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Peer Mentoring: It's Effect on Students' Mathematics Performance, Attitudes and Epistemological Learning Beliefs in Mathematics

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ABSTRACT

This study is conducted in the fact that non-passer in the College Entrance Test (CET) may not be able to pass the Maritime Schools Assessment Program (MSAP) examination; thus, peer mentoring was utilized. The investigation focused on the performance, epistemological beliefs and attitudes towards mathematics among maritime transportation students. Thirty students that were selected randomly were gathered in the program and were divided into fifteen pairs. Each pair had an assigned mentor that was selected purposively. The students' performance and attitudes towards mathematics were measured using a researchers' made 50 item pre and posttest multiple choice questionnaire and a researchers' made attitudes instrument respectively; pilot – tested, validated and reliability-tested. Schommer's Epistemological Belief Questionnaire was used to

assess their epistemological learning beliefs. Frequency count and means were the descriptive statistical tools and paired sample t-test and Pearson's r set at .05 Alpha levels are the inferential statistical tools. Results showed "low" pre and "high" post mathematics performance. Simple knowledge, certainty of knowledge and omniscient authority are best possessed by the participants for the epistemological learning beliefs. Positive attitudes towards mathematics manifested in both pre and post attitudes of the participants. There is a significant difference between the pretest and posttest mathematics performance and between pre-attitudes and post attitudes towards mathematics of the participants. There is no significant relationship between mathematics performance, attitudes, and epistemological learning beliefs. Sustainability of the program, the conduct of similar studies, continuing training and re-training of student mentors and financial support to those who rendered their services as mentors are highly recommended.

KEYWORDS

Peer mentoring, mathematics performance, epistemological learning beliefs, attitudes, descriptive design, experimental design, Iloilo City, Philippines.

INTRODUCTION

Deficiency in mathematics performance has been a prevailing problem. Lack of appreciation and negative attitude towards the subject is one of the existing barriers to success (Aquino, 2011; Ganal and Guiab, 2014; Hussain, 2006; Boehler et al., 2001; Awang & Sinnadurai, 2010; Silva, Tadeo, Delos Reyes & Dadigan, 2006). Also, the identification of certain epistemological beliefs (Hofer, 2001; Hofer & Pintrich, 1997) is crucial (Perry, 1999) and provides impact to multiple aspects of learning (Schommer-Aikins, 2002). This was later on hypothesized by Schomer (1990) into five that include beliefs about Certain Knowledge, Simple Knowledge, Omniscient Authority, Quick Learning, and Innate Ability (Schommer-Aikins, 2002; Schommer-Aikins & Easter, 2006).

To cope up with the prevailing situation, every institution should at least address certain prevalent academic concerns through assistance and evaluation. Models of intervention must simply suit the lacking cognitive deficiency (Aquino, 2011; Henson, 2012; Hussain, 2006; Bohler et al., 2001; Patrick, Furlow & Donovan, 1988; Awag and Sinnadurai, 2010). Following the suggestions of Hardegree (2012) and Silva et al. (2006) that there is a positive influence on an individual the people who he/she came in contact with, thus, peer mentoring was utilized which

is also agreed by Aquino (2011), Henson (2012) and Boehler et al. (2001) that an intervention is a form of cooperative learning. The recommendations of Aquino (2011), Hussain (2006), Henson, Hagos & Villapando (2009), Patrick, Furlow and Dovan (1988) & Ganal and Guiab (2014) that institutions must conduct an intervention to the prevailing problem proved the basis for conducting this study. Furthermore, the study of Aquino (2011), Powell (1997), McKimm, Jollie & Hatter (2007), Andrews and Clark (2011), Burke and Sass (2008), Colvin and Ashman (2010), Roger and Tremblay (2003), Sprague (2007), Thompson and Kelly-Vance (2011), Budny, Paul and Bon (2006), Varkey et al. (2012); Goff (2011) and Henson et al. (2009) proved that peer mentoring provides positive effects on the mentee academically. This study is anchored on socio-cognitive theory (Castro 2004; Liem & Bernardo, 2010; Piaget, 1926), and sociocultural theory (Lantolf, 2000; Thorne, 2005; Vygotsky, 1978), which emphasize the role of the social context in the construction of knowledge. Peer interactions provide a rich and necessary context for the revision of cognitive systems and creation of new meanings (Aquino, 2011; Henson, Hagos & Villapando, 2009; Akker, Denessen, Van Der Rijt & Veenman, 2005).

Peer mentoring is defined as a process or a form of support through helping someone else called mentee or learner by a more experienced individual called the mentor, but it can be very powerful and rewarding in terms of learning because it develops one's potential (McKimm et al., 2007). Its concerns include the development of cognitive thinking, providing emotional and psychological condition support, directing assistance in subject activities, role-modeling, developing self-esteem and confidence, improving communication skills, strengthening time management skills and academic skills leading to students' success.

Hardegree (2012) studied the effects of peer mentoring on ninth grade students at Liberty University, Georgia, USA, found out that there is no academic impact on first-time ninth grade students who receive assistance from trained freshmen friend mentors on a standardized test such as the post-test interim assessment of about six weeks in the subject, Integrated Algebra 1. At the end of the semester, the students in the experimental group and students in the control group have similar median post-test scores. Furthermore, Varkey et al. (2012) revealed that facilitated peer mentoring program demonstrated a positive impact towards the academic skills and manuscript writing for junior women faculty. It was done through a pre-and post-program evaluation consisting of a 25-item self-assessment of academic skills, self-efficacy, and career academic satisfaction to 19 mentees from Rochester, Minnesota.

The study of Budny, Paul, and Bon (2006) showed that the average GPA of their respondents increases from 2.59 (1997-2000) to 2.82 (2001-2005) however they did not compare if there is a significant difference. That is why, Goff (2011) further explained that students attending three or more sessions performed significantly better in the introductory biology courses, measured by final grades achieved than attending fewer sessions.

Money et al. (2011) suggested key ingredients to peer support to make it more meaningful and long-lasting relationship. These are: first, social support from both the mentor and the mentee; second, experiential knowledge of the area tackled by the mentor; third, trust from each other including the coordinator of the project; fourth, confidentiality between the mentor and the mentee and finally, easy access to both the mentor and mentee in fulfilling a task. Colvin and Ashman (2010) added that successful peer mentoring in a university setting is the result of the relationship between students, mentors, and instructors.

OBJECTIVES OF THE STUDY

The present research is intended to investigate the effects of peer mentoring on the mathematics performance, determine the epistemological learning beliefs in mathematics and attitudes towards mathematics among Maritime Transportation students for the fact that non-passer in the College Entrance Test (CET) last school year 2012-13 may not be able to pass the Maritime Schools Assessment Program (MSAP) examination on 2014. Promoting and guiding further research on peer mentoring effectiveness on students' academic performance, attitudes towards their studies and learning beliefs are also the goals in conducting the study. Thus, to remedy this problem peer mentoring was utilized. Specifically, the following statements guided the study; (1) the pre and post mathematics performance, (2) the pre and post-epistemological learning beliefs towards mathematics, (3) the pre and post attitudes towards mathematics, (4) the significant differences in the pre and post-performance towards mathematics, (5) the significant difference in the pre and post-epistemological learning beliefs towards mathematics, (6) the significant difference in the pre and post attitudes towards mathematics and lastly, (7) the significant relationships among the attitudes, mathematics performance and epistemological learning beliefs among the participants.

METHODOLOGY

Research Design

This study adopted a Descriptive-Quasi-Experimental and Correlational designs. The descriptive research design (Borg & Gall, 1983; Gay, 1996) was used to determine both pre and post attitudes and epistemological learning beliefs of the participants Quasi-Experimental design (Tuckman, 1999) was used to determine the mathematics performance. A Quasi-Experimental design was used because of the fact that the participants were not randomized, and it utilized peer mentoring as an intervention. The correlational design (Gay, 1992; Lanthier, 2002) was used to determine the relationship between attitudes, mathematics performance and epistemological learning beliefs among the participants.

Participants

The peer mentoring included two groups of participants; the mentors, and the mentees (qualifiers and non-qualifiers), all second-year students who are enrolled at John B. Lacson Foundation Maritime University-Arevalo, School Year 2013-2014. The peer mentors included 15 participants, were qualifiers, selected purposively from the second year class of Polaris 2A. The mentees included 30 randomly selected non-qualifier students who took their College Entrance Examination (CET) last school year 2012-13; however, they were not able to pass the CET because they did not pass the cut-off score in mathematics that is 20.

Instrument

The data needed for the present study were gathered through the use of a set of three questionnaires. Schommer's (1990) Epistemic Belief Inventory (EBI), used to measure the participants' epistemological beliefs, a Learning Attitude Scale, and were used to measure students' attitudes towards learning mathematics and a 50-item multiple choice mathematics examination to measure their mathematics performance.

Ensuring the quality of the data that were gathered for analysis and interpretation, the Learning Attitude Scale, and the 50-item multiple choice mathematics examination questionnaires was subjected to reliability and validity testing that was done using a pilot testing and the scores were used to determine the reliability and content validity. Reliability was determined using the Cronbach-Alpha set at .05. The Statistical Package for the Social Sciences (SPSS) Version 21 Software was used for this purpose.

Pre-intervention Procedures

Permission to conduct the study was sought from the Administrators and the Dean of JBLFMU-Arevalo. The researcher served as the coordinator of the mentoring program. A 3-hour training and discussion intended for the mentors was held at the Mentoring Center with the guidance of the Academic Coordinator as the head of the school's mentoring program. A separate 3-hour discussion intended for the mentees' roles and benefits for the whole duration of the study was conducted.

Data Collection

A pretest for the non-qualifier students' mathematics performance was conducted before the intervention starts. After which, questionnaires on attitudes and epistemological learning beliefs in mathematics were administered.

The intervention shall have a total of six hours per week for a total of five weeks with proper documentation and monitoring of the mentor, mentee and the researcher involved.

The posttest was administered after the intervention. The same questionnaires on attitudes and epistemological learning beliefs in mathematics were also administered.

Data Analysis

The number of the student population was determined using frequency count while the means were used to determine the level of the students' mathematics performance, epistemological learning beliefs and attitudes towards mathematics.

To determine the significance of the correlation between mathematics performance and epistemological learning beliefs, between epistemological learning beliefs and attitudes towards mathematics, and between mathematics performance and attitudes towards mathematics, Pearson's r set at .05 alpha level was used. Paired sample t-test set at .05 level of significance was used to determine the significance of the difference between pre and post mathematics performance, pre and post-epistemological learning beliefs and pre and post attitudes towards mathematics.

Guide for data analysis:

For Mathematics Performance

Scale	Description
26.00 - 50.00	High
1.00 - 25.00	Low

For Epistemological Belief

Score	Description
1.00-1.79	Very Low
1.80- 2.59	Low
2.60- 3.39	Moderate
3.40- 4.19	High
4.20- 5.00	Very High

For Attitudes towards Mathematics

Scale	Description
2.51 - 5.00	Positive
1.00 - 2.50	Negative

RESULTS AND DISCUSSION

Pre and Post Mathematics Performance of the Participants

The mean pre-test score of the participants group is "low" with a mean of 18.50 which proves that the participants have little knowledge about the subject. The post-test mean score of the participants group is "high" with a mean score of 26.70 means that the participants gained significant information from their mentors. This clearly implies that peer mentoring could be an effective measure in elevating student learning as agreed by McKimm et al. (2007), Aquino (2011), Powell (1997), Andrews and Clark (2011), Burke and Sass (2008), Colvin and Ashman (2010), Roger and Tremblay (2003), Sprague (2007), Thompson and Kelly-Vance (2011), Budny et al. (2006), Varkey et al. (2012) and Goff (2011). Furthermore, Henson & Villapando (2009) explained that peer mentoring can effectively and inexpensively increase a student's academic achievement and at

the same time, this shows improvements in the student's performance. This study was also in coherence with the study of Roger and Tremblay (2003) but not specifically in math but all subjects at a particular university in Europe that undergone peer mentoring. Likewise, this study agreed the study of Thompson and Kelly-Vance (2001) had higher academic gains in reading and math but not in spelling.

On the other hand, the present result was opposite to the study of Sprague (2007) wherein there was no significant difference in the peer mentoring on the academic performance in a particular high school in New Jersey, USA.

Table 1. Means of the Pre-test and Post-test Scores of the Participants

Mathematics Performance	N	Means	SD	Description
Pre-test	30	18.50	4.99	Low
Post-test	30	26.70	7.13	High

Scale	Description
26.00 - 50.00	High
1.00 - 25.00	Low

Pre and Post Epistemological Learning Beliefs towards Mathematics of the Participants

The means of the posttest of all epistemological learning beliefs are higher than the pretest results. This implies that the participants come to think that mathematics is but a simple matter, and this largely supports the study of Perry (1999). Gaining interest in the subject means that you are indeed appreciate it. This claim is supported by the study of Silva et al. (2006) which states that interest in the subject is a manifestation that takes place in an individual that is largely brought by an intervention. Showing "High" levels, simple knowledge, certainty of knowledge and omniscient authority agreed on the study of Perry (1999). This tells us that learning with experience in mentoring through gradual step by step process of ideas throughout the intervention can produce progressive learning. Through peer mentoring, non-qualifiers changed their speed of learning that is, from gradual to quick and increase their ability in solving the mathematics problem.

Table 2. Means of the Pre and Post Epistemological Learning Beliefs of the Participants

Epistemological Learning Beliefs	Means	SD	Level
Quick Learning			
Pre	3.05	.71	Moderate
Post	3.37	.62	Moderate
Innate Ability			
Pre	2.83	.66	Moderate
Post	3.13	.50	Moderate
Simple Knowledge			
Pre	3.82	.44	High
Post	3.78	.40	High
Certainty of Knowledge			
Pre	3.44	.55	High
Post	3.45	.43	High
Omniscient Authority			
Pre	3.83	.48	High
Post	3.73	.39	High

Pre and Post Attitudes towards Mathematics of the Participants

Both pre and post attitudes of the participants manifested positively. This implies that peer mentoring could change the students' outlook in solving problems in mathematics. This statement is supported by the study of Ganal and Guiab (2014) which states that positive attitude is necessary to improve performance in the said subject. This proves that through peer mentoring, there will be a better appreciation of mathematics as implied by the results. Peer mentoring works by addressing fears and providing a sense of belongingness (Andrews and Clark, 2011 and Powell, 1997).

Table 3. Means of the Pre and Post Attitudes towards Mathematics of the Participants

Attitudes towards Mathematics	Means	SD	Description
Pre-Attitude	3.26	.59	Positive
Post Attitude	3.56	.33	Positive

Scale	Description
2.51 - 5.00	Positive
1.00 - 2.50	Negative

Differences between the Pre and Post Mathematics Performance of the Participants

The findings support that there is a significant difference between the pre and post mathematics performance of the participants t(29) = 11.20, p<.05. This supports the claim that it can positively affect academic achievement as evidenced by improvement in test scores, grade point averages (GPA) and course pass rates (Powell, 1997; Budny, Paul and Bon, 2006; Sprague, 2007 and Colvin and Ashman, 2010), develop friendship and mentors become even better themselves (Colvin and Ashman, 2010).

Table 4. T-test Results for the Differences in the Pre and Post Mathematics Performance of the Participants

Mathematics Performance	Means	SD	T	Df	Sig(2-tailed)
Pre-test	18.50	4.99	11.20	29	.000*
Post-test	26.70	7.13			

Note: Significant at .05, *p<.05

Differences between Epistemological Learning Beliefs towards Mathematics of the Participants

The pre and post-epistemological learning beliefs of the participants differed significantly about the following epistemological beliefs as revealed by the following data; quick learning, t(29)=3.117, p<.05; and innate ability, t(29)=3.248, p<.05.

Data showed that the post-epistemological learning beliefs on quick learning were significantly higher than pre-epistemological learning beliefs. This supports the judgments of Hofer (2000) that beliefs are activated as learners engage in learning and knowing. This also proves that the participants have varied outlooks towards mathematics that supports the claims of Hofer & Pintrich, 1997 that students have diverse views of the academic and social environments.

Table 5. T-test Results for the Differences in the Pre and Post Epistemological Learning Beliefs of the Participants

Epistemological Learning Beliefs	Means	SD	T	Df	Sig(2-tailed)
Quick Learning					
Pre	3.05	.71	3.117	29	.004*
Post	3.37	.62			
Innate Ability					
Pre	2.83	.66	3.248	29	.003*
Post	3.13	.50			
Simple Knowledge					
Pre	3.82	.44	.687	29	.497
Post	3.78	.40			
Certainty of Knowledge					
Pre	3.44	.55	.131	29	.896
Post	3.45	.43			
Omniscient Authority					
Pre	3.83	.48	1.332	29	.193
Post	3.73	.39			

Significant at .05, *p<.05

Differences between the Pre and Post Attitudes towards Mathematics of the Participants

Table 6 reveals that, although both the pre and post attitudes of the participants registered positive attitudes towards mathematics, a significant difference existed in the level of their positive attitudes, $t(29)=3.498$, $p<.05$. Students showed social interaction as evidenced by improved attendance, reduced disciplinary referrals, improved students attitudes toward school, improve academic achievement of disadvantaged children by altering the low achiever's self-perception as an incompetent learner, raises the academic achievement of both peer tutors and peer tutor-mentors and improve their self-esteem (Powell, 1997 and Sprague, 2007). The results were opposite to the suggestion of Bowen and Richman (2000) that when students demonstrate a weak commitment to their academics, then they are bound to underperform. Since Attitude possesses both cognitive and emotional components, it is highly susceptible to change (Fazio and Roskes, 1994).

Table 6. T-test Results for the Differences in the Pre and Post Attitudes towards Mathematics of the Participants

Attitudes toward Mathematics	Means	SD	T	Df	Sig(2-tailed)
Pre	3.26	.59			
Post	3.56	.33	3.498	29	.002*

Significant at .05, *p<.05

Relationship between Mathematics Performance and Attitudes among Participants

Mathematics performance is not significantly correlated with the attitudes of the participants. The coefficient of correlation is .290, p>.05. This statement is in contradiction to the claims of Aquino (2011) who pointed out that peer mentoring develops good study habits and positive learning attitudes. The idea is also contradicted by Bandura (1977) while stating that attitude is often used in conjunction with motivation to achieve. It is how capable people judge themselves to perform a task successfully. This simply means that outlook or belief and attitude are two separate entities that do not affect one another.

Relationship between Epistemological Learning Beliefs and Mathematics Performance among the Participants

Almost all components of epistemological beliefs are not significantly correlated with mathematics performance among the participants except for certainty of knowledge that is negatively and significantly correlated with mathematics performance, r=-.419, p<.05. In the former statement, this was agreed by Bransford, Brown and Cocking (2000) that beliefs are imprinted in the minds of the students and can affect learning in math and Hofer (2000) that epistemological beliefs influence learning and knowing.

Table 7. Correlation between Epistemological Beliefs and Mathematics Performance among the Participants

Mathematics Performance		Epistemological Beliefs (post)				
		Quick Learning	Innate Ability	Simple Knowledge	Certainty of Knowledge	Omniscient Authority
Post-test	r	-.219	-.186	.312	-.419*	.69
	sig	.246	.325	.093	.021	.717

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Relationship between Epistemological Learning Beliefs and Attitudes among Participants

All dimensions of epistemological learning beliefs are not significantly correlated with attitudes among the participants. This is opposed to the results of Andrews and Clark, 2011 and Powell, 1997 who stated that peer mentoring works by addressing fears and providing a sense of belongingness. Money, Moore, Brown, Kasper, Roeder, Bartone, and Bates (2011) added that the key ingredients to peer support to make it more meaningful and long-lasting relationship. On the other hand, Anastasi (1990) claimed that attitude may be said to connote response consistency with regards to certain categories of stimuli. This implies that not all the time, what we believe greatly reflects our attitude.

CONCLUSIONS

In the view of the results, peer mentoring creates an avenue for a successful intervention for non-performing students in mathematics. Its effectivity is not only isolated in the academic performance but also it widened their understanding on different epistemological learning beliefs and shows a positive attitude towards mathematics. The significantly higher posttest result revealed the effectivity of the facilitated peer mentoring in raising bars of academic performance as the results differ significantly from both pre-test and posttest results. The acquisition of the participants of the three epistemological beliefs namely: omniscient authority, the certainty of knowledge and simple knowledge, proves that the participants are willing to learn, their reasoning skills are evolving, and their knowledge has greatly integrated with the intervention. The positivity of attitudes suggests that

the participants are having a positive outlook on the subject. Throughout the course of the intervention, peer mentoring served as the catalyst that promotes higher levels of attitude towards the subject involved. The changed perception of the participants is revealed by the study. Higher posttest epistemological belief proved that people can change their perception and paradigms when a catalyst is added. The certainty of knowledge is negatively and significantly correlated with mathematics performance. The interaction of the mentor influenced the cognitive thinking of the mentee, thus providing us valuable information that peer mentoring is capable of shifting ideological paradigms.

TRANSLATIONAL RESEARCH

The outcome of this study entitled "Peer Mentoring: Its Effect on Students' Mathematics Performance, Attitudes and Epistemological Learning Beliefs in Mathematics" had been translated into a Peer Mentoring flow chart and was used as a guide for all Bachelor of Science in Marine Transportation Students of JBLFMU-Arevalo. The flow chart improved the peer mentoring practice of JBLFMU-Arevalo in Iloilo City, Philippines.

RECOMMENDATIONS

Sustainability of the program, a conduct of similar studies to further test its effectiveness, lastly, is continuing training, re-training, and financial support to those who rendered their services as mentors.

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