlation of Grit Mindset to Attitude towards success in Abstract Algebra and Academic Achievement in Abstract Algebra.

### Respondents of the Study

G-Power 3.1.9.7 was used to determine the sample size for the study. Using F-Test with two predictors at 95% test power and 5% level of significance, a sample size of 107 was identified. These 107 respondents were taken randomly from the four (4) campuses of CBSUA.

### Research Instrument

This study utilized several instruments to facilitate the gathering of data. Profile of the respondents was gathered using questionnaire. Grit Mindset was determined using validated Grit Scale instrument. Attitude towards success in Abstract Algebra was gathered using validated survey questionnaire. And lastly the Academic Achievement of the students in Abstract Algebra was determined through the final grade submitted by the instructor/teacher in Abstract Algebra course.

### Method Of Data Analysis

The gathered data for profile along sex and age were statistically treated using mean and percentage. The data on Grit Mindset was treated statistically using mean. The gathered data on Attitudes Towards Success in Abstract was calculated using mean. The data on academic achievement in Abstract Algebra was calculated using mean. The correlation between the profile, Grit Mindset, Attitude and Academic Achievement was calculated using MS Excel.

## RESULTS AND DISCUSSIONS

### DEMOGRAPHIC PROFILE OF THE RESPONDENTS

These undertakings examined the demographic profile of the respondents. It includes sex and age.

**Table 1. Profile of the Respondents along Sex and Age**

		n	%
SEX	Male	37	34.58
	Female	70	65.42
	<b>Total</b>	<b>107</b>	<b>100</b>
AGE	20.00 - 21.24	49	45.79
	21.25-22.40	42	39.25
	22.5-23.74	9	8.41
	23.75-24.00	7	6.55
	<b>Total</b>	<b>107</b>	<b>100</b>

As revealed in Table 1, in the profile of the respondents along sex, around 65% of the respondents are female and only 34% are male. The results indicated that there is a dominance of female students in 3<sup>rd</sup> year BSEd-Mathematics program. The data on profile along age shown that 45.79% of the respondents has age ranging from 20 – 21.24 years old, 39.25% of the respondents got the mean age of 21.25 – 22.40 years old, 8.41% of the respondents has age ranging from 22.5 -23.74 years old, and 6.55% of the respondents has age ranging from 23.75 – 24.00. It is pointer that in the 3<sup>rd</sup> year BSEd-Mathematics class, large numbers of students are relatively young. The result indicated that majority of the respondents are relatively young.

### GRIT MINDSET OF THE RESPONDENTS

The persistence of the respondents towards their studies pertains to their Grit Mindset. In this study, Grit Mindset was gathered using validated questionnaire and the result was calculated using mean

**Table 2. Grit Mindset of the Respondents**

	Mean	Interpretation
Male	3.06	High
Female	2.85	High
Combined	2.92	High

It was reflected in Table 2, that the combined mean of the respondents for Grit Mindset was 2.92 with verbal interpretation of High. The result shown that generally, the respondents have high level of persistent towards their studies.

### ATTITUDE TOWARDS SUCCESS IN ABSTRACT ALGEBRA

The self-concept of the respondents regarding whether they could be successful or not in Abstract Algebra course pertains to their Attitude Towards Success in Abstract Algebra.

**Table 3. Attitude Towards Success in Abstract Algebra of the Respondents**

	Mean	Interpretation
Male	2.75	Positive
Female	2.61	Positive
Combined	2.66	Positive

As revealed in Table 3, the combined mean of the respondents was 2.66 with verbal interpretation of Positive. These results indicated that the respondents are sure that they can learn Abstract Algebra. They believed that knowing concepts in Abstract Algebra will help them earn a living. They are convinced that they need Abstract Algebra for their future work.

### ACADEMIC ACHIEVEMENT IN ABSTRACT ALGEBRA

This research study examined the academic achievement in Abstract Algebra of the respondents. The data was determined using the computed final grade given by the instructor/teacher in Abstract Algebra course. The data was statistically treated using mean and analyzed using a scale.

**Table 4. Academic Achievement in Abstract Algebra**

	Mean	Interpretation
Male	94.850	Highly Outstanding
Female	94.913	Highly Outstanding
Combined	94.89	Highly Outstanding

As reflected in Table 4, the combined mean of the respondents was 94.89 with verbal interpretation of Highly Outstanding. This indicated that the respondents fared better in understanding Abstract Algebra lessons.

### CORRELATION BETWEEN PROFILE, GRIT MINDSET, ATTITUDE TOWARDS SUCCESS AND LEVEL OF ACADEMIC ACHIEVEMENT IN ABSTRACT ALGEBRA OF THE RESPONDENTS

The relationship between profile along age and sex, with Grit Mindset, Attitude Towards Success in Abstract Algebra and Academic Achievement in Abstract Algebra were analyzed by this study.

**Table 5. Correlation Between Profile, Grit Mindset, Attitude and Academic Achievement in Abstract Algebra**

		Correlation		t-test for testing the significance of r			Coefficient of Determination	
		Comp.	Int.	Comp.	Crit.	Int.	Comp.	Int.
S	Grit	0.2845	SC	1.7050	1.6931	Sig	8.1	SI
E	Att.	0.2854	SC	1.7106	1.6931	Sig	8.1	SI
X	Acad	0.2845	SC	1.7048	1.6931	Sig	8.1	SI
A	Grit	0.4340	MC	2.7675	1.6931	Sig	18.8	SI
G	Att.	0.4665	MC	2.9477	1.6931	Sig	20.8	SI
E	Acad	0.2878	SC	1.7263	1.6931	Sig	8.3	SI
G	Att.	0.2858	SC	1.7131	1.6931	Sig	8.17	SI
R	Acad	0.2835	SC	1.7131	1.6931	Sig	8.04	SI
I								
T								
A	Acad	0.2856	SC	1.7120	1.6931	Sig	8.16	SI
T								

SC-Slight Correlation  
Sig – Significant

MC-Moderate Correlation  
SI-Slight Influence

Table 5 shown that the profile along sex and age had significant relationship with Grit Mindset, Attitude towards Success in Abstract Algebra and Academic Achievement in Abstract Algebra. Similarly, Grit Mindset has significant relationship with Attitude towards success in Abstract Algebra and Academic Achievement in Abstract Algebra. Additionally, Attitude towards Success in Abstract Algebra has significant relationship with Academic Achievement in Abstract Algebra. The result revealed that there exists a significant relationship between the profile of the respondents along age and sex, Grit Mindset, Attitude towards Success, and Academic Achievement in Abstract Algebra of the respondents.

**STRUCTURAL EQUATION MODEL (SEM) THAT REPRESENTS THE RELATIONSHIP BETWEEN THE PROFILE OF THE RESPONDENTS, GRIT MINDSET, ATTITUDE TOWARDS SUCCESS IN ABSTRACT ALGEBRA AND ACADEMIC ACHIEVEMENT IN ABSTRACT ALGEBRA**

The main goal of this study was to create an equation model that represents the relationship between variables. The model developed as the result of this study was subjected to the following limitations:

1. The model can predict only the approximate value of the dependent variable.
2. The calculated value of the dependent variable needed to be expressed in nearest whole numbers for interpretation.
3. The model was developed using 4-point scale and the calculated result for the dependent variable must be interpreted using the 4-point scale.
4. The scale used in the model for the dependent variable was defined in specific range of value only.
5. The model treated sex as fixed quantity, thus giving a value of 1.
6. The model may not hold true for other scales of values.

The Structural Equation Model (SEM) for Academic Achievement in Abstract Algebra was given by,

$$Y = b_0 + (-0.76929)X_1 + (-0.10220)X_2 + (0.19949)X_3 + (-0.08171)X_4$$

Where:

- Y is the approximate value of the dependent variable
- X<sub>1</sub> is the first independent variable (Attitude Towards Success in Abstract Algebra)
- X<sub>2</sub> is the second independent variable (Grit Mindset)
- X<sub>3</sub> is the third independent variable (Age)
- X<sub>4</sub> is the fourth independent variable (Sex)

$$b_0 = 4.39430$$

**CONCLUSIONS AND RECOMMENDATIONS**

Based on the results and discussions, the following conclusions and recommendations were drawn.

**Conclusions:** Majority of the respondents are female and young. The respondents have high level of Grit Mindset. The respondents have positive attitude towards success in Abstract Algebra. The respondents got highly outstanding level of Academic Achievement in Abstract Algebra. The profile of the respondents is significantly related to their GritMindset, Attitude towards success in Abstract Algebra and Level of Academic Achievement in Abstract Algebra. The GritMindset of the respondents is significantly related to their Attitude Towards Success in Abstract Algebra and Academic Achievement in Abstract Algebra. The Attitude Towards Success in Abstract Algebra of the respondents is significantly related with their Academic Achievement in Abstract Algebra. Structural Equation Model (SEM) could be used to represent the relationship between the profile of the respondents, GritMindset, Attitude towards success in Abstract Algebra and Academic Achievement in Abstract Algebra.

**Recommendations.**

Encouraging more male enrolees in BSEd-Mathematics program was highly advised to lessen the dominance of female students. Maximizing potentials of young students for the benefits of the University and the students could be undertaken. To maintain the high level of Grit Mindset of the respondents, integrating the importance of persistence towards studies might be considered by professional education subject instructors/teachers. Seminar on importance of Grit Mindset towards studies could also be considered by the Program Chair/OSAS. To maintain the positive attitude towards Abstract Algebra of the respondents, integrating the importance of Abstract Algebra on their lesson could be undertaken by Mathematics instructors/teachers. Seminars on importance of Mathematics might be conducted by the OSAS. In order to sustain the high level of Academic Achievement in Abstract Algebra, continuous improvement of instructional practices of instructors/teachers might be considered. Proper information dissemination regarding the relationship between profile, GritMindset, Attitude towards success in Abstract Algebra and Level of Academic Achievement in Abstract Algebra might be considered by instructors, OSAS and/or Program Chair. Seminars on improving Grit Mindset of the students might be considered by the OSAS to further enhance their attitude towards studies. Improving the attitude towards studies of the students through seminars might be conducted by the Program Chair or OSAS. This would also be helpful in enhancing the academic achievement of the students. Studying the limitations of the model might be considered to enhance its generalizability. Possible applications of Structural Equation Model (SEM) in other disciplines might be explored.

**ACKNOWLEDGEMENTS:**

The author would like to extend his sincerest gratitude and thanks first and foremost to the Almighty for giving him life and strength all day, to his supportive wife- Jocelyn N. Orogo, to the campus administrator of CBSUA-Pasacao Campus, Prof. Carlo M. Cornejo, for allowing him to conduct the study, to the research coordinator of CBSUA-Pasacao Campus, Dr. Jayson M. Dañas, for continued support and encouragement, to Maam Ara Jill D. Umali for unending support in data gathering and tabulation, and lastly, to all the respondents who religiously participated in the study.

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