



ON THE DARK SIDE OF LEARNING CALCULUS: EVIDENCE FROM AGRIBUSINESS STUDENTS

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<https://doi.org/10.24071/ijiet.v5i1.2825>

received 1 September 2020; accepted 11 January 2021

Abstract

This study focused on evaluating the agribusiness students' negative experiences in learning Calculus. The study employed 121 agribusiness students in the first semester of the school year 2019-2020 at Visayas State University, Baybay City, Leyte, Philippines. Selected secondary data from the study of Casinillo and Casinillo (2020a) was utilized in this study. With the aid of a correlational research approach, this study stresses to explain the nature and characteristics of negative effects of learning calculus which is very helpful for improving the level of achievement of students and modifying the strategy of mathematics teachers. Results showed that most of the agribusiness students don't have enough background in pre-calculus topics since there are only 9% of them took a STEM strand during senior high school. Seemingly, it is revealed that students are experiencing extreme stress, natural emotional exhaustion and frustration, and average absenteeism, somatic burden, and laziness in learning Calculus. It is found out that the negative experiences of these agribusiness students are significantly related to each other. This suggests that these negative experiences are inter-correlated and dependent on each other which is wearisome to their studies and leads to poor academic performance. However, these students are driven to pursue studying calculus since it's part of their requirements in their degree program. Hence, by proper motivation and appropriate teaching strategy in Calculus, these students can progress their level of achievement.

Keywords: agribusiness students, correlational research approach, negative experiences, poor academic performance

Introduction

Studying calculus subject is a tough learning process. A lot of students at the college level are struggling to pass the calculus course as part of their curriculum. Apparently, in mathematics class, there are shortcomings and negative experiences in learning that are existing in the classroom environment due to math anxiety (Casinillo, 2019; Maloney & Beilock, 2012; Vukovic et al., 2013). In the paper of Awaludin et al. (2020), it is stated that the common problems in learning calculus are low participation of students, difficulties in answering problem sets, little mastery of basic calculus concepts, and lack of logical minds in problem-solving. To have a good performance in calculus class,

students must be able to actively participate in answering problem sets, have knowledge and thinking skills that can be used in problem-solving for contextual problems, and able to make problem-solving models (Awaludin et al., 2020). This means that students must develop their problem-solving skills in mathematics with the aid of suitable teaching strategies. Furthermore, students must have an interest and enough background on pre-calculus topics (Casinillo&Aure, 2018). However, there are also learning experiences of students that need to be addressed. These are the negative effect of learning due to boggling and difficulties they have encountered in the classroom environment which affects their learning behavior.

In Visayas State University, Baybay City, Leyte, Philippines, Bachelor of Science in Agribusiness (BSAB) is one of the degree programs that require a Calculus subject due to its usefulness in their field of studies. In other words, the Calculus subject is part of their curriculum. According to Berggren (2018), calculus has diverse application in real life that deals with how related variables change. In particular, business-related subjects are dependent on the applicability of Calculus. Leithold (1996) stated that learning calculus can be stimulating and exciting considering that a student knows certain mathematical background in algebra, geometry, trigonometry, and pre-calculus. However, most of the enrollees of the BSAB program are not Science, Technology, Engineering, and Mathematics (STEM) students in the K to 12 Education Curriculum in the Philippines. Hence, these types of students are expected to have difficulty in learning calculus due to their lack of mathematics background. In that case, this results in improper motivation in learning and causes negative effects on their behavior in the classroom. Studies have shown that a negative learning attitude is a growing barrier for many students (Mazana et al., 2019; Popham, 2008). These negative learning attitudes will affect students' likelihood of exhibiting learning problems in mathematics, that is, students are experiencing difficulties with attentiveness and lack of task persistence and flexibility. This is somehow parallel to the findings of Alabekee et al. (2015) that a positive learning experience leads to active engagement. According to Casinillo and Casinillo (2020a), that in the past semesters, about 50% of the agribusiness students failed in calculus due to a lack of self-determination and motivation. Another reason is that they lack the mathematical background to grasp college-level calculus topics. In that case, most of the students are experiencing stress, emotional problem, frustration/disappointment, absenteeism, somatic burden, and laziness in learning (Casinillo&Casinillo, 2020a). However, in the study of Casinillo et al. (2020b), mathematical resilience is one that locates itself in positive psychology which addresses mental wellness and interest despite challenges. Perhaps, self-determination in learning played a vital role in students' development in knowledge and understanding (Conchie, 2013; Denson et al., 2015). This is also supported by Kitchen and colleagues (2018) that cooperative and interactive learning strategies contribute to the promotion of higher-order thinking for students. Hence, to find a remedy for negative experiences in learning calculus, one must understand its nature and characteristics.

To date, studying the dark side of learning calculus at Visayas State University, Philippines has never been done and its concepts are also limited in the literature. Hence, the study is conducted to evaluate the different negative learning experiences of agribusiness students with the aid of the correlational method approach. The result of the study will be used to improve the strategy of the mathematics teacher in any math course at the department level of Visayas State University. In fact, mathematics teachers will understand the situation of these agribusiness students in terms of their learning capacity and limitations. This study is also useful for the students' side since it will provide a better understanding of the negative effects of learning calculus which gives them the idea of how they will react during times of difficulties and how to cope up with negative

experiences. Furthermore, this study is relevant in the sense that it could be used as a guide on how to improve the existing policy in mathematics education in the Philippines.

In this section, we systematically reviewed the existing results in the literature on the negative experiences in mathematics particularly in calculus such as stress, emotional exhaustion, frustration/disappointment, absenteeism/tardiness, somatic burden, and laziness. These dark effects are due to worrying demanding situations in problem-solving in calculus, time pressure due to deadlines, and math anxiety. Several findings in the literature stated that negative experiences and stressful situations in learning can interfere with the achievement of mathematical tasks (Ashcraft & Faust, 1994; Ashcraft and Kirk, 2001; Casinillo, 2019; Casinillo et al., 2020a; Maloney & Beilock, 2012). According to Schiffrin and Nelson (2010), students who were stress in learning are less likely happy and motivated.

Furthermore, due to mathematical anxiety, the students are prone to errors and mistakes in mathematical problem solving which causes frustration and disappointment (Ashcraft and Kirk (2001), Vukovic et al., 2013). In the findings of Ashcraft and Kirk (2001), and Ashcraft and Krause (2007), it is found out that cognitive processes can be negatively affected by the interference of negative emotions or emotional exhaustion, due to math anxiety or pressured situations. This suggests how negative feelings might influence the emotional aspect of students, thus resulting in a drop in academic performance in calculus. A student with emotional exhaustion in learning may result from the sustained experience of negative attitudes towards the subject and unexplained physical symptoms (Olafsen et al., 2017). Similarly, a student who perceive their studies as stressful and who experience somatic symptoms may be more likely to express intentions to laziness in studying or even stop their education, or shift to the other degree programs (Brown et al., 2016). Perhaps, laziness could cause students some serious problems in their futures. In the study of Gillet and colleagues (2014), and Williams and colleagues (2014), it is found that the negative effects of a dislike learning environment are stress, frustration/disappointment, absenteeism, and somatic symptom burden. If a student has excessive thoughts in worrying and fear or major distress in learning, this relates to the somatic symptoms they might experience.

In this study, it stresses the nature and characteristics of the different negative effects of learning calculus to find a remedy and achieve a good academic performance of agribusiness students. Hence, generally, the study aimed to evaluate the dark side of learning calculus of agribusiness students. Specifically, this study wanted to answer the following objectives: (1) to determine the socio-demographic profile of the students; (2) to measure the level of different negative learning experiences in calculus; (3) to construct a correlation matrix between different negative learning experiences in calculus.

Method

The study adopted the research design of Casinillo et al. (2020b) to explain the negative experiences of agribusiness students in learning calculus that deals with correlation analysis. Both descriptive and inferential statistical methods were employed. Descriptive statistics such as mean, standard deviation, the minimum, and maximum value were utilized to describe and evaluate the data used in this study. To explain the negative learning experiences, a correlational research approach was used as an inferential method.

In this study, it utilized the data of the current paper of Casinillo and Casinillo (2020a) entitled "Econometric Evidence on Self-Determination Theory in Learning Calculus among Agribusiness Students." The study deals with the motivation/interest and its influencing factors of students in learning Calculus. However, this study only focuses on the dark side or negative experiences resulted from learning the said subject. Hence,

the study includes some of the demographic profile of students such as age (in years), gender (1=Male, 0=Female), and academic senior high school strand (1-STEM, 0-Non STEM). It also utilized a 6-item scale to evaluate the different negative experiences in learning calculus. Students were asked using a 10-point Likert scale, that is, 1-Not

experiencing to 10- Extremely experiencing. The questions are focusing on the following: Stress, Emotional Exhaustion, Frustration or Disappointment, Absenteeism or Tardiness, Somatic Burden, and Laziness. Table 1 shows the mean perception score interval and its corresponding interpretation.

Table 1. Mean score interval for problems in learning calculus and its interpretation.

Mean score interval	Interpretation
1.00 – 2.80	Not experiencing
2.81 – 4.60	Slight experiencing
4.61 – 6.40	Average experiencing
6.41 – 8.20	Naturally experiencing
8.21 – 10.00	Extremely experiencing

In describing the data of the study, some descriptive statistics were employed such as, mean, standard deviation, minimum, and maximum value. The use of descriptive statistics is to characterize and evaluate the data to provide simple summaries and extract some useful interpretation. The Spearman rho correlation was used to determine the relationship between two variables when at least one of them is ordinal. Then, the correlation coefficient was computed as follows:

$$\hat{r}_s = 1 - \frac{6}{n(n^2 - 1)} \sum_{i=1}^n d_i^2$$

Where n is the number of paired ranks in the sample section and d_i is the difference between the paired ranks. Furthermore, the said correlation coefficient was validated and tested for significance. To avoid an error for the results, the calculation was done with the aid of statistical software called Statistical Packages for Social Science (SPSS) version 20. Table 2 shows the range of the correlation coefficient and its degree of relationship according to Albert (2008).

Table 2. Rule of thumb for interpreting the size of the correlation coefficient of Spearman rho

Range of $ r $	Degree of Correlation
$0 < r < 0.3$	Weak
$0.3 < r < 0.7$	Moderate
$ r > 0.7$	Strong

Findings and Discussion

This section presents the descriptive measures for the demographic profile of agribusiness students. It also discusses the level of experience of agribusiness students to the different negative effects of learning calculus. Furthermore, the study tackles the degree of relationship of the different negative learning behavior and provide some policy inputs to improve the well-being of students in learning calculus.

Demographic Profile of Agribusiness Students

Table 1 shows that the mean age of the agribusiness students is closed to 19 years old. About 60% of the agribusiness students are female and (40%) are males. Only 9% of

these students took Science, Technology, Engineering and Mathematics (STEM) strand during senior high school which implies that these students have lesser exposure to science and mathematics (Sarmiento &Orale, 2016). Perhaps, most of the students who took the STEM strand are enrolling in a degree program that is parallel to their strand. So, most of these students are having difficulty and academically challenged since they don't have enough stock knowledge and background. According to Casinillo and Casinillo (2020a), these agribusiness students were not prioritizing mathematics due to a lack of interest since the said subject is not their forte and some students are just studying mathematics when examinations are near. Hence, these agribusiness students in general are experiencing negative learning behavior while studying calculus.

Table 3. Descriptive Statistics for the variables in the study (n=121)

Variables	Mean	Std Dev	Min	Max
Age (in years)	18.89	1.1324	18	26
Male (1-Male, 0-Female)	0.40	0.4929	0	1
STEM Student(1-STEM, 0-Non STEM)	0.09	0.2887	0	1

Agribusiness Students' Level of Negative Experiences

In Table 3, it shows that Agribusiness students are extremely experiencing stress in learning calculus. This is due to the difficulty of the subject encountered since they don't have enough background and proper training during their high school days. Stress is attained due to long hours of studying the subject without proper motivation, tight deadlines of problem sets and being pressured during exams. This is also due to ever-increasing demands that can leave the students feeling worried, drained, and overwhelmed. According to the findings of Beilock and Carr (2005), if stress exceeds the ability of students to cope, then it starts causing damage to the students' minds and body which leads to poor performance. Emotional exhaustion and frustration/disappointment are naturally experienced by agribusiness students (Table 3). It is worth noting that emotion has a significant effect on the cognitive processes and learning attitudes of the student, including perception, attention, learning, reasoning, and problem-solving (Ashcraft & Krause, 2007; Awang et al., 2013). Hence, once the emotion of students is negatively affected, then it also influences negatively the level of achievement in Calculus. Perhaps, the same thing with frustration/disappointment, it engages in other negatives, self-destructive or addictive behaviors that destroy the learning attitude of students. Table 3 also reveals that absenteeism/tardiness, somatic burden, and laziness are averagely experienced by agribusiness students. On average, it suggests that these types of students are not likely to enjoy the class discussion in calculus. The study of Abecia(2014), and Casinillo and Casinillo (2020b) suggest that happiness in learning is a substantial determinant in achieving good academic performance. However, most of them are not actively participating in the class activities and procrastinating the submission deadline of problem sets/assignments. This goes to infer that due to the somatic burden and learning problems they experience in the learning process, it hinders their grasping ability to the topics and leads to low performance (Sahatsathatsana et al., 2014).

Table 3. Descriptive Measures for problems encountered in learning calculus and its interpretation.

Problems in Learning Calculus	Mean	Std Dev	Min	Max	Interpretation
Stress*	8.27	2.2876	1	10	Extremely experiencing
Emotional Exhaustion*	7.74	2.2676	1	10	Naturally experiencing
Frustration/Disappointment*	7.61	2.3887	1	10	Naturally experiencing

Absenteeism/tardiness*	5.02	2.9196	1	10	Average experiencing
Somatic Burden*	6.04	2.6439	1	10	Average experiencing
Laziness*	5.85	2.6946	1	10	Average experiencing
Overall Mean		6.76			Naturally experiencing

Note: * - Scale 1 to 10.

Correlation Matrix for Different Kinds of Problems in Learning Calculus

Table 4 shows that stress is correlated to an emotional problem, frustration, Absenteeism, Somatic Burden, and Laziness. This indicates that stress in the classroom environment in Calculus subjects affects the students’ cognitive behavior and causes different learning problems. According to Beilock and Carr (2001), stressful feelings can also be induced when students are struggling and problematic, such as punishing poor performance with social consequences or low academic achievement which resulted in failing grades. Moreover, mathematics anxiety is increasing due to fear of negative consequences resulted in less efficient strategy use, and even consequently poorer academic performance (Beilock and Carr, 2005). Table 4 reveals that emotional problem and frustration is highly correlated among different kinds of learning problems except for laziness. This suggests that when a student is emotionally exhausted and frustrated, it results in stress, absenteeism, and somatic burden. However, even if agribusiness students are emotionally exhausted and frustrated, they are forced to work with their problem sets and study their lessons for the fact that it is part of their curriculum. In other words, students may feel sad, uncertain, depressed, or anxious in learning calculus, but still overcome their laziness since if they fail, they can’t graduate to their degree program. An appropriate teaching strategy might help these students to improve their academic performance (Casinillo&Guarte, 2018). Furthermore, it is revealed in Table 4 that absenteeism is highly correlated to somatic burden and laziness. Several studies have shown that absenteeism and tardiness harm academic performance and learning behavior (McConnell &Kubina, 2014; Raftu, 2017; Van Eck, 2017). If a student has a lot of absences in a class, then there is a higher chance that they are left behind on the lessons. This suggests that it leads to stress and excessive thoughts, and negative feelings and behaviors it resulted in somatic symptom burden. A student with somatic burden might experience insomnia, restlessness, and muscle aches due to emotional distress or anxiety. Somatic symptom disorder involves a person having a significant focus on physical symptoms, such as pain, weakness, or shortness of breath, which results in major distress and/or problems functioning due to stress and depression (Fujii et al., 2018; Gierk et al., 2015; Williams, 2014). This goes to infer that students lead to laziness which stems from reduced grades in their classes and negative learning attitudes.

Table 4. Correlation (Spearman rho) matrix between the students’ problems in learning calculus (n=121).

Problems in Learning Calculus	Problems in Learning Calculus					
	Stress	Emotional	Frustration	Absenteeism	Somatic Burden	Laziness
Stress	1	0.677*** (<0.001)	0.604*** (<0.001)	0.155* (0.089)	0.392*** (<0.001)	0.224** (0.014)
Emotional	-	1	0.708*** (<0.001)	0.224*** (<0.001)	0.538*** (<0.001)	-0.017 ^{ns} 0.856
Frustration	-	-	1	0.378*** (<0.001)	0.558*** (<0.001)	-0.002 ^{ns} 0.981
Absenteeism	-	-	-	1	0.503*** (<0.001)	0.600*** (<0.001)

<i>Somatic Burden</i>	-	-	-	-	1	0.443*** (<0.001)
<i>Laziness</i>	-	-	-	-	-	1

Note: p-values are in parenthesis.
 ns – not significant
 *p <0.10
 **p <0.05
 ***p <0.01

Conclusion

This study focused on the evaluation of the different negative effects on learning calculus among agribusiness students. Perhaps, understanding the nature and characteristics of the dark side of learning calculus is one of the goals of the educational system particularly in mathematics to improve its teaching-learning process. Results showed that only 9% of the agribusiness students took the STEM strand which indicates that most of these students don't have enough background in mathematics. Hence, most of these agribusiness students are having difficulties in learning calculus at the college level. Conclusively, this results in extreme stress which affects their learning behavior and leads to poor performance. Also, it is concluded that these agribusiness students are naturally experiencing emotional exhaustion and frustration in learning calculus due to its challenges that they faced. Furthermore, these students are averagely experiencing absenteeism, somatic burden, and laziness in learning. It is found out that these negative learning experiences are inter-correlated and dependent on each other which is troublesome in the classroom environment. However, it is revealed that these students are still moved to learn for the fact that this calculus subject is part of their curriculum. Hence, calculus teachers must facilitate well the student's interest and well-being of students to find a remedy for their negative experiences. Through proper motivation of these students, it can improve their happiness in learning and progress their level of achievement in calculus.

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