

Mediated Moderation Effects Of Gender, Year Level And Learning Approaches On Attitude, Teaching Efficacy And Mathematics Achievement Of Education Students

Leonardo G. Gorero¹

Edwin A. Balila²

¹University of Antique Sibalom, Antique, Philippines,

²Adventist University of the Philippines Puting Kahoy, Silang, Cavite, Philippines

leonardogorero@yahoo.com & edwinbalila2006@yahoo.com.ph

Abstract

This study aimed to establish a mediated moderation model by investigating the effects of gender and year level in the relationship between Attitude towards Mathematics, Mathematics teaching efficacy and Mathematics achievement mediated by deep and surface approaches. Participants in this study were 319 second year and third year elementary education students enrolled in the second semester of school year 20132014.

Study have shown that relationship between attitude and mathematics achievement was partially mediated by surface approach while mathematics teaching on mathematics achievement fully mediated by surface and deep approaches. There was a direct relationship between year level and mathematics achievement. This indicated that students on the higher year level tend to have a higher achievement in mathematics. Furthermore, year level interacted positively the effect of mathematics teaching on mathematics achievement. This means that students in the higher year level more likely intensified the effect of mathematics teaching on mathematics achievement while those in the lower level weakened the effect. On the other hand, in the coding of gender, 0 and 1 assigned to female and male respectively, the effect of the interaction of gender and mathematics teaching on mathematics achievement was fully mediated by surface approach. This can be inferred that female intensified the effect of mathematics teaching on surface approach with an effect of surface approach to math achievement is negative. Hence, male education students tend to strengthen the effects of mathematics teaching on mathematics achievement while female education students weakened the effects.

Keywords: Mediated moderation effects, attitude towards mathematics, mathematics teaching efficacy, mathematics achievement, Structural Equation Modeling

I. Introduction

Mathematics has been considered subjects in a school curriculum yet hated by most students and professionals alike. It is likely to be taught than any other subject in schools and colleges throughout the world (Orton, Orton, & Frobisher, 2004), but still students perform less than what they are expected. In fact students' under achievement to this subject has become a global concern over the years and not just a concern for particular countries (Programme for International Student

Assessment, 2003).

This is also the concern of the Philippines that showed the dismal ranking of 39th in the math test and 41st in the science test out of 42 participating countries from the 1995's Third International Mathematics and Science Study (TIMSS) later known as Trends in International Mathematics and Science Study (TIMSS) (Somerset, 1999). It was then followed by the gloomy mathematics achievement in the succeeding TIMSS surveys: third from the lowest for Grade 8 in 1999; third and fifth from the lowest for Grade 4 and Grade 8 in 2003 respectively

(Villafania, 2004), and lowest for Grade 8 in 2008 (Ogena, Laña, & Sasota, 2010). These merely showed that Filipino students have not really retained or learned lessons (deep approach) but using only rote learning (surface approach) where there is no real learning and lessons can easily be forgotten. Teachers play a vital role in promoting deep approach to learning for good teaching can influence students to take a deep approach, while poor teaching can pressure students to take a surface approach (Lublin, 2003).

Thus, it is necessary to improve the quality of teachers in the country by investigating the education students' attitude towards mathematics, mathematics teaching efficacy, learning approaches and the possible impact to their mathematics achievement. Reviewed literature in the Philippines revealed limited studies focus on the said constructs among elementary education students; hence the researcher attempted to conduct this study.

Statement of the Problem

This study aimed to establish a mediated moderation model by investigating the mediated effect of learning approaches to the interaction of gender and year level in the relationship between attitude towards Mathematics, Mathematics teaching efficacy, and Mathematics achievement of elementary education students.

Methods

The descriptive research design using path analysis of the Structural Equation Modeling (SEM) was employed in this study. The exogenous variables are attitude towards mathematics and mathematics teaching efficacy and the endogenous variable is mathematics achievement. Learning approaches serve as the endogenous variable of attitude towards mathematics and mathematics teaching efficacy and as exogenous variable of mathematics achievement. The population of the study was the second and third year Bachelor of Elementary Education (BEEd) students enrolled in the main campuses of State Universities and Colleges in Western Visayas (Region VI) of the Philippines for the second

semester of the academic year 2013-2014. The researcher used cluster random sampling in choosing the main campuses of SUCs in each of the five provinces, and then followed by convenience sampling in selecting the individual respondents. Students present during the gathering of data were the ones selected as respondents. However, those who were absent during the period of the research and grossly failed to complete the research instrument were immediately excluded from the study. The list of the total number of respondents (N = 853) was taken from the dean's offices and distributed and retrieved only 537 questionnaires. It was still reduced to (n = 319) after addressing the missing data, consistent pattern of responses, and univariate and multivariate outliers. The total cases treated in the study were 37.40% considering the total population of 853 with 20% were males while 80% were females when grouped as to gender and 56% were enrolled in second year while 44% were enrolled in third year when grouped as to year level.

The instrument used in the study was divided into 5 parts: Part I is about the respondent's profile; Part II is about assessing the attitude towards mathematics using the adapted and revised Attitude Towards Mathematics Inventory (ATMI) by Tapia (1996); Part III is about measuring the mathematics teaching efficacy using the revised Mathematics Teaching Efficacy Belief Instrument (MTEBI) of Enochs, Smith and Huinker (2000); Part IV is about the approaches or strategies of the respondents in studying. The researcher adapted and examined again the Revised Two Factor Study Process Questionnaire: R-SPQ-2F by Biggs, Kember & Leung (2001); Part V is about the researcher's made cognitive test in Basic Mathematics. This test measures the respondents' mathematics achievement. The topics included were limited only to the following: addition, subtraction, multiplication and division of whole numbers, decimals, integers, and fractions; percent, ratio and proportion with their corresponding concepts and applications. Prior to data collection, the research instruments were subjected to validation by

12 experts in the field of mathematics, psychology and research, including two laymen from selected sectarian universities and colleges in the Philippines, then followed by reliability testing. The final instrument was composed of 23 items for attitude towards mathematics with Cronbach's alpha reliability of 0.90 (57.5% of the original instrument), 19 items for mathematics teaching efficacy with Cronbach's alpha reliability of 0.89 (95% of the original instrument), nine (9) items for deep approach with Cronbach's alpha reliability of 0.83, 10 items for surface approach with Cronbach's alpha reliability of 0.87 and 27 items for mathematics achievement test with Cronbach's alpha reliability of 0.80. The collected data were encoded using IBM SPSS Statistics 20 software and treated by Analysis of Moment Structures (AMOS) 18.

Results

The respondents of the study generally rated "agree" to attitude towards mathematics inventory with an overall mean of 2.84 and a standard deviation of 0.41 which is interpreted as having "positive" attitude towards mathematics. Similarly, they responded "agree" in mathematics teaching efficacy belief instrument with an overall mean of 2.77 and a standard deviation of 0.35, which is interpreted as having "high" mathematics teaching efficacy. Table 1 presents the data.

Table 1: *Profile of the Respondents*

Predictor, Mediator & Dependent Variables	M	SD	SR	VI
ATM (Overall)	2.84	0.41		<i>Positive Agree</i>
MTE (Overall)	2.77	0.35		<i>High Agree</i>
LA:				
DA	3.61	0.61	FTOM	<i>High</i>
SA	2.49	0.69	STOM	<i>Low</i>
Level of	17.44	4.83		<i>High</i>

MA

Note: ATM=Attitude towards mathematics,
MTE=Mathematics teaching efficacy,
LA=Learning Approaches, DA=Deep Approach, SA=Surface Approach, MA=Mathematics Achievement,
M=Mean, SD=Standard Deviation, Scaled Response, VI=Verbal Interpretation,
FTOM=Frequently true of me,
STOM=Sometimes true of me

The deep approach to learning was "high" as they responded, "frequently true of me" with an overall mean of 3.61 and standard deviation of 0.61 whereas the surface approach to learning was "low" as they responded "sometimes true of me" with an overall mean of 2.49 and a standard deviation of 0.69. Consequently, their mathematics achievement was interpreted as "high" for having an overall mean and standard deviation of 17.44 and 4.83, respectively. Table 1 also shows the data.

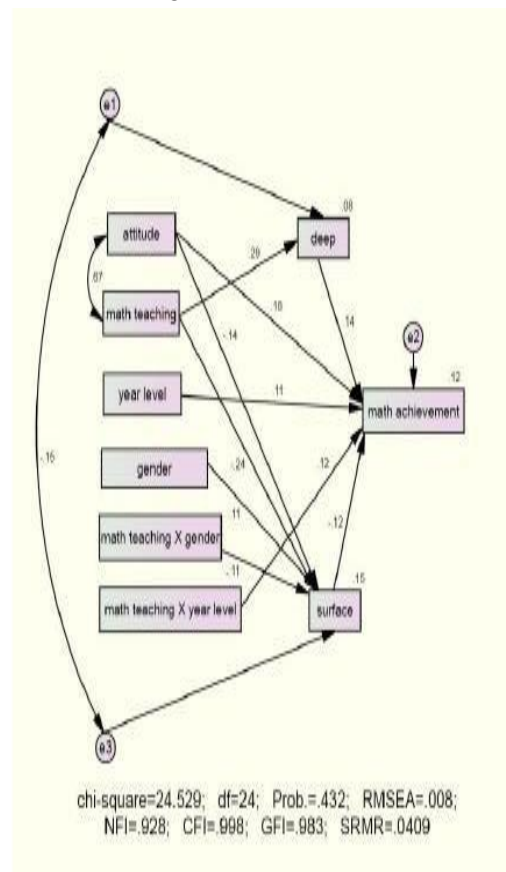
Predictors of Learning Approaches and Mathematics Achievement

Six measures were used to determine the fitness of the generated model. The values of χ^2 (24.529), RMSEA (0.008), CFI (.998), GFI (0.983), and SRMR (.0409) fall within the range of values for the category of a good fit except for NFI (.928) where it falls within the category of an acceptable fit (Meyers et al., 2013, pp. 870-872). Thus, the mediated moderation model could be concluded to have a good fit with the sample data. Path analysis revealed mathematics teaching efficacy ($b = .291$) significantly predicted deep approach to learning, while attitude towards mathematics ($b = -.140$), mathematics teaching efficacy ($b = -.239$), gender ($b = .112$) and the interaction of gender and mathematics teaching efficacy ($b = -.107$) are significant predictors of surface approach to learning. On the other hand, significant predictors of mathematics achievement are attitude towards mathematics ($b = .176$), year level ($b = .107$), deep approach ($b = .139$), and

surface approach ($b = .120$). Deep approach to learning accounts 8% of the variance predicted by mathematics teaching efficacy, surface approach accounts 15% of the variance predicted by attitude towards mathematics, mathematics teaching efficacy, gender, and the interaction of gender and mathematics teaching efficacy and mathematics achievement accounts 12% of the variance predicted by the model. Moreover, year level moderated in the relationship between mathematics teaching efficacy and mathematics achievement ($b =$

.119). Deep approach only mediated in the relationship between mathematics teaching efficacy and mathematics achievement ($b = .040$), while surface approach mediated in the relationships between attitude towards mathematics and mathematics achievement ($b = .017$), between mathematics teaching efficacy and mathematics achievement ($b = .029$), and further mediated in the relationship between the interaction of gender and mathematics teaching efficacy on mathematics achievement ($b = .013$). Figure 1 reveals the data.

Figure 1. Mediated Moderation Model Predicting Mathematics Achievement



Discussion

The positive attitude towards mathematics of elementary education students of SUCs was consistent with previous studies (Anderson, 2007; Goodykoontz, 2008; Ma & Xu, 2004; Mensah, Okyere & Kuranchie, 2013). It the mathematics teaching efficacy belief was “high” affirming previous studies that high mathematics teaching efficacy of the

respondents showed their perseverance in the attempts to reach learning goals (Bruce, Esmonde, Ross, Dookie & Beaty as cited in Volante, Villalon & Muller, 2010); for it can be inferred that they replicate their teachers positive attitude towards mathematics, the clarity of their teachers’ explanation of mathematics that influenced their understanding, there by they have positive

attitude towards it.

Concomitantly, can predict their future behavior in mathematics teaching (Ryang, 2012); and can affect their efforts, goals and level of inspiration they put into teaching (Isiksal & Cakiroglu, 2005).

Similarly the deep approach to learning was “high” implying that high deep approach to that require higher level thinking skills that they could not answer by bits they memorized, hence they start studying differently (Weimer, 2012). On the other hand the surface approach to learning was “low” showing that elementary education students of SUCs were not likely to use the surface approach to learning as they less occupied with superficial retention of the material for examination. Thus, they engaged in the critical analysis of new ideas, linking to already known concepts that can be useful for problem solving in unfamiliar contexts (Houghton, 2004). The result agrees with Texas A and M University’s first year engineering students who had slightly higher level of deep approach compared to surface approach to learning (Fowler, 2003).

Consequently, their mathematics achievement was interpreted as “high” showing that the respondents are knowledgeable to teach basic mathematics. This may be brought about by their teachers’ frequent explanations of the rules and definitions in mathematics, frequent solving of examples, frequent giving of homework, showing how to solve problems and relating these problems to everyday life as House mentioned in Hoang (2007). The result, however, contradicts with the Filipino performances: in TIMSS (Ogena, Laña & Sasota, 2010; Villafania, 2004); in National Achievement Test (The National Achievement Test in the Philippines, 2013); in basic mathematics (Gonzaga, 2006; Leongson & Limjap, 2003). The contradiction in mathematics achievement in favor of the elementary education students of SUCs (2nd year and 3rd year) was attributable to their more mathematics subjects taken compared with previous studies were few mathematics subjects taken there by low Malahmadi & Amani, 2010; Premuzic &

learning entailed respondents’ aim toward understanding (Houghton, 2004), that is why they were intrinsically motivated and truly engaged in the meaningfulness of the task (Fowler, 2003). It gives also evidence on their teachers’ commitment in preparing questions

mathematics achievement.

Path analysis revealed mathematics teaching efficacy significantly predicted deep approach and surface approach to learning. The result corroborates with Leung and Man (2005) that mathematics teaching self-efficacy influences the approach to learning, with negative effect on surface approach to learning (Leung, 2001) and positive effect to deep approach to learning (Silverman & Davis, 2009). In addition to that attitude towards mathematics and gender are significant predictors of surface approach to learning. The result supports the study of Alkahateeb and Hammoudi (2006) that scores in mathematics attitude scale were negatively related to scores for surface approach to learning with younger males were beginning to show disaffection in mathematics lessons (Borthwick, 2011). Moreover, the interaction of gender and mathematics teaching efficacy predicts negatively the surface approach to learning implying that gender moderates the effect of mathematics teaching efficacy on surface approach to learning with females are better than males in lowering this effect.

On the other hand, significant predictors of mathematics achievement were attitude towards mathematics that supports earlier studies (Bordas & Valdez, 2012; Gibbons, Kimmel & O’Shea cited in Yara, 2009; Hoon & Fah, 2013; Mahanta & Islam, 2012; Mensah, Okyere & Kuranchie, 2013; Nicolaidou & Philippou, 2003; Peker & Mirasyedioglu, 2008), year level that agrees with previous studies (Gokce, 2005; Isiksal & Cakiroglu, 2005), deep approach that validates previous studies (Artelt, Baumert, Julius-McElvany, Peschar, 2003; Azar, Lavasani,

Furnham, 2013; Richardson as cited in

Peters, Jones & Peters, 2007), and surface approach that supports the study of Azar et al.(2010).

Moreover, year level moderated in the relationship between mathematics teaching efficacy and mathematics achievement implying that mathematics teaching efficacy of third year respondents have better effect on mathematics achievement compared to second year respondents. Deep approach fully mediated in the relationship between mathematics teaching efficacy and mathematics achievement. Similarly, surface approach fully mediated in the relationship between mathematics teaching efficacy and mathematics achievement. The result implies that the respondents' mathematics teaching efficacy beliefs have better effect on mathematics achievement if deep approach is strengthened while lowering the use of surface approach to learning. The result agrees with the study reported in Leung and Man (2005) that mathematics teaching self-efficacy indirectly influenced achievement through deep approach to learning. Accordingly, surface approach mediated in the relationship between the interaction of gender and mathematics teaching efficacy on mathematics achievement implying that since males are critical thinkers (Farooq & Shah, 2008), so mathematics teaching efficacy of males tend to have better effect on mathematics achievement if they less likely use the surface approach to learning. Furthermore, surface approach partially mediated in the relationship between attitude towards mathematics and mathematics achievement. The result supports the study of Leung (2001) that learning approaches significantly mediated the effect of attitude towards mathematics to mathematics achievement.

Conclusion

Teaching is an attractive profession among women in the State Universities and Colleges (SUCs) as evidenced by majority of them is taking elementary education course. to learning lowers its effectiveness suggesting that even though they have positive attitude towards mathematics but if accompanied by merely memorizing without truly understanding the lessons yield low

Elementary education students like to learn mathematics as reflected in their positive attitude towards it and they believe that they are capable of teaching basic mathematics in the field as shown by their high mathematics teaching efficacy. Moreover, their high mathematics achievement showed that they have enough knowledge on the topics they are expected to teach. Because they are expected to teach the subject, they are eager to learn or understand it deeply, not just reproducing facts in the test as revealed in the high deep approach, and low surface approach to learning.

The elementary education students' positive attitude towards mathematics, high mathematics teaching efficacy and high deep approach to learning yield high mathematics achievement, however the high surface approach yields lower mathematics achievement.

Furthermore, positive attitude towards mathematics and high mathematics teaching efficacy tend to more likely use deep approach to learning rather than using the surface approach to learning.

The higher year level and the high deep approach of elementary education students of SUCs predict higher mathematics achievement while the high surface approach predicts lower mathematics achievement. Mathematics teaching efficacy has a positive effect on mathematics achievement if mediated by the use of deep approach to learning while lowering at the same time the mediated effect in the use of surface approach to learning. Positive attitude towards mathematics on the other hand is directly effective in improving mathematics achievement indicating that the liking of the students in mathematics is being translated into high mathematics achievement; however the mediated use of surface approach

mathematics achievement.

Year level moderates the effect of mathematics teaching efficacy on mathematics achievement.

It means that significant difference existed

between third year and second year elementary education students with third year college students are better in effecting this relationship. In addition, surface approach to learning mediates in the moderation of gender in the effect of mathematics teaching

efficacy on mathematics achievement. It means that the effect of mathematics teaching efficacy on mathematics achievement if accompanied by the low surface approach to learning is better for males than to their female counterparts.

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