Original Article

SELF-EFFICACY AND MATHEMATICS PERFORMANCE AMONG COLLEGE STUDENTS: BASIS FOR DEVELOPMENT OF MATHEMATICS ENGAGEMENT TRAINING

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DOI: 10.47750/pnr.2022.13.S01.203

Abstract

This descriptive-correlational study aimed to determine the extent of self-efficacy and mathematics performance among College students, which will be the basis for mathematics engagement training. One hundred fifty students chosen randomly were the respondents of the study. Findings revealed that most students rated "moderate" self-efficacy and "very high" mathematics performance. exhibited "extremely high" mathematical proficiency in a category like sex and course. When the respondents were divided by course and sex, there were no discernible variations in their mathematical ability and sense of self-efficacy. Only when performance in mathematics is categorised as to course does a noticeable difference appear. There were significant and adverse associations between respondents' self-efficacy and mathematical performance.

Keywords: College students, Mathematics, Mathematics engagement training, Mathematics performance, Self-efficacy.

1. INTRODUCTION

Self-efficacy has an impact on every aspect of human endeavour. The ability to meet obstacles head-on and the decisions one must make are both significantly influenced by self-efficacy. Self-efficacy, according to Bandura (2020), is a person's confidence in their ability to take the actions necessary to accomplish particular goals. A strong sense of self-efficacy fosters success and personal fulfilment in people. High self-efficacy individuals see obstacles as opportunities to learn from rather than dangers to be avoided. These individuals may bounce back from failure more quickly and are more inclined to blame ineffectiveness on lack of effort. They assume they can control dangerous circumstances as they approach them.

On the other hand, those with low levels of self-efficacy avoid complicated jobs because they perceive them as personal dangers. Complex challenges cause individuals to focus on the abilities they lack rather than their strengths. After a failure, they are prone to losing confidence in their talents. Higher stress and depression levels have been correlated with low self-efficacy.

2. LITERATURE REVIEW

2.1. Mathematics Performance

Other than cognitive aspects, learning mathematics requires a strong sense of effect. One of the emotional aspects that can influence how well students learn is self-efficacy. Student's behaviours, attempts, tenacity, adaptability in the face of differences, and goal utilisation are all impacted by their level of self-efficacy, according to Bandura (1993). According to Bandura's hypothesis, persons who have high self-efficacy—those who are confident in their ability to do well—are more inclined to regard hard activities as challenges to be overcome rather than avoid. The degree to which a student believes in his own abilities has a big impact on how well he does in school. According to Zimmerman (2019), during the past 20 years, self-

efficacy has become a highly accurate predictor of students' motivation and learning.

The authors Negara, Nurlaelah, Wahyudin, Herman, and Tamur (2021) confirmed a favourable correlation between mathematics performance and self-efficacy. He goes on to say that math performance increases with self-efficacy and vice versa; decreasing self-efficacy would result in increasing math performance. Students who perform well in arithmetic have high levels of self-efficacy, which gives them the assurance that they can rely on their skills. Students with strong levels of self-efficacy can complete assignments with excellent mathematical proficiency. The results of earlier research by Wang, Liang, Lin, and Tsai (2017), which show a favourable association between the two variables, are supported by these findings. This outcome further supports the notion that online learning might boost self-efficacy.

2.2. Mathematics Engagement and self-efficacy

According to Sullivan, McDonough, and Harrison (2004), student engagement is defined as their participation in mathematical activities in the classroom and their dedication to understanding the material. In order to learn concepts and methods and to keep participating in the topic, students must pay close attention to Mathematics. However, the low level of student interest in mathematics is frequently bemoaned.

Self-efficacy is a key factor in influencing our odds of success, according to Zimmerman (2019). The self-efficacy or self-belief of a student has a significant impact on his academic achievement. Self-efficacy is the belief that one can accomplish a goal or prevail in a certain circumstance. Over the past 20 years, self-efficacy has developed into a highly successful predictor of students' motivation and learning. Perceived self-efficacy, according to Bandura (1993), is the belief that a person has in their ability to achieve a goal. Their objectives, level of motivation, and academic success are all influenced by students' perceptions of their ability to control their learning and direct academic activities. Gandhi (2008) realised the crucial part that self-belief plays in our lives. Similar principles apply to metacognition, which is just thinking about one's own thinking. In particular, it alludes to the processes used to arrange, monitor, and assess a person's performance and knowledge. It involves being critical of one's own thinking, learning, and identity as a thinker, learner, and student. Tok, zgan, and Döş (2010) stressed the significance of metacognitive awareness and learning approaches for students to achieve academically in an online English course. The subscales evaluating the evaluative method and metacognitive awareness both positively predicted academic success. Peer learning practises, organisation, and MSLQ subscales were effective predictors of academic performance. Schoenfeld (1985) came to the conclusion that "learning to solve problems is the main motivation for studying mathematics" as a result".

The first step in creating the framework was to take into account prior work. The majority of the research on mathematical problem-solving has been used to support Polya's (1957) four-phase definition of problem-solving activity, which may be found on study.com (2022). Numerous heuristic procedures that may promote effective problem-solving are identified by the four phases of comprehending, planning, executing the plan, and reflecting back.

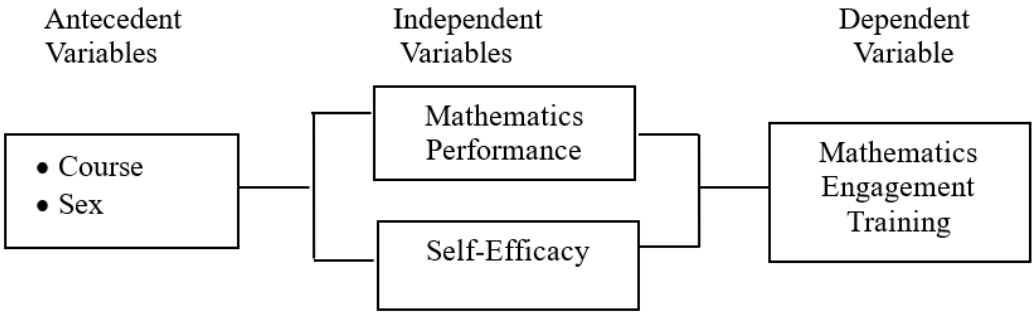
According to Susanto and Mukhidin (2016), there is a connection between the student achievement index and the metacognition score from the Awareness Inventory (MAI). Research has shown a substantial relationship between student achievement and students' metacognitive abilities as assessed by the MAI index test. This association is consistent with that research. It revealed a strong relationship, using quadratic models, between metacognitive abilities and student achievement index. A student's problem-solving skills can be inferred from their metacognitive skill ratings. Susanto goes on to say that metacognitive abilities can aid pupils in comprehending the causal connection between two events. Implicitly, it can be claimed that metacognitive abilities influence how well pupils comprehend the subject matter and solve difficulties while learning.

Perceived self-efficacy, as defined by Bandura (1993), is the belief that one can achieve a goal, according to Betoret, Roselló, and Artiga (2017). Their objectives, level of motivation, and academic success are all influenced by students' perceptions of their ability to control their learning and direct academic activities.

Gifted math students demonstrated high self-efficacy, according to Camarista (2012). In terms of cognitive ability and self-efficacy, students with moderate parental support outperformed those with high parental consent. When respondents were divided according to course and sex, there were noticeable disparities in self-efficacy; mediating these differences were the effects of cognitive capacity and parental support.

Numerous studies have examined the value of performance and self-efficacy in college students. To assess arithmetic performance, more research on self-efficacy is important. the many courses offered at the West Visayas State University-Pototan Campus serve as the foundation for mathematical training. The findings of the study would also be advantageous to WVSU-Pototan Campus. Figure 1 depicts the other variables' paradigms.

Figure 1. The research paradigm shows the relationship among variables.



The conceptual paradigm shows the relationship among variables. The antecedent variables of the study are the course and sex. The study's independent variables are mathematics performance and self-efficacy, which is the basis for the mathematics engagement training dependent variable.

3. OBJECTIVES OF THE STUDY

In order to provide training in mathematics engagement, this study intends to ascertain the level of self-efficacy and mathematical performance among college students.

This research specifically aimed to respond to the following questions:

1. What is the self-efficacy level of the respondents when seen as a whole and divided into groups based on course and sex?
2. What are the respondents' overall performance levels in Mathematics when classified by course, sex, and self-efficacy?
3. When comparing respondents by course and sex, is there a discernible difference in their self-efficacy?
4. When the respondents are divided by course and sex, do the results in mathematics show a discernible difference?
5. Is there a connection between mathematical performance and self-efficacy?

Based on the preceding problems, the following hypotheses are advanced:

1. When the respondents are categorised by course and sex, there is no discernible variation in their self-efficacy.
2. When the respondents are categorised by course and sex, there is no discernible difference in how well they perform in math.
3. Is there no connection between math achievement and the variable self-efficacy?

4. METHODOLOGY

4.1 Research Design

Descriptive-correlational research was the methodology employed in this study. Descriptive and correlational research methodologies are combined in descriptive-correlational research. To test hypotheses or provide answers to inquiries about the current state of the issue under investigation, descriptive research entails gathering data. Descriptive research determines and

describes how things are, while correlational research gathers data to ascertain whether and to what extent there is a relationship between two or more quantifiable factors. This is how Siedlecki (2020) distinguished the two types of research.

4.2. Participants of the Study

155 students from the West Visayas State University-Pototan Campus who were enrolled in various courses participated in the study. These participants were chosen at random during the second semester of the academic year 2017–2018 and include graduates of the bachelor's degree programmes in secondary education (BSEd), elementary education (BEED), technical teacher education (BTTE), hotel and restaurant technology (BSHRST), information technology (BSInfo Tech), and industrial education (BSIT). 15 BSEd, 74 BEED, 7 BTTE, 30 BSHRST, 22 BSInfo Tech, and 15 BSIT students were enrolled. Table 1 displays the respondents' course and sex classifications.

Table 1. Distribution of the Respondents

Category	**f**	**%**
A. Entire Group	155	100
B. Sex		
Male	37	23.87
Female	118	76.13

Table 1 shows the distribution of responses by course, sex, mathematical performance, and self-efficacy. Men made up 37 or 23.87% of the respondents, while women made up 118 or 76.13%. 96 or 61.94 and 59 or 38.06% of the respondents were judged to be average and low, respectively, when the respondents were separated into groups based on their math prowess. When the respondents were categorised by self-efficacy, 141 or 90.97% had high and moderate self-efficacy, respectively, while 14.3% had low self-efficacy.

4.3. The Instrument

A 4-point Likert scale self-efficacy scale created by Jerusalem and Schwarzer was adapted by the researcher to the data collection tools (2010). Additionally, the Metacognitive Awareness Inventory (MAI), created in Oz by Schraw and Dennison in 1994, was used to determine how well students performed in math (2016). Additionally, content validity and reliability test were performed on the instruments, with a self-efficacy coefficient of 0.805 and an MIA coefficient of 0.934. The respondents' average final grade in mathematics class served as the basis for their performance in mathematics. The participants graded each item on a scale of not at all true (1) to exactly true (4). Additionally, there are two components to the study's instrument: Part I contains personal information and a student's math grade. Part II posed roughly fifteen questions concurrently.

4.4. Data Gathering Procedures

The final questionnaire was utilised for 155 participants. A letter asking permission was given to the Campus Administration of the WVSU-Pototan Campus to conduct the study. Afterwhich, the researcher administered the questionnaire giving the participants enough time to answer the questions. All data gathered were tabulated and computed.

4.5. Data Analysis

The following statistical tools were used to analyse the data gathered to obtain the desired data: the Means and standard deviation for descriptive statistics—the Analysis of Variance (ANOVA), and the Pearson r correlation for self-efficacy and mathematics performance. For the inferential statistics, t-tests for independent samples were used. All statistical computations were computed using the Statistical Packages for Social Sciences (SPSS) set at a 0.05 alpha significance level.

5. RESULTS AND DISCUSSION

Table 2. *Means and Standard Deviations of Self-Efficacy Grouped According to Some Categories*

Category	Mean	SD	Description
A. Entire Group	3.15	0.43	Moderate
B. Sex			
Male	3.19	0.07	Moderate
Female	3.13	0.04	Moderate
C. Courses			
BEED	3.16	0.45	Moderate
BSEd	3.15	0.43	Moderate
BTTE	3.25	0.56	Moderate
BSIT	3.24	0.26	Moderate
BSInfo Tech	3.09	0.33	Moderate
BSHRST	3.07	0.43	Moderate

Note: 3.26-- 4.00 Very High Self-efficacy, 2.51-3.25 Moderate, 1.76-2.5 low, 0-1.75 very low

The self-efficacy levels of the respondents are shown in Table 2 together with their means and standard deviations. The respondents' overall self-efficacy is "moderate" (M = 3.15, SD = 0.43) and is also "moderate" when the respondents are divided by sex. The respondents also have "moderate" self-efficacy when categorised by course and sex.

Table 3. *Means and Standard Deviations of Mathematics Performance when Grouped According to Some Categories*

Category	Mean	SD	Description
Entire Group	46.24	5.24	Very High
Sex			
Male	47.95	3.61	Very High
Female	45.70	5.56	Very High
Course			
BEED	46.36	5.07	Very High
BSEd	41.80	6.21	Very High
BTTE	44.71	8.98	Very High
BSIT	50.14	3.29	Very High
BSInfo Tech	46.73	4.52	Very High
BSHRT	47.23	3.63	Very High

Note: 41.61-52 Very High, 31.21-41.60 High, 20.81-31.20 Moderate, 10.41-20.80 Low, 00-10.40 Very Low

The averages and ranges for math performance are shown in Table 3. The respondents' performance in mathematics showed "extremely high" and rather considerable dispersion on average (M 46.24, SD=5.24). Males and females performed equally well in mathematics when categorised by sex.

Table 4. *t-test Results of Self-Efficacy when the Participants were Grouped According to Sex*

Category	Mean	t-value	df	Sig.
Sex				
Male	3.19	0.802	153	0.424
Female	3.12			

Table 5. *Results of Self-Efficacy when the Participants were Grouped According to Course*

Source of Variance	Sum of Squares	df	Mean of Squares	F-Value	Sig.
Between Groups	0.671	5	0.134	0.73	0.60
Within Groups	27.31	149	0.183		
Total	**27.99**	**154**			

ANOVA and the t-test are displayed in Tables 4 and 5. The outcome reveals that there are no significant differences in the respondents' self-efficacy when they are categorised as to sex (t (0.802) = 0.424, p>0.05), and course (F (5, 149) =0.73, p>0.05). The respondents' levels of self-efficacy were similar across all groupings, including those based on sex and course. According to Chen's (2014) research, more female students than males showed high levels of self-efficacy. When respondents were categorised according to sex, Camarista (2012) found a substantial variation in their self-efficacy.

Table 6. *t-test Results of Mathematics Performance when the Participant was Grouped According to Sex*

Category	Mean	t-value	df	Sig.
Sex				
Male	2.30	-0.195	153	0.845
Female	2.32			

Table 6 demonstrates that there was no statistically significant difference in respondents' math scores when they were grouped by sex, with t (-0.195) = 0.845, p>0.05. This result suggests that math performance is comparable for male and female students.

Table 7. *ANOVA Results of Mathematics Performance when the Respondents were Grouped According to Course*

Source of Variance	Sum of Squares	df	Mean of Squares	F-Value	Sig.
Between Groups	454.603	5	90.921	3.59	**0.004***
Within Groups	3775.565	149	25.339		
Total	**4230.168**	**154**			

Table 7 demonstrates a statistically significant difference in the respondents' math ability by course (F(5, 149)= 1.66, p .05. This appears to indicate that respondents from BSEd performed better in mathematics than respondents from other courses or programmes. This finding conflicts with research by Tiyuri, Sabiri, Bayat, and Salehiniya (2018), Garavand, Kareshki, and Ahanchian (2014), and Park, Kim, and Chung (2011), which found no significant differences in self-efficacy scores by gender or between students from various schools.

Table 8. *Post hoc (Scheffe Test) of Mathematics Performance*

Category		Mean Difference	Significance
BSEd	BSIT	8.343*	0.026
	BSHRT	5.433	0.056
BSIT	BSHRT	-5.433	0.055

Table 9. *Correlation Results Among Variables*

Category		Mathematics Performance
Self-efficacy	Correlation I	-0.41*
	Significance	0.00
Mathematics Performance	Correlation I	
	Significance	

Table 9 shows that self-efficacy and mathematical performance have a significant association (r=-0.41, p.05). This suggests that the respondents' self-efficacy and math prowess were the criteria discovered to be substantially connected. The results might suggest that people perform better in mathematics if they have a stronger belief in their ability to handle challenges or challenging circumstances. In other words, kids tend to perform better in arithmetic when they have a stronger belief in their ability to handle upcoming scenarios. The findings of this study are corroborated by a study by Tiyuri, Sabiri, Bayat, and Salehiniya (2018) that found a significant direct association between students' GPA and self-efficacy, with the latter having a major impact on academic accomplishment.

Additionally, kids are more self-assured and capable of managing unforeseen circumstances well. The results show that self-efficacy has a major impact on how well respondents perform mathematically. As a result, it may be hypothesised that people who score well in math have a strong belief in being able to handle stresses and problems in their surroundings. According to Chen's (2014) research, students who felt highly capable of succeeding generally performed better (GPA). According to Camarista (2012), the influence of cognitive capacity and parental support was moderated by self-efficacy.

SUMMARY OF FINDINGS

The following were the findings from the data gathered:

1. The respondents have "moderate" self-efficacy as a whole and when divided by sex and course groups.
2. When categorised according to the course, the respondents' dispersion was, on average, "moderate" and rather large. In terms of gender, math performance was "moderate" for both genders.
3. Overall, the responders' math performance was rated as "Very high." Respondents had "Very High" math skills with a small difference when categorised by course. No matter their sex or subject, their math performance was "Very High." The arithmetic performance of those who reported having "moderate" self-efficacy was also "Very High."
4. The respondents' self-efficacy when divided by sex and course does not significantly differ. The respondents exhibited comparable levels of self-efficacy regardless of the categories, including those based on sex and course.
5. When arithmetic performance is categorised according to course, there is a sizable variation, and the difference is between BSED, BSIT, and BSHRST. This finding appears to indicate that the BSEd respondents performed better in mathematics than their colleagues from other degrees or courses.
6. As a foundation for mathematics engagement training, the statement "Mathematics performance has a significant link with self-efficacy" seems to imply that "self-efficacy and mathematics performance were the factors discovered to significantly affect the respondents' mathematics performance." As a result, the relationship between the research self-efficacy score and the student's academic performance is that self-learning techniques are associated with academic success.

6. CONCLUSIONS

Academic performance is generally greater for students who have a high feeling of self-efficacy. It should not be the students' only obligation to educate themselves. To improve students' performance, teachers should implement new ideas and strategies like mathematics engagement training. The findings of the study support the notion that a student's sense of self-efficacy is crucial to their academic achievement. Along with possible academic advantages, the association between college students' self-efficacy and mathematics performance lends credence to the notion that this will serve as the foundation for mathematics engagement training. In the end, college students' performance is influenced by their level of self-efficacy. As a result, it provides the framework for the mathematics educators' training programmes on engaging college students in mathematics.

7. RECOMMENDATIONS

In order to improve student's performance in mathematics, school administrators and deans should think about organising initiatives like mathematics engagement training. The study's findings provide a solid foundation on which to design and put into practice strategies for raising the calibre of graduates from higher education institutions who will go on to have successful careers as employees. The pupils' self-efficacy should be developed through activities led by guidance counsellors. The performance of kids in mathematics should be improved by schools. Schools and teachers should think about ways to include students in learning at all stages of schooling's developing process. Diverse forms of participation should be encouraged, such as support and monitoring tasks. Schools that struggle to produce mathematicians at a high level should think about how to motivate students to take mathematics engagement training. More research is required in this area, even if the study's findings are consistent with the notion that self-efficacy has favourable effects on students' mathematical ability.

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Appendix

Mathematics Engagement Training

a. Rationale

This mathematics training is based on the research entitled "Self-efficacy and Mathematics Performance among College Students: Basis for Mathematics Engagement Training".

b. Objectives: To conduct language facility and problem-solving ability, mathematical ability and research/statistical capability among college students.

c. Plan of Objectives

Activities/Projects	Strategies	Performance Indicator	Timeframe	Person Responsible
Language Facility & problem-solving ability	Conduct grammar & language In-Service Training used in problem-solving	Students who are poor in mathematics per course	Five weeks	Subject Teachers
Mathematical Ability	Conduct Seminar on Problem-solving, Mathematical Investigation & Statistical games	Students per course are given seminar-workshop on Problem-solving activities.	Four weeks	Subject Teachers
Research / Statistical Capability	Conduct statistical and research capability building, research forum and research preparation for both Quantitative and Qualitative research	Students apply their mathematical/statistical knowledge in research preparation for qualitative and quantitative research.	Five weeks	Subject Teachers