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MATH ANXIETY, LEARNING ENGAGEMENT AND PERCEIVED USEFULNESS OF TECHNOLOGY AS PREDICTORS TO PERFORMANCE OF STUDENTS IN MATHEMATICS

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Abstract:

The focus of this research was to verify if there was a link among anxiety toward mathematics, learning engagement, and their perception of technology's usefulness in mathematics. This ex-post research looked into the relationship and predictive degree of students' math anxiety, learning engagement, and perceived usefulness of technology to their mathematics achievement. Both math anxiety and students' perceptions of the utility of technology in learning have a significant impact on students' mathematics performance, but not on their engagement. The findings showed the importance of a high level of anxiety in improving student math performance. Additionally, math anxiety and the perceived usefulness of technology were discovered to be predictors of student mathematics performance. The findings suggest that anxiety, engagement, and perceptions of technology's usefulness should all be considered when improving students' general mathematics performance.

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SỰ LO ÂU VỀ TOÁN HỌC, SỰ THAM GIA HỌC TẬP VÀ TÍNH HỮU ÍCH CỦA CÔNG NGHỆ: CÁC YẾU TỐ DỰ BÁO KẾT QUẢ HỌC TẬP CỦA SINH VIÊN TRONG MÔN TOÁN

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Tóm tắt

Việc đạt được tầm nhìn, sứ mạng và mục tiêu của một tổ chức phụ thuộc phần Nghiên cứu này nhằm tập trung xem xét liệu có mối liên hệ nào giữa sự lo lắng đối với môn toán học, sự tham gia học tập và nhận thức của họ về tính hữu ích của công nghệ trong toán học hay không. Kết quả nghiên cứu đã chỉ ra có sự tồn tại mối quan hệ giữa mức độ dự đoán của sự lo lắng đối với toán học, mức độ tham gia học tập và tính hữu ích của công nghệ đối với thành tích toán học của sinh viên. Cả sự lo lắng về toán học và nhận thức của người học về tiện ích của công nghệ trong học tập đều có tác động đáng kể đến kết quả học toán, nhưng không ảnh hưởng đến sự tham gia của các em. Kết quả cho thấy tầm quan trọng của mức độ lo lắng cao trong việc cải thiện thành tích toán học của sinh viên. Ngoài ra, sự lo lắng về toán học và tính hữu ích của công nghệ được phát hiện là những yếu tố dự báo hiệu quả học toán của sinh viên. Các phát hiện cho thấy rằng sự lo lắng, sự tham gia và nhận thức về tính hữu ích của công nghệ đều nên được xem xét khi cải thiện thành tích toán học nói chung của sinh viên.

Introduction

Even before the pandemic, it was well knowledge that college students struggled the most, if not the majority of the time, especially in mathematics classes which is confirmed by the latest Philippine National Achievement Test (NAT) results which revealed a deteriorating mathematical competency in 2004-2012 [13]. Intriguingly, the Philippines is not the only country where students' passing rates in math-related college courses are declining. Harrington, et al. [16] found a significant performance problem in Algebra among black universities in United States and Benken [6] highlights the findings that the knowledge of students in Mathematics gained in their high school years is not an indicator of student readiness and their academic performance in the subject does not necessarily means that students are prepared to take college. In Compostela Valley State College of Davao de Oro, Philippines, practices open admissions which means that students no longer undergo written examination in order to be admitted and upon evaluating students' performance in mathematics, the institution finds it very low and also observed that students find difficulty in delivering intended student's learning outcomes in math-related courses and mastering advance mathematical skills. Dowker, Sarkar and Looi [12] claim that anxiety is a problem not only in elementary and high school students, but also in tertiary education and considered a major concern among college students, but also because it has been a decade-long issue in educational settings

[12]. Not only that, understanding the behavior of the students or how students engage in learning the subject provide an indication of how the instructions and academic practices are going on in an institution [10] and providing students the luxury to several access to learning through technology such as E-learning can contribute to the success of students in their academic endeavor [19].

Despite the initiative of the researchers to give clarification to these phenomena, there are no researches or little studies if there is, have explored the identified factors connecting to mathematics performance of tertiary education students. The intent of this research focused on the ability of students' anxiety, learning engagement and perceived usefulness of technology in mathematics to predict student mathematics performance in tertiary education of the selected second year college students in the selected Teacher Education Institutions (TEIs) in Davao de Oro specifically in Compostela, New Bataan, Montevista and Maragusan who took mathematics subjects/courses.

Student Math Anxiety. Stubblefield [35] as cited in the study of Ayadi [5] believes that if the students suffer from mathematics anxiety, their willingness to enroll, engage and succeed in the subject might decreased. In teaching Mathematics, many teacher practices have been shown to raise students' anxiety. Embarrassing students in front of the class through giving negative feedback or emphasizing their mistakes in front of their classmates, displaying signs of gender stereotyping and/or gender bias, having a negative attitude when discussing the topic, preventing students from raising questions or clarifications by responding angrily, and the instructor's capacity or knowledge of the topic [29]. Syed Wahid, Yusof, and Razak [41], on the other hand, examine Malaysian students' emotion, assessment, and environment as factors in math anxiety. This indicates that the expression of students' anxiety can be seen in the math assessment test which includes feelings like fear of receiving poor grades, tiring preparations, and low self-confidence, among others. Furthermore, the self-efficacy, grade anxiety, future, in-class, and assignment factor are significant aspects that measure students' math anxiety and attitude considered in this study ([24]; as cited by [34]).

Self-Efficacy refers to a set of beliefs students have regarding their academic abilities. Another dimension that increases student anxiety towards Mathematics is grade. Academic grades are "*used to provide feedback, promote or retain students, identify students for special classes, grant admission into colleges or universities and even college scholarships. Academic grades have been used as a mechanism for managing adolescent behavior*" ([21], pp. 65-66). The future factor is thought to be linked to self-efficacy and math anxiety, both of which are linked to future courses and careers ([24]; as cited by [34]). This pertains on the different insights of the students on the use of Mathematics in their future career. In-class factors are another dimension of student math anxiety. Assignment factor is another dimension of anxiety which includes the dimension of self-efficacy and anxiety related to students' attitude in making assignments ([24]; as cited by [34]).

According to Tariq and Durrani [42], students with higher levels of self-efficacy have higher levels of general mathematical achievement and a good attitude toward Mathematics, indicating that self-efficacy has a comparable effect on students' Mathematics performance [32]. Students with high levels of self-efficacy exhibit actions such as routinely attending class, completing homework, reading mathematical textbooks, and seeking help from others [18]. Math anxiety can emerge even in young children, according to Dempsey and Huberi [11], and they may even experience the tremendous load of learning the subject in high school, according to Pollio and Hochbein, [33], who also believe that grades have a key part in these repercussions. Academic grades can then affect students' emotions about the subject, as well as their risks of losing opportunities like scholarships, admission to desired colleges, confidence, and even the desire to continue studying [33].

Student Learning Engagement. Learning or student engagement is considered to be one of the significant determinants of student behavior in the academe [10]. It refers to the positive interaction of students in the learning environment such as the teacher, its peers and the school ([23]; as cited by [10]). The dimensions of student learning engagement are affective, behavior and cognitive which were used in this study [40].

Affective engagement refers to the optimistic behavior of students during mathematics classes like interest, happiness, enjoyment and alertness ([40];[31]). Behavioral engagement can be observed through students' active participation in the class such as asking questions, their efforts, attendance to classes, volunteering to answer problems and non-academic activities [3]. Cognitive engagement refers to metacognitive and self-regulatory strategies employed by students to better comprehend the instructional material [31]. Rotgans and Schmidt [35] defined cognitive engagement as the "*extent to which students are willing and able to take on doing the task at hand*" (p. 467). Cognitive engagement comprises

"*more inward indicators, for example, such that self-regulation, the worth about education, objective orientation, self-sufficiency*" ([1]; p.7).

Student Perceived Usefulness of Technology. E-Learning gives students the freedom to learn from anywhere, at any time, and at their own pace. It gives students the option of learning at their own pace. People from all around the world may join together to learn, cooperate, and share knowledge thanks to eLearning. E-Learning is more likely to be used as a way of learning by those who find it useful. It was believed that the attitude of the students towards technology is a major determinant of students' acceptance and rejection of the system ([9]; as cited by [15]). To understand student perception on the use of technology in learning, dimensions such as perceived ease of use, perceived usefulness and attitude toward using technology (E-learning) adapted from Granić and Marangunic [15] are used in the study.

The degree to which a person believes that utilizing a certain technology would be painless is referred to as perceived ease of use ([9]; [45]). Ngabiyanto, Nurkhin, Widiyanto, Saputro, and Kholid [27] found that perceived ease of use influenced student intention to use internet-based learning indirectly through perceived usefulness and perceived enjoyment. Keržič, et al. [20] found that perceived ease of use has a significant effect on students' attitudes and perceived usefulness simultaneously. On the other hand, perceived usefulness refers to the level to an individual believes that technology enhances performance [15]. Lastly, the perceived ease of use refers to the degree which individual felt less difficulty in using technology ([9]; as cited by [15]).

Student Mathematics Performance. Mathematics is used in almost every aspect of life. A critical mathematics education is concerned with addressing mathematics in its many varied applications and activities. There are no attributes that may be immediately connected with mathematics, such as objectivity and neutrality. Mathematics-based action can be used to fulfill a variety of purposes, but it must be properly scrutinized. This holds true for any type of mathematics, including daily math, engineering math, academic math, and ethno math ([38]; [44]).

In the neighboring countries of the Philippines like Taiwan, despite of its high average performance in Mathematics compared to other countries as revealed from the results of the Program for International Student Assessment Student Assessment (PISS) and the Trends in Mathematics and Science Study (TIMSS) in 2015, there are still substantial percentage of low-achieving students ([28]; [26]). The problem of unsatisfactory performance of college students in mathematics is also prevalent in Malaysia ([41]; [4]). Another study cited by Chaman et al. [7] recorded a significant decline in the number of students enrolled in the college mathematics subjects in India.

Students' eventual failure in the subject are very much alarming and need immediate attention. The thinking that Mathematics is a difficult subject worsens the situation of Mathematics in the education system. Some students express disinterest and unwillingness in the subject. Instead of being challenged, they have resigned to the idea that they just cannot make it. In addition to this, the students' inability to comprehend and master mathematical concepts and develop skills leads to low achievement in Mathematics, weak attainment of higher-level skills, and unsatisfactory academic performance.

Methodology

This study employed a causal-comparative research design. This study was conducted in a state college in Davao de Oro, Philippines specifically in the selected college institutions in Davao de Oro particularly in Compostela, New Bataan, Maragusan and Montevista. These schools were chosen since they are currently offering teacher education courses who are taking GED 3 subjects. The population of the study were the second-year college education students across all campuses of the selected TEIs in the different municipalities in Davao de Oro, Philippines who already took the GED 3 (Mathematics in the Modern World). This study includes 264 respondents which were divided proportionally into all participating and selected randomly in all selected campuses located in Davao de Oro, Philippines.

Three test questionnaires were adopted in this study: The Mathematics Self-Efficacy and Anxiety (MSEA) Questionnaire [24], Classroom Engagement Inventory Questionnaire [43] and the Questionnaire on Students' Attitude towards the use of an E-learning environment [2]. Statistical Packages for the Social Sciences (SPSS) version 20 was used to tally, classify, and analyze all of the data and information. The Likert scale was used to determine the weighted values attributed to professional skills and work ethics.

Results and Analysis

Correlation between Mathematics Anxiety, Learning Engagement and Perceived Usefulness of Technology to Student Performance in Mathematics

Presented in table 1 the significance on the relationship between mathematics anxiety, learning engagement and perceived usefulness of technology to student performance in Mathematics using the Pearson-r correlation test. It can be perceived in the

table that there is significant relationship between math anxiety (r=0.137, p=0.012) and perceived usefulness of technology (r=0.036, p=0.002) to the student performance in Mathematics. Also, using the r-value found in the table, it can be deduced that there is a positive correlation (0.137) from Math anxiety

and a negative correlation from perceived usefulness of technology (-.173). On the other hand, since the p-value of learning engagement (0.276) is greater than 0.05, then, there is no significant relationship between student learning engagement and student performance Mathematics. This is similar to the findings of Rozgonzuk et al. [36], who suggested that math anxiety is linked to unfavorable attitudes toward mathematics. This is in contrast to the findings of Zhang, et al. [46], who found a negative relationship between anxiety and performance, indicating that when students' anxiety is high, their math performance is likely to be low, and that the association is present among senior high school students, leaving a clearer picture in the tertiary condition. A study by Hartono et al. [17] found similar results, claiming that student involvement varied significantly by gender and class level, with upper-class students interacting. One factor that led to the students' low engagement is the institution's current online learning setup, in which teachers and students meet only twice a month, which reduces their involvement.

Daher [8] found similar results which showed that effectiveness of the instructional support using groups work and technology led to positive impacts on students' emotions and communication abilities in learning geometry. Furthermore, according to Moreno-Guerrero, Aznar-Diaz, Caceres-Reche, and Alonso-Garcia [25], the use of e-learning has a favorable impact on motivation, autonomy, participation, mathematical concepts, results, and grades.

Regression Analysis on Mathematics Anxiety, Learning Engagement and Perceived Usefulness as Predictors of Technology to Student Performance in Mathematics

Presented in table 6 is the regression analysis on mathematics anxiety, learning engagement and perceived usefulness of technology as predictors of technology to student performance in Mathematics. The table shows a computed F-ratio of 4.360 and a p-value of 0.005 which means that the three independent variables can significantly predict student performance in Mathematics when taken as a whole. The r-value is 0.217, indicating a positive relationship between mathematics anxiety, learning engagement and perceived usefulness of technology as predictors of technology to student performance in Mathematics. The overall R^2 is 0.047, indicating that 4.7% of student performance in Mathematics is explained by mathematics anxiety, learning engagement and perceived usefulness. Moreover, only Math anxiety and perceived usefulness of technology significantly predict student mathematics performance. On the other hand, learning engagement does not significantly predicts the performance of the students in Mathematics.

These findings are backed up by Olango [29], who claims that mathematics anxiety can predict student performance in the subject. It is reasonable to assume that grade conscious pupils have a direct positive impact on their performance based on this notion. Lim's [22] conclusion that mathematics anxiety is a good predictor of student results was also supported by the findings. He claims that anxiety before, after, answering quizzes, and doing difficult mathematical tasks, as well as four basic operations and their application in daily life, is a good predictor of mathematics achievement. These data, however, contradict Getahun's et al. [14] assertion that anxiety is not a predictor of student performance. Prior achievement (pre-university mathematical performance) and self-efficacy attitudes were found to be significant predictors of performance on the university mathematics course, according to the researchers. In the case of E-learning, Zolochevskaya et al.

Table 5. Correlation between Anxiety, Engagement and Perceived Usefulness of Technology to Student Performance in Mathematics

Independent Variable	**Dependent Variable**	**r**	**r^2**	**p-value**	**Decision**
Math Anxiety	Student Performance in Mathematics	0.137*	0.019	0.012	Reject Ho
Learning Engagement		0.036	0.001	0.276	Fail to reject Ho
Perceived Usefulness of Technology		-0.173*	0.030	0.002	Reject Ho
**p > 0.05; **p > 0.01*					

Table 6. Regression Analysis between Anxiety, Engagement and Perceived Usefulness of Technology to Student Performance in Mathematics

Independent Variables	Unstandardized Coefficient		Standardized Coefficient	t-value	p-value	Decision
	B	SE	(beta)			
(constant)	2.623	0.413				
Math Anxiety	0.155	0.071	0.133*	2.185	0.030	Reject Ho
Learning Engagement	-0.008	0.069	-0.007	-0.115	0.908	Fail to reject Ho
Perceived Usefulness of Technology	-0.220	0.079	-0.170*	-2.797	0.006	Reject Ho
Dependent Variable: Mathematics Performance						
Dependent Variable			Mathematics Performance			
R= 0.217*			R^2 = 0.047			
F-ratio = 4.360			p-value = 0.005			

[47] back up this assertion by revealing that ICT has a significant statistically advantageous effect on students' academic progress.

Moreover, the study also found out that learning engagement is not a predictor to students' performance in Mathematics. This contradicts the planned behavior theory, which states that attitudes and subject norms influence behavioral intentions and student engagement [37] implying that students' level of involvement with the subject has no bearing on their performance.

Conclusion

The researcher concluded that the level of students' math anxiety and perceived usefulness of technology were high. The level of student engagement, on the other hand, were recorded low. The level of students' performance in Mathematics in term of their average grade in a general mathematics subject were also recorded high. Both math anxiety and perceived usefulness of technology in learning have significant relationship to students' performance in Mathematics and were found to be predictors to student performance in Mathematics. However, when taken as a whole, all the independent variables have predictive ability to student performance in Mathematics.

After giving thoughtful consideration to the probable ramifications of the study's results and analysis, the researcher came up with a number of recommendations as follows: (1) school administrators may reconsider the curriculum revision and incorporate the use of student anxiety, engagement, and technology in learning through teaching strategies, learning outcomes, and assessments. (2) Teachers may encourage learners to enhance their skills in the use of technology in learning through providing and exposing them to different platforms, software and learning platforms available online. (3) Teachers may provide authentic learning experiences to instruction to boost student learning the subject. (4) Teachers may provide a step-by-step process on how to use different methods in solving problems, equip students with the basic solving skills and provide real-life problems solving and lastly (5) the researcher recommends to inculcate the value of sense of responsibility to the students through understanding the importance of performance and maintain positive attitude towards learning Mathematics.

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