



Classroom Learning Environment and Self-Efficacy in Mathematics of Freshmen Engineering Students of the University of Eastern Philippines

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Authors' contributions

This work was carried out in collaboration between both authors. Author RES designed the study, performed the data gathering and statistical analysis, wrote the proposal, and the manuscript. Author RCB assisted in the conceptualization of the study, how the data gathering process will be done and the statistical tool to use. She also read and edited the first draft, indorsed it to the panel of examiners for final defense. Both of them read and approved the final manuscript.

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ABSTRACT

Aims: To determine the classroom learning environment in terms of goal orientation, physical facilities, student-student interaction, teacher-student interaction, method of teaching, and the degree of self-efficacy in mathematics; and establish if there is a significant relationship between their classroom environment and the degree of self-efficacy in mathematics.

Study Design: Descriptive correlational research design.

Place and Duration of Study: College of Engineering, University of Eastern Philippines, Catarman, Northern Samar in the school year 2012-2013.

Methodology: Complete enumeration of 260 freshmen students from the College of Engineering courses: Bachelors of Science in Agricultural Engineering, Civil Engineering, Electrical Engineering, and Mechanical Engineering enrolled in Mathematics were surveyed using the 50-

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item Learning Environment Schedule developed by Sunitha and Mathematics Self-efficacy Survey developed by Betz and Hackett. The data gathered were tabulated, analyzed, and treated statistically using the Statistical Package for Social Sciences (SPSS 16.0 Version).

Results: With the total score of 50594 out of 65000 and a mean of 3.89, the respondents found the classroom learning environment in terms of goal; orientation, physical facilities, student-student interaction, teacher-student interaction, and methods of teaching to be favorable; that the total score of 17634 and a mean of 3.61 showed that respondents had much confidence or had high self-efficacy in Mathematics; and that the Pearson r of .187 with the respective significant value of .001, .000, .011, and .000, goal orientation, student-student interaction, teacher-student interaction and methods of teaching were found to have a significant relationship with self-efficacy in mathematics; and only physical facilities was not significantly correlated to self-efficacy in mathematics.

Conclusion: Classroom learning environment variables are significantly related to self-efficacy in mathematics.

Keywords: learning environment; self-efficacy; mathematics; goal orientation.

1. INTRODUCTION

Generally, students who enroll in engineering courses have a keen interest in mathematics. This is manifested in the admission requirements set by universities and colleges. The entrants in the College of Engineering of the University of Eastern Philippines (UEP-CE) should have an average high school grade of not less than 80% in Mathematics, Science/Physics, and English; 60% PR and above of the Otis Lenon School Ability Test (OLSAT) administered by the UEP Guidance and Testing Center; and 50% and above the mark of the UEP-CE entrance examination of which 80% is on Mathematics before they would be accepted in any engineering course. In other words, admitted freshmen engineering are confident that they can tackle mathematics lessons as evidenced by their good grades in elementary and high school years, and good results in the admission tests.

However, grade sheets in the first-semester Mathematics from 2008-2012 revealed an average failure of 42 percent. As a result, the number of students is trimmed down as they continue the five-year engineering course, mostly because they fail in Mathematics.

The highest percentage of failure, reaching 65%, was recorded in the first semester of the school year 2012-2013. This failure rate is quite alarming and no longer normal. That is why the College of Engineering was prompted to offer the subject in the second semester. Every year more and more students would fail; more and more would-be-engineers would shift, drop, or stop schooling completely.

There may be many reasons why engineering students, whose self-efficacy in Mathematics is expected to be high, fail in their first mathematics subject. Learning environment referred to by authorities stated in Edutechwiki as the whole range of components and activities, within which learning happens, maybe one of these reasons.

Students' immediate environment is the classroom. A classroom is a place where an interpersonal relationship among its occupants is marked by a unique face-to-face encounter. These interpersonal relationships essentially include teacher-student relationships and peer relationships. The general atmosphere within the academic activities that take place influences social relationships. Two types of social interactions occur in the classroom - teacher vs. students and students vs. students. The first one is the most referred in the educational context. However, the interaction going on amongst students is equally significant from a psychosocial standpoint. The success or the failure of the students also depends on the quality of the classroom's social climate. The classroom environment aids the development and effective achievement of a student.

Self-efficacy theorists reported that academic self-efficacy may be sourced from active mastery experience, physiological and affective states, vicarious experiences, and other factors. While not explicitly recognized, some of these sources can be attributed to the classroom learning environment that students experience in their schools and classrooms.

It is noted, however, that not a single study has been conducted on the mathematics self-efficacy

of freshmen engineering students in the University. Since Mathematics is a subject mostly loved by would-be-engineers yet could hardly be hurdled by freshmen who are first-timers in the classroom setting of the University, this study was proposed to investigate this knowledge gap.

2. METHODOLOGY

This descriptive correlational study was conducted at the College of Engineering, University of Eastern Philippines, Catarman, Northern Samar.

The respondents of this study were composed of 260 freshmen students: twenty-four (24) BSAE; ninety-one (91) BSCE; seventy-seven (77) BSEE; and sixty-eight (68) BSME.

In gathering the data of this study, the researcher used a survey questionnaire which was divided into three parts: the questionnaire for the Profile of the Respondents; the 50-item Learning Environment Schedule developed by Sunitha [1]; and the questionnaire in the Mathematics Self Efficacy Survey (MSES) developed by Betz and Hackett as cited by Burnham [2]. This survey was originally developed for the college setting and has been widely used throughout mathematics self-efficacy research. The mathematics self-efficacy described the confidence level of the respondents. It consisted of 18 questions on math problem solving, for which students responded by rating their confidence for each question on a Likert scale ranging from no confidence at all (0) to complete confidence (5).

Part II was the classroom learning environment in terms of goal orientation, physical environment, student-student interaction, teacher-student interaction, and methods of teaching were tallied, and averaged to get the means and percentages.

The responses utilized a five-point Likert scale that was interpreted in the following manner:

Classroom Learning Environment

Scale	Range	Description
5	4.20-5.00	Highly favorable
4	3.40-4.19	Favorable
3	2.60-3.39	Moderately favorable
2	1.80-2.59	Less favorable
1	1.00-1.79	Least favorable

Part III of the questionnaire dealt with the degree of mathematics self-efficacy that described the

confidence level of the respondents, using a rating scale expressed in the following manner:

Mathematics Self-Efficacy

Scale	Range	Description
5	4.20-5.00	Complete Confidence
4	3.40-4.19	Much Confidence
3	2.60-3.39	Some Confidence
2	1.80-2.59	Very Little Confidence
1	1.00-1.79	No Confidence at all

The data gathered were tabulated, analyzed and treated statistically using the Statistical Package for Social Sciences (SPSS 16.0 Version). The statistical measures such as weighted mean, percentage, ranking, and Multiple Regression were used.

3. RESULTS AND DISCUSSION

3.1 Classroom Learning Environment

3.1.1 Goal orientation

The result of the study showed favorable goal orientation of the freshmen UEP-CE students as manifested by the 4.01 mean. This means that these students are better prepared for school activities, assignments, and examinations. This result confirmed the study of Cheng and Phillipson [3] which stated that goal orientation is associated with adaptive outcomes, including high persistence in the face of challenge, use of more elaborate study strategies, positive learning attitudes, and high self-efficacy.

3.1.2 Physical facilities

The classroom learning environment in terms of physical facilities is favorable with a mean of 3.52. This means that the building, rooms, furniture, and teaching facilities in the College of Engineering are more sufficient.

3.1.3 Student-student interaction

The result of the study shows that this aspect of the classroom learning environment gathered the highest score of 10558 or 4.06 means described still as favorable. This means that respondents had better relationships among classmates by the way they participate, help, and share ideas, resources, and even feelings toward other classmates in Mathematics classes.

3.1.4 Teacher-student interaction

This component of the classroom learning environment got a mean of 3.83, lower compared to the other three components yet still described as favorable. This means that the respondents had a better connection to the teacher which enables both to understand each other as manifested by the attention, praise, interest, and help that the student gets from the Mathematics instructors.

3.1.5 Methods of teaching

The result of this survey showed a mean of 4.05 in methods of teaching which is described as favorable. This means that the instructor of Mathematics uses theoretical or practical methods, lectures, explains or uses audio-visual aid in teaching, and other ways so that the concepts to be learned will reach the students.

Generally, the results mean that these respondents prepared for assignments, and other activities in mathematics; that their school building and other facilities are sufficient; that they prefer working with their classmates; and that they expect their teachers to use teaching methods and aids to enhance learning and understanding. It is further implied that the freshmen engineering students will be self-efficacious or confident that they can tackle the challenges of their course for as long as their classroom environment is conducive.

Table 1 shows a classroom environment of UEP-CE students rated as “favorable”. This means that the physical and psychological atmosphere in the college of engineering is generally better.

3.1.6 Degree of self-efficacy in mathematics of UEP-CE students

Guided by the Self-efficacy Theory of Bandura and using the questionnaire designed by

Burnham, the four (4) groups of freshmen engineering students of the UEP-CE were surveyed to test their degree of self-efficacy in Mathematics which is described in this study as confidence in solving mathematics questions. It was found out that The BSCE freshmen scored 6065 with a 3.92 mean, which is described as much confidence. This means that almost 75% of the 18 questions can be solved by the BSCE freshmen students. It is further observed that this group of respondents has the highest confidence that they can solve most of the problems in the questionnaire.

The BSEE, composed of 77 respondents had a score of 5259 or a mean of 3.84 described as having much confidence that they could answer the questions. This means that the freshmen BSEE students have better mathematics self-efficacy.

The freshmen BSME students also were found to have much confidence that they could solve the questions given with a score of 5076 or 3.80 mean. This means that they can solve successfully more than half of the items given in the test.

BSAE composed of 24 students got a score of 1234 or 2.86 mean described as “some confidence” in mathematics. This means that from the 18 questions which cover the various mathematics concepts learned in freshman Mathematics, most of the BSAE freshmen students feel that they can successfully solve 50% of the questions. Among the four groups of respondents, BSAE had the least mean score so it can be inferred that this group had average mathematics self-efficacy.

This result implied that engineering students are equipped with the knowledge and skills needed to pursue the course. However, their self-efficacy needs to be enhanced so that they could excel and be successful engineers in the future.

Table 1. Classroom learning environment of freshmen UEP-CE students

Classroom Learning Environment	Score	No. of respondents	Mean	Description
Goal Orientation	10414	260	4.01	Favorable
Physical Facilities	9152	260	3.52	Favorable
Student-Student Interaction	10558	260	4.06	Favorable
Teacher-Student Interaction	9951	260	3.83	Favorable
Methods of Teaching	10519	260	4.05	Favorable
Total	50594		3.89	Favorable

Table 2. Degree of self-efficacy in mathematics of freshmen UEP-CE Students

Freshmen CE Students	Score	No. of respondents	Mean	Description
BSCE	6065	91	3.92	Much confidence
BSEE	5259	77	3.84	Much confidence
BSME	5076	68	3.80	Much confidence
BSAE	1234	24	2.86	Some confidence
Total	17634	260	3.61	Much confidence

The findings of this study are congruent to Burnham's illustration on how different students interpret efficacy sources in different ways, as well as what considerations might be made for future implementations of the course to fit the needs of characteristically different student populations. Comparison of these sources within each group of students provided considerable insight into the conditions that were most conducive to learning.

The results of the survey give some indication of differences between the groups and suggest that a larger study may yield benefits in the selection of students for courses and also the way mathematical material is taught. Table 2 shows the mathematics self-efficacy of UEP-CE students.

3.1.7 Relationship between the classroom learning environment and mathematics self-efficacy

3.1.7.1 Goal orientation and mathematics self-efficacy

The correlation table below shows the Pearson r of .187 with a significant value of .001 on goal orientation and self-efficacy. This result showed a significant relationship between the variables. This means that the more favorable the goal orientation; the more self-efficacious or confident were the respondents. It means further that the better prepared for school activities, assignments, and examinations were the respondents, the more confident they were in mathematics classes.

This result partly affirmed the study conducted by Hsieh, et al. [4] which indicated that goal orientation moderated the relation between self-efficacy and science achievement, indicating that self-efficacy has positive influences on achievement when students are goal-oriented.

Likewise, this result affirmed the findings of Saunder [5] which suggested that student's tendencies to set goals oriented toward

performance (e.g., obtaining a specific test score) versus mastery (e.g., understanding specific concepts) may be associated with self-efficacy and performance.

3.1.7.2 Physical facilities and mathematics self-efficacy

The Pearson r value of .033 which is far to one with a significant value of .298 on physical facilities and mathematics self-efficacy showed no significant relationship. This means that physical facilities did not affect the mathematics self-efficacy of the freshman UEP-CE students. The result further showed that building, furniture, and things the mathematics teachers are using to facilitate learning do not relate to mathematics self-efficacy. This result negated the study conducted by Higgins [6] that established that there are significant improvements in the learning environment that were attributed to the better attitudes to teaching and learning the improvements in the physical environment created amongst all users.

3.1.7.3 Student-student interaction and mathematics self-efficacy

Table 3 also shows a correlation between student-student interaction and mathematics self-efficacy. Pearson r .262 and significant value is .000 presents a strong relationship and a very significant correlation. This meant that the more favorable the student-student interaction, the more self-efficacious or confident in mathematics were the respondents.

The result of this study validated the study of Tatar [7] stating that students will be willing, even keen, to participate in class discussions and other activities in a supportive environment which might be a manifestation of their high level of self-efficacy.

3.1.7.4 Teacher-student interaction and mathematics self-efficacy

Table 3 also presents the significant relationship of teacher-student interaction and

mathematics self-efficacy with a Pearson r value of .142 and a significant value of .011. This means that teacher-student interaction had something to do with the mathematics self-efficacy of the respondents. It means further that if the connection of the teacher and the student which enables both to understand each other was favorable which was manifested by the attention, praise, interest, and help that the student gets from the Mathematics 111 and 112 instructors, the more confident the respondents that they can tackle mathematics lessons and problems in class.

The result of this study confirmed the study conducted by Bloklin [8] which indicated that there were significant improvements in student achievement, confidence, and attitude toward teachers when pre-and post- scores were compared in both the control and treatment groups. However, no statistically significant difference occurred in achievement or self-efficacy when the classes were analyzed between groups, treatment group vs. control group.

3.1.7.5 Methods of teaching

Table 3 also shows the relationship between methods of teaching and mathematics self-efficacy. The Pearson r of .276 with a significant value of .000 presents a strong relationship between the above variables. This means that the teaching method used whether the theoretical or practical method, lectures, or explains or uses audio-visual aid in teaching, and other ways affected the mathematics self-efficacy of the respondents. It means further that the more favorable the method used by the teacher to the respondents, the more confident that they could cope up with mathematics.

It can be implied that the above variables mentioned can affect the self-efficacy or confidence of the students. It can be implied further that since physical facilities were found not significantly related, the respondents did not think that facilities will affect so much their confidence in mathematics. Meaning, even if facilities were lacking, other variables could make them confident and eventually enable them to perform better.

Table 3. Correlation table on classroom learning environment and mathematics self-efficacy

		self_ efficacy	goal_ orienta tion	physical facilities	student_ student_ interaction	teacher_ student_ interaction	methods of teaching
Pearson Correlation	self_efficacy	1.000	.187	.033	.262	.142	.276
	goal_orientation	.187	1.000	.337	.393	.365	.400
	physical_facilities	.033	.337	1.000	.441	.591	.528
	student_student_interaction	.262	.393	.441	1.000	.529	.559
	teacher_student_interaction	.142	.365	.591	.529	1.000	.649
	methods_of_teaching	.276	.400	.528	.559	.649	1.000
	Sig. (1-tailed)	self_efficacy	.	.001	.298	.000	.011
goal_orientation		.001	.	.000	.000	.000	.000
physical_facilities		.298	.000	.	.000	.000	.000
student_student_interaction		.000	.000	.000	.	.000	.000
teacher_student_interaction		.011	.000	.000	.000	.	.000
methods_of_teaching		.000	.000	.000	.000	.000	.
N		self_efficacy	260	260	260	260	260
	goal_orientation	260	260	260	260	260	260
	physical_facilities	260	260	260	260	260	260
	student_student_interaction	260	260	260	260	260	260
	teacher_student_interaction	260	260	260	260	260	260
	methods_of_teaching	260	260	260	260	260	260

The result of this study partly confirmed the study conducted by Albayrak and Unal [9] which indicated that the methods of teaching mathematics courses significantly increased the pre-service teachers' mathematics teaching efficacy beliefs.

4. CONCLUSIONS

The following conclusions were drawn from the findings of the study.

Generally, the freshmen engineering students found the classroom learning environment to be favorable. It was found out that the respondents had much confidence and had high self-efficacy in mathematics. There was a significant relationship between the classroom learning environment (CLE) and mathematics self-efficacy. However, of the five CLE variables, only four were significantly related. These were goal orientation, student-student interaction, teacher-student interaction, and methods of teaching.

CONSENT

Consent from the respondents was sought and the statement of confidentiality as indicated in the request letter sent by the author to the dean, the professors, and the student respondents.

ETHICAL APPROVAL

The authors, before the survey was conducted, asked permission from the Dean of the College of Engineering, the subject professors, and student respondents. The purpose and the role of the respondents were explained before the questionnaire was distributed.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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