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Conception of mathematics, learning approach and strategies of university freshmen students

Christopher J Cocal

Pangasinan State University, Alaminos City Campus, #78 Tara, Bolinao, Pangasinan, Philippines

Abstract
Past learning experiences on Mathematics have profound influence on the conception of a learner about mathematics, learning approaches, and strategies to study mathematics. The study determined the conception of freshman university student on mathematics, mathematics learning approaches, and the different learning strategies employed by them in studying mathematics. The study made used of the descriptive-correlational research design with 199 freshmen students enrolled during the S.Y. 2012 – 2013 as respondents. Results showed that students usually have shallow conception about mathematics, not seeing its important role in their lives. Majority of freshmen students believed that mathematics should be learned using low level or surface approaches. Findings showed that 5.02% of the performance of the students is related to their conception on mathematics and 10% to their conception on learning approach. The way a student conceives mathematics and mathematics learning approach affects his performance in Mathematics.

Keywords: mathematics concept, learning approach, memorization, strategy

1. Introduction

Mathematics is viewed by most as one if not the most difficult subject ever taken by a student. Past learning experiences on Mathematics have a profound influenced on the conception of a learner about mathematics, the different approaches on how to study mathematics and ultimately, on the different strategies employed by a learner to study mathematics. These factors are believed to affect the performance of a student in mathematics.

A number of researches have shown the importance of conceptions (attitudes and beliefs) on the motivation and psychological/emotional conditions of students studying mathematics (Sangcap, 2010; Sumpter, 2010; Crawford et. al, 2006; Hannula, 2006; Githua and Mwangi, 2003) [5, 2]. Likewise, researches have established the connection of previous learning experience, which are the bases of conceptions of the students, influence the approaches of students to learn, their attitudes, study habits and outcomes in learning mathematics (Sangcap, 2010; Crawford et.al, 2006; OECD, 2005; Githua and Mwangi, 2003) [5, 2]. Interpretation of mathematical learning affects the mathematical thinking skills of a learner (Crawford et.al, 2006). Using the 2003 Program for International Student Assessment (PISA 2003) [3] data sets, Thiessen and Blasius (2008) documented that the extent of construct differentiation in students' mathematics learning strategies is strongly associated with their level of mathematics achievement.

Reid *et al*. (2003) in a study conducted in five countries found that student' experiences mathematics in three qualitative different ways. The narrowest view of mathematics was labeled as "component": at this label, students focus their attention on disparate mathematical activities or aspects of mathematics, including the notion of calculation (interpreted in the widest sense), which are nevertheless viewed as part of a coherent mathematical investigation. A broader view is mathematics as "modeling": at this label, students see mathematics as being about building and using models, translating some aspect of reality into mathematical form specific situations such as a production line or universal principles such as the law of gravity. The broadest view of mathematics was labeled as "life": at this label, students view mathematics as an approach to life and a way of thinking, and make a strong personal connection between mathematics and their own lives. Likewise, Crawford *et al*. (2006) found that majority of students view mathematics as a necessary set of rules and procedures to be learned by rote that are unrelated to other aspects of their lives. Learning strategies are used by students to help them understand information and solve problems. A learning strategy is a person's approach to learning and using information. Students who do not know how to use good learning strategies often learn passively and ultimately fail in school.

The conception of a student about mathematics affects his attitudes towards learning mathematics and the learning strategies that he is going to employ. These in return affect the performance of the student. In this regards, the study determined the conception of freshman university student on mathematics and mathematics learning approaches and the different learning strategies employed by them in studying mathematics. Specifically, this study determined the performance of the students in mathematics, their conception of mathematics and mathematics learning approaches and the learning strategies employed by them in their study of mathematics. Likewise, the difference in the performance of the students in mathematics across their conception on mathematics and mathematics learning approaches were determined. Moreover, the relationship between the students' conception of mathematics, learning approaches with their mathematics performance were also determined. With these, I posit the following hypotheses:

H_1: There is no significant difference between the pperformance of the students in Mathematics across their conception on mathematics and mathematics learning approaches; and

H_2: There is no significant relationship between the students' conception of mathematics, learning approaches with their mathematics performance.

2. Methods

Research Design

The study made used of the descriptive-cross sectional - correlational design considering that the objectives of the study were to determine the (1) performance of the students in mathematics, their conception about mathematics, mathematics learning approaches and the learning strategies employed by them in their study of mathematics; (2) the differences between the performance of the students in mathematics across their conception about mathematics and mathematics learning approach; and (3) relationship between the performance of the students in mathematics with their conception about mathematics, mathematics learning approach.

Respondents of the Study

The subject of the study was the 396 freshmen students who have taken Algebra during the A.Y. 2014 – 2015 enrolled in the different programs of the Pangasinan State University – Alaminos City Campus. A total of 199 students which is equivalent to 50.25% of the total population served as respondents of the study; randomly selected employing the clustered sampling technique. Each program was considered as a cluster.

Data Gathering Instrument

The main instrument employed in the gathering of pertinent data was a questionnaire checklist adopted from Crawford *et al*. and Reid, modified to meet the objectives of the study. The performance of the students in the subject Algebra was requested from the office of the registrar with the permission and approval of the campus executive director.

Statistical Analysis

Mode, mean, standard deviation and skewness were employed with regards to the performance of the students in Algebra. Frequency count and percentages were employed to determine the conception of the students on Mathematics, Mathematics learning approaches and learning strategies employed by the students in their study of mathematics.

The differences between the performance of the students in mathematics across their conception about mathematics and mathematics learning approach were determined using Analysis of Variance. Significant differences were determined using LSD.

The relationships between the performance of the students in mathematics with their conception on mathematics and mathematics learning approach were determined using eta square.

3. Results and discussion

Table 1: Performance of the Freshmen Students in Algebra

Indicator	Value
Mean	2.64
Mode	3.00
Std. Deviation	0.38
Variance	0.15
Skewness	-1.35
Std. Error of Skewness	0.17
Minimum	1.25
Maximum	3.00

Note: The Pangasinan State University follows a grading system with 1.00 as excellent and 5.00 as failed.

The performance of the students in Algebra has a mean of 2.64 which is equivalent to a satisfactory performance. The mode of the students' grade is 3.0 or passed. The standard deviation of 0.38 implies that if the students are going to take Algebra again, their grades would probably range from 2.25 to 3.00. The skewness of -1.35 shows that a greater number of the students have grades lower than 2.64 (Table 1). Findings of the study revealed that the students are generally poor in Mathematics.

Table 2: Conception of the Freshmen Students about Mathematics

	Category	Frequency	Percent
1.	Mathematics is about numbers, equations and formula.	4	2.01
2.	Mathematics is about numbers, equations formula and problem solving.	76	38.19
3.	Mathematics is a complex, logical yet systematic system.	16	8.04
4.	Mathematics is a complex, logical yet systematic system used to solve complex but real life problems.	22	11.06
5.	Mathematics is life (an approach to life, a way of thinking, a technique in problem solving, a way of understanding abstract ideas and a tool for development.	81	40.70

It can be noted from Table 2 that 81 or 40.70% of the respondents considered mathematics as life (an approach to life, a way of thinking, a technique in problem solving, a way of understanding abstract ideas and a tool for development). On the other hand, 22 or 11.06% conceived mathematics as a complex, logical yet systematic system used to solve complex but real life problems. Moreover, 76 or 38. 19% of the respondents conceived mathematics is about numbers, equations formula and problem solving.

Results showed that most of the students have seen mathematics only as a process and have not understood the importance of mathematics in their day-to-day lives. The 40.70% students who conceived mathematics as life have higher awareness on the role of mathematics than the other 59.30%. According to Crawford *et al*. (1999), categories 1 and 2 present mathematics as a fragmented body of knowledge while categories 3, 4, and 5 proffer a cohesive view of mathematics. Fragmented view on mathematics is focused more on the part rather than the whole while cohesive view focused on the whole rather than the part.

Table 3: Conception of the Freshmen Students on the Learning Approach to Mathematics

Approach	Frequency	Percent
1. Learning by memorization with the intention to reproduce or be familiarized with the knowledge and procedures.	27	13.57
2. Learning by solving lots of examples with the intention to reproduce or be familiarized with the knowledge and procedures.	64	32.16
3. Learning by solving lots of examples with the intention of gaining understanding of the theory or concepts.	53	26.63
4. Learning by doing difficult problems with an intention of gaining a relational understanding of the entire theory, and seeing its relationship with existing knowledge.	33	16.58
5. Learning with the intention of gaining a relational understanding of the theory and looking for situations where the theory will apply.	22	11.06

As shown in Table 3, 27 or 13.57% of the students believed that mathematics should be learned by memorization with the intention to reproduce or be familiarized with the knowledge and procedures. This strategy emphasized rote memorization as a learning strategy to mathematics. On the other hand, 64 or 32.16% of the respondents believed that mathematics should be learned by solving lots of examples with the intention to reproduce or be familiarized with the knowledge and procedures. Further, 22 or 11.06% of the respondents believed that mathematics should be learned with the intention of gaining a relational understanding of the theory and looking for situations where the theory will apply.

Strategies 1 and 2 are low level approaches in learning mathematics while approaches 3, 4 and 5 are high level and more difficult approaches to learn mathematics. Findings showed that the number of students believing that mathematics should be learned using low level or surface approaches is almost the same with the number of students believing that learning mathematics need high level or deep approaches. It has to be noted however that those using higher approaches do not necessarily employ lower or shallow approaches to learn mathematics.

Presented in Table 4 are the strategies employed by the students in studying mathematics categorized as control, memorization and elaboration. The students do not necessarily employ all the strategies in studying mathematics.

It can be noted from Table 4 that 70 or 35.18% of the students try to work out what are the most important parts to learn when studying mathematics while 76 or 38.19% check to see if they remember the work they have already done. Of the different control strategies to study mathematics, trying to figure out which concepts are still have not understood properly was employed the most by the students, wherein, 125 or 62.81% of the students were using the strategy in studying mathematics.

Table 4: Frequency and Distribution of Students Using the Different Control Strategies in Studying Mathematics

Strategy	Frequency	Percent
1. When I study for a mathematics test, I try to work out what are the most important parts to learn.	70	35.18
2. When I study mathematics, I make myself check to see if I remember the work I have already done.	76	38.19
3. When I study mathematics, I try to figure out which concepts I still have not understood properly.	125	62.81
4. When I cannot understand something in mathematics, I always search for more information to clarify problems.	113	56.78
5. When I study mathematics, I always search for more information to clarify the problem.	52	26.13

Always search for more information to clarify problems when they cannot understand something in mathematics was employed by 56.78% of the students. Results showed that the students employ various control strategies in studying mathematics. Using a single strategy in studying mathematics is not recommended for one to become successful in any mathematics subject.

Table 5: Frequency and Distribution of Students Using the Different Memorization Strategies in Studying Mathematics

Strategy	Frequency	Percent
1. I go over some problems in mathematics so often that I feel as if I could solve them in my sleep.	21	10.55
2. When I study mathematics, I try to learn the answers to problems off by heart.	42	21.11
3. In order to remember the method for solving a mathematics problem, I go through examples again and again.	115	57.79
4. To learn mathematics, I try to remember every step in a procedure.	129	64.82

As shown in Table 5, 129 or 64.82% of the students try to remember every step in a procedure in order to learn mathematics. It is important to note that mathematics is learned not by memorizing terms but understanding concepts, principles, theories and laws and their use or applications. It has to be noted however that only 21 or 10.55% of the students go over some problems in mathematics so often that I feel as if I could solve them in my sleep while 42 or 21.11% of the students try to learn the answers to problems off by heart. The finding is indicative of the fact that mathematics is one of the most hated subject by the students.

Table 6: Frequency and Distribution of Students Using the Different Elaboration Strategies in Studying Mathematics

Strategy	Frequency	Percent
1. When I am solving mathematics problems, I often think of new ways to get the answer.	66	33.17
2. I think how mathematics I have learned can be used in everyday life.	57	28.64
3. I try to understand new concepts in mathematics by relating them to things I already know.	75	37.69
4. When solving mathematics problems, I often think about how the solution might be applied to other interesting questions.	103	51.76
5. When learning mathematics, I try to relate the work to things I have learned in other subjects.	35	17.59

Of the different elaboration strategies to study/learn mathematics, often thinking about how the solution might be applied to other interesting questions was employed the most by the students, wherein, 103 or 51.76% of the students employ the strategy. Trying to understand new concepts in mathematics by relating them to what the students already know followed; 75 or 37.69% of the students employed the strategy. It has to be noted that only 57 or 28.64% think how the mathematics they have learned can be used in everyday life. This could be attributed to the fact that only 81 or 40,70% of the students conceived mathematics as life.

Table 7: Differences in the Performance of the Students in Algebra Across their Conception on Mathematics

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.440	4	0.3599	2.5504	0.0405
Within Groups	27.378	194	0.1411		
Total	28.818	198			

Significant differences were observed in the performances of the students in Algebra when compared across their conceptions on mathematics. This was manifested by the computed significance value of 0.0405, lower than the set level of significance of 0.05. Further analysis showed that the performance of the students who conceived mathematics as a complex, logical yet systematic system is significantly different and better than the students who conceived mathematics as life (an approach to life, a way of thinking, a technique in problem solving, a way of understanding abstract ideas and a tool for development), as a complex, logical yet systematic system used to solve complex but real life problems, is about numbers, equations formula and problem solving and is about numbers, equations formula. The performance of the students who conceived mathematics as life followed. More, the students who conceived that mathematics is about numbers, equations formula have the lowest performance in Algebra. The findings implied that the higher the level of conception about mathematics, the better the performance in algebra becomes. Further, the conception of a student on mathematics is a determinant of his performance.

Significant differences were observed in the performances of the students in Algebra when compared across their conceptions on mathematics. This was manifested by the computed significance value of 0.000, lower than the set level of significance of 0.05.Further analysis showed that those who believed that mathematics should be learned with the intention of gaining a relational understanding of the theory and looking for situations where the theory will apply performed best as compared to others followed by those who believed that mathematics should be learned by solving lots of examples with the intention of gaining understanding of the theory or concept. On the other hand, the students who believed that mathematics should be learned by solving lots of examples with the intention to reproduce or be familiarized with the knowledge and procedures have performed the lowest in algebra.

Table 8: Differences in the Performance of the Students in Algebra Across their Conception on Mathematics Learning Approach

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2.870	4	0.717	5.364	0.000
Within Groups	25.948	194	0.134		
Total	28.818	198			

The performances of the students who believed that mathematics should be learned with the intention of gaining a relational understanding of the theory and looking for situations where the theory will apply those who believed that mathematics should be learned by solving lots of examples with the intention of gaining understanding of the theory or concept are comparable with each other and significantly different with those who believed in the other three strategies. Findings implied that the conception of a student on mathematics learning approach is a determinant of his performance in mathematics.

Table 9: Relationship Between the Performance of the Students in Algebra with Their Conception on Mathematics and Mathematics Learning Approach

Conception on	eta	eta-square	Remarks
Mathematics	0.224	0.050176	Moderate
Mathematics Learning Approach	0.316	0.099856	Moderate

Moderate relationships exist between the performances of the students in Algebra with their conception on mathematics and mathematics learning approach. Findings showed that 5.02% of the performance of the students is related to their

conception on mathematics while 10% of their performance is related to their conception on learning approach. The way a student conceives mathematics and mathematics learning approach affects his performance.

4. Conclusions

Based from the findings of the study, the following conclusions were generated:

1. Frehmen university students generally perform low in mathematics.
2. Students usually have shallow conception about mathematics, not seeing the important role of mathematics in their lives. Majority of freshmen students believed that mathematics should be learned using low level or surface approaches is almost the same with the number of students believing that learning mathematics need high level or deep approahes.
3. Students employ multiple strategies in learning mathematics.
4. The conception of a student on mathematics and mathematics learning approach are determinants of his performance.

5. Recommendations

Based from the conclusions generated, the researcher recommends that the students should realize the role and importance of mathematics in their day-to-day lives, that mathematics is not only about numbers and problem solving, but Mathematics is life (an approach to life, a way of thinking, a technique in problem solving, a way of understanding abstract ideas and a tool for development. They should have higher level conception about mathematics. The students should learn Mathematics with the intention of gaining a relational understanding of the theory and looking for situations where the theory will apply. Likewise, the students should use higher level learning techniques or approaches on mathematics.

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