EXAMINING FACTORS INFLUENCING STUDENTS' ACHIEVEMENT IN MATHEMATICS USING HIERARCHICAL LINEAR MODELING

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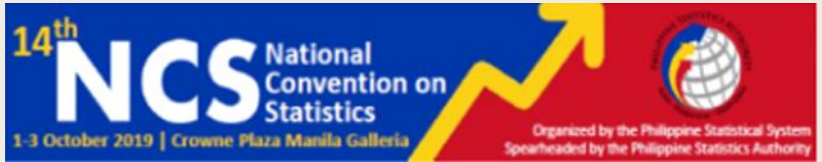


Introduction

- The 1999 TIMSS results show that the Philippines is third from the bottom (of the participating countries); it got 345 points while Singapore had 604 for mathematics. The two lower countries were Morocco (337) and South Africa (275).

- The report for the 2003 TIMSS for mathematics indicate that the international average score is 495. The Philippines was again third from the bottom (358 points); only Morocco (347) and Tunisia (339) was lower.

Introduction

- In the National Achievement Test (NAT), the national target has been set at 75 percent which is the median of the range 66 – 85, interpreted as “Moving towards Mastery” level.

- However, the national target remains elusive in the overall particularly in Mathematics. For instance, in school year 2005-2006, Mathematics generated the second lowest score of 53.66 MPS for the elementary level. While, more than half (59.09%) of the Fourth Year High School students obtained Low Mastery (15-34% MPS) in all subject areas. And in 2012, high school students obtained an MPS of 46.37 in mathematics, which was lower than in 2006 (47.82%) and in 2005 (50.70%). Also, during this period, Region XII’s performance in all subject areas was poor placing it second from the bottom position.

Introduction

- Students low performance in mathematics has been a concern in many educational systems.

- Several studies conducted have examined the factors impacting students' performance in mathematics

- Factors such as students' **gender** and **socio-economic status** (SES) (Ewumi, 2012; Özdemir et al., 2014), **parental involvement** (Sheldon & Epstein, 2005), **environmental factors**, such as school or classroom climate (Malik & Rizvi, 2018), and students' **self-efficacy** (Peters, 2012) are just few factors examined and found to have significant influence on students' mathematics performance.

Introduction

- Choi and Chang‘s (2011) study reveal that more student-level variables were found to have significantly affected student’s mathematics achievement. The findings reveal that parents' educational level had a significant positive effect on students' performance. Student’s gender was likewise found to be statistically significant, indicating that girls, on average, scored lower than boys on mathematics achievement. Further results reveal that students’ attitudes toward mathematics also had a significant effect on their mathematics performance; that is, when a student had a positive attitude toward mathematics, he or she, on average, scored higher on mathematics performance

Introduction

- Teachers have constant and direct contact with students on a daily basis.

- In some studies, it was found that teachers can influence students' performance as much as the students themselves. This was found to be true in Singapore, but not in the USA in the study conducted by Ker (2015), which investigated on the student-, teacher- and school-level factors that impact students' mathematics achievement

Methods

- There were 638 Grade Six elementary and Fourth Year high school students and 24 mathematics teachers of public schools in Cotabato City who participated in the study.

- Students' score in mathematics area of the National Achievement Test (NAT) administered by the National Education and Testing Research Center (NETRC) of the Department of Education (DepEd) was used as the measure of achievement.

Methods

- At the teacher-level, the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) was used to measure teachers' beliefs in teaching mathematics. This was adopted from Enochs, Smith, and Huinker (2000). It consists of 20 items with five-point Likert-type scale, ranging from "strongly disagree" to "strongly agree" with two uncorrelated dimensions, personal mathematics teaching efficacy (PMTE) and mathematics teaching outcome expectancy (MTOE).

- Teaching Practices Scale (TPS) was adopted from the Teaching and Learning International Survey (TALIS, 2008). This consists of 18 items with five-point Likert-type scale ranging from "never or hardly ever" to "in almost every lesson." This has three correlated sub-scales, structured teaching practice (STP), student-oriented teaching practice (SOTP) and enhanced-activities teaching practice (EATP).

Methods

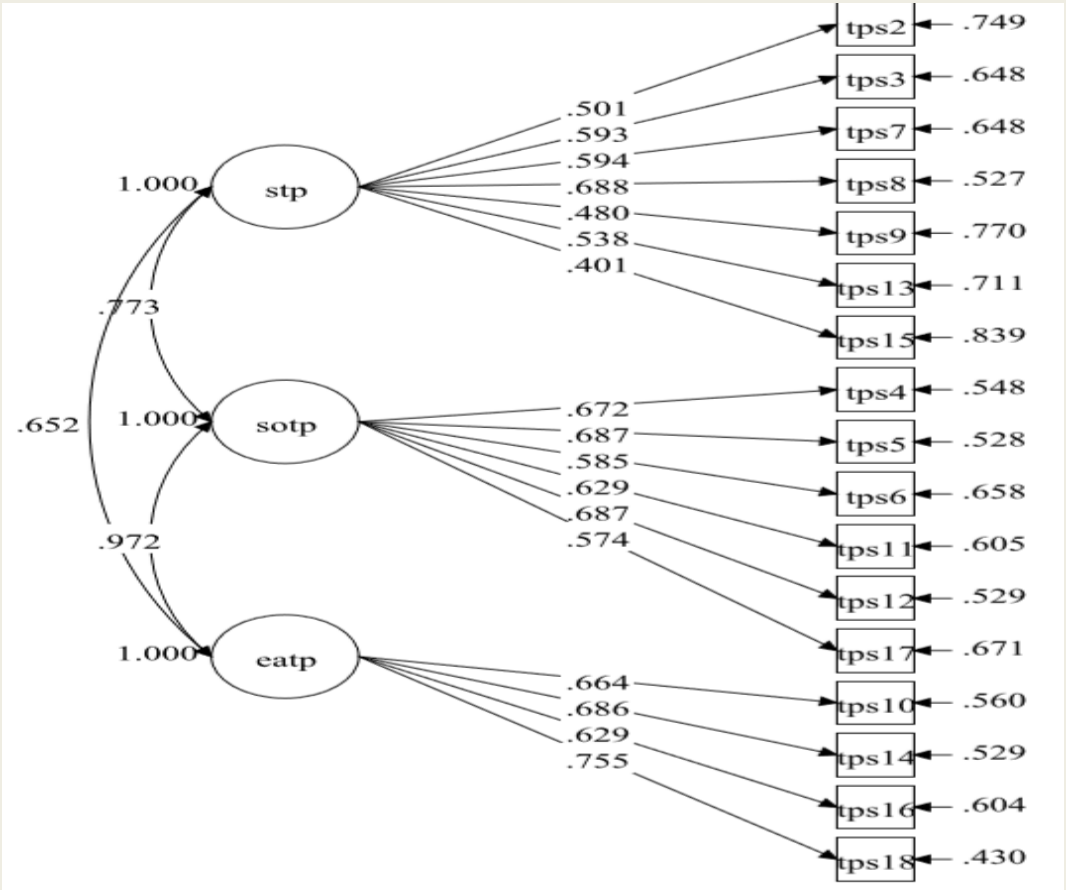
- At student-level, both Confidence in Learning Mathematics (CLM) and Mathematics Anxiety (MAS) scales were adopted from Fennema and Sherman (1976) Mathematics attitude scales. Both have a five-point Likert-type scale which ranges from “strongly disagree” to “strongly agree.”

Methods

- All the scales were subjected to construct validation by using confirmatory factor analysis (CFA) employing Mplus. The scales were further examined at the item-level by using the Rasch model. The weighted likelihood estimates (WLE) of the four scales, obtained using Conquest after item validation are then used in the conduct of hierarchical linear modeling (HLM).

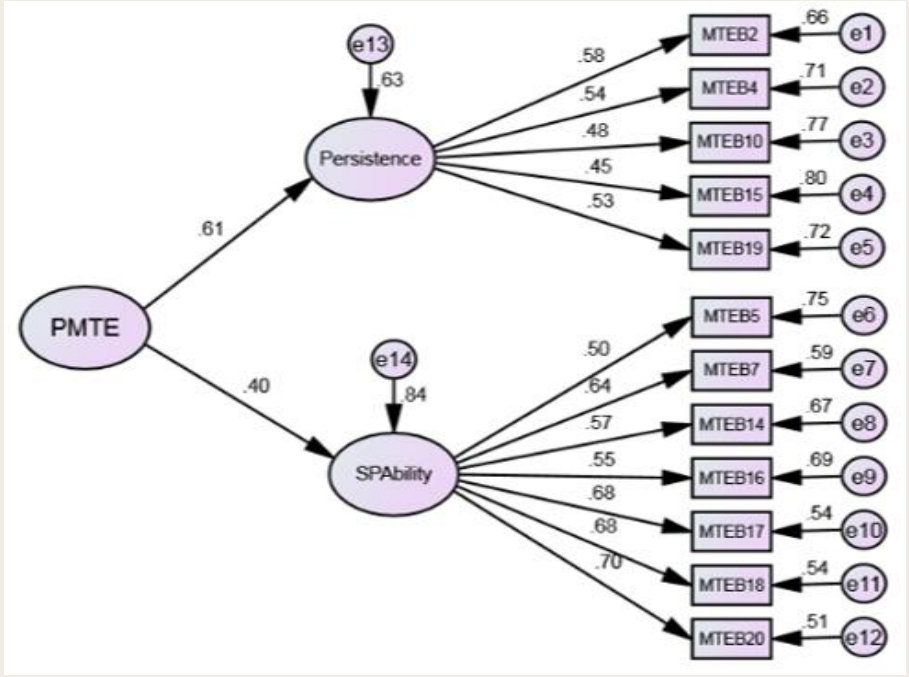
Methods

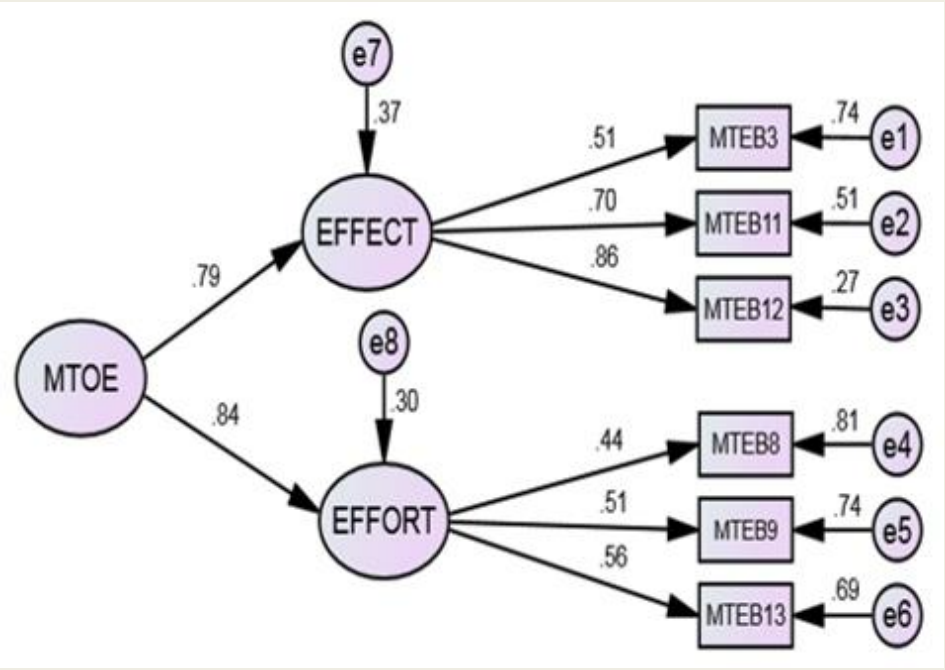
- Three-factor correlated model of TPS



Methods

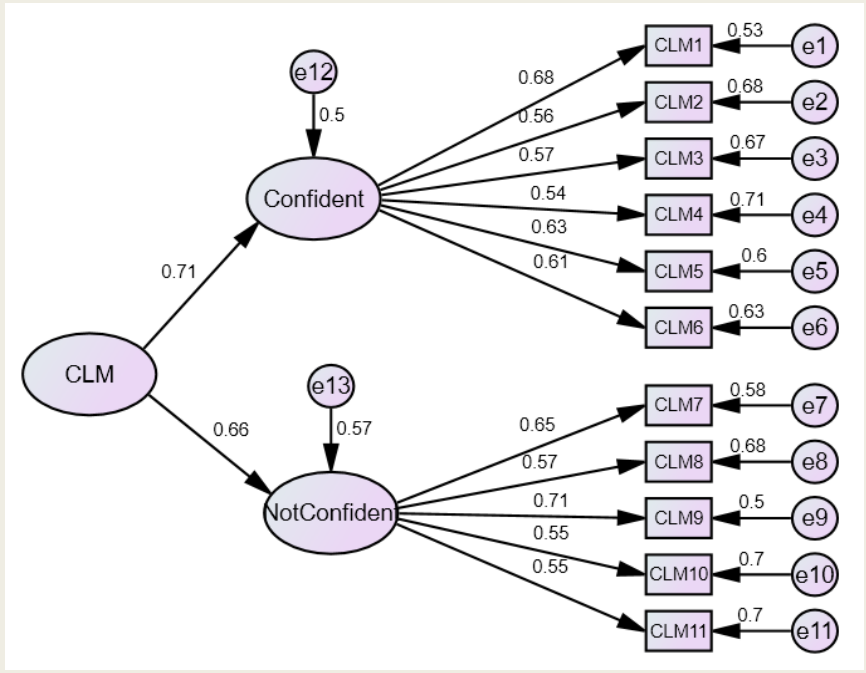
- Final structure of the efficacy beliefs of mathematics teachers (PMTE and MTOE)

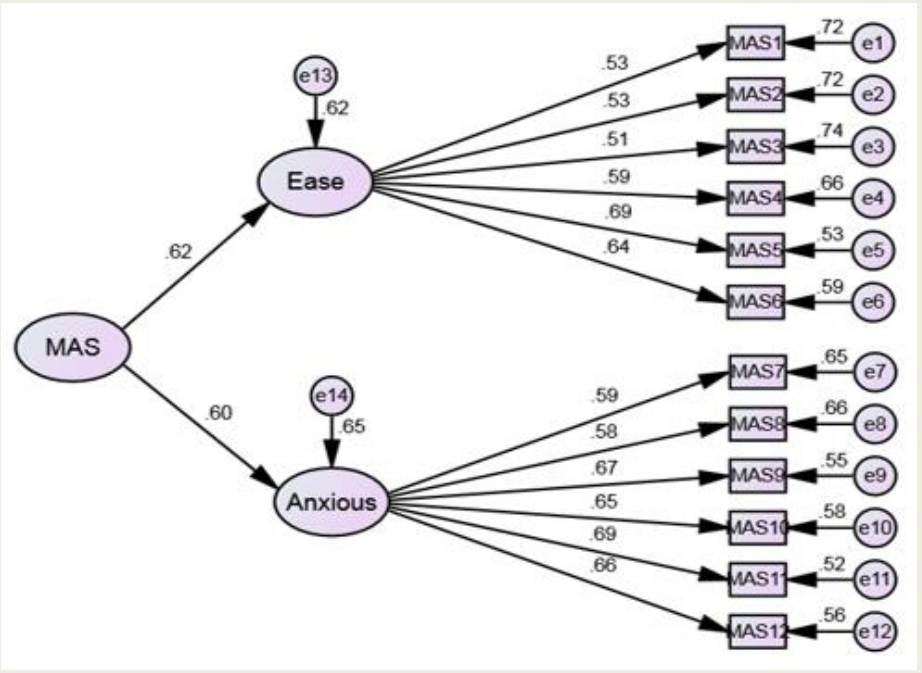




Methods

The final structure of students attitudes scale (CLM and MAS)





Methods

- The Hierarchical Linear Modeling (HLM) version 6 (Raudenbush, Bryk, & Congdon, 2005) software was used to conduct multi-level analysis to examine the factors that influence or affect students' mathematics achievement (Level 1 outcome variable).

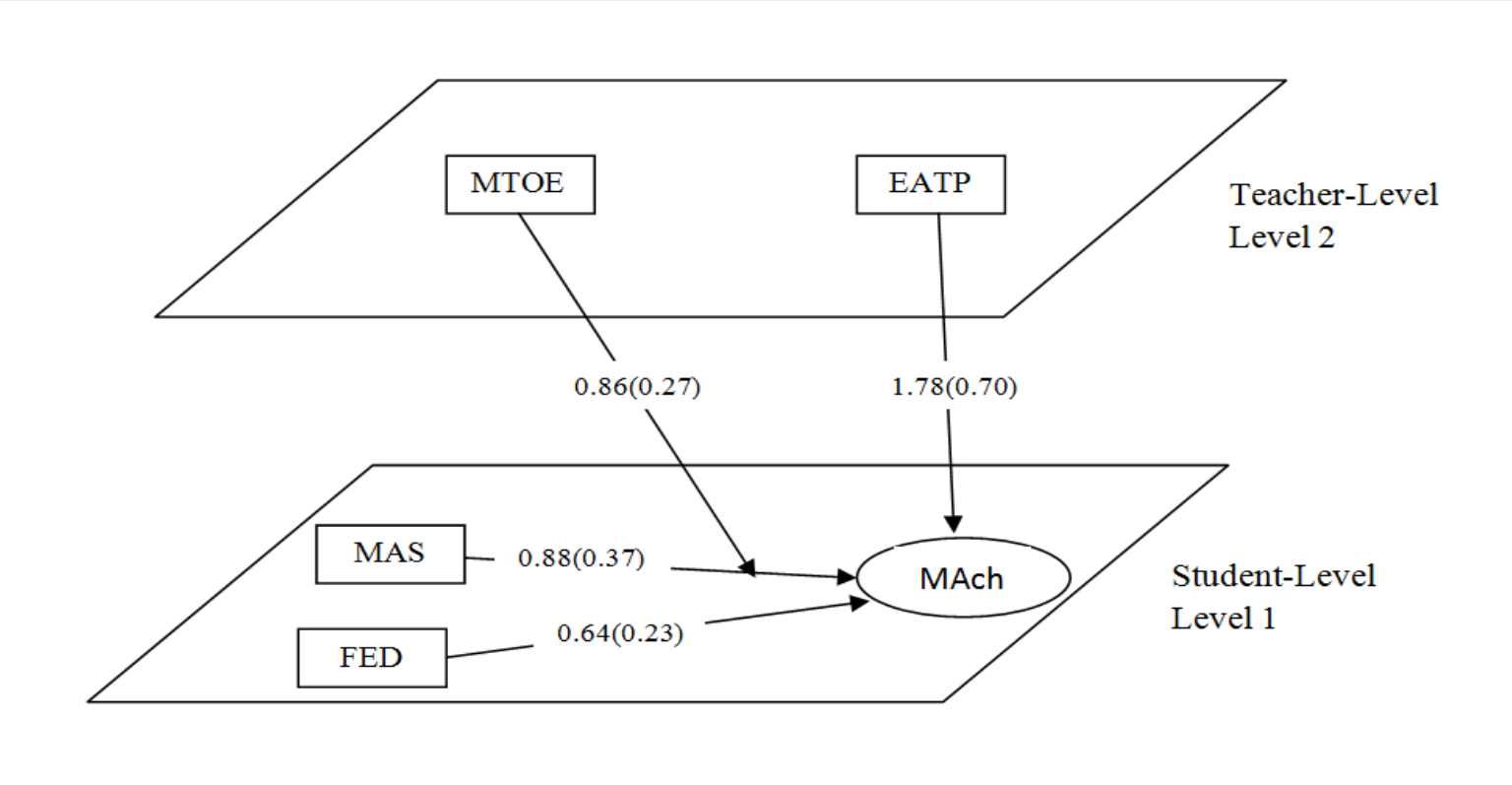
- The multi-level analysis was more appropriate as, by nature, students (Level 1) would be considered as nested within classrooms (Level 2), thus the observations are not fully independent (Osborne, 2000).

Results

- The unconditional (null) model revealed an intraclass correlation (ICC) of .46, which means that 46% of the variance in mathematics achievement is between-class and 54% is between students within each class/teacher.

Results

- After predictor variables in both levels have been added, only the significant predictors have been considered. This results in the final model shown below:



Results

- The final model is specified by the following equations:

Level – 1 Model

- $MAch = \beta_0 + \beta_1 (FED) + \beta_2 (MAS) + r$

Level – 2 Model

- $\beta_{00k} = \gamma_{00} + \gamma_{01} (EATP) + \gamma_{02} (MTOE) + u_{0k}$

Results

- Among the six predictor variables at the student level (Level 1), only the father's educational attainment (FEd) and mathematics anxiety (MAS) have a positive and statistically significant influence on students' achievement. This means that the higher the fathers' educational attainment, the better the student performs.

- In parallel, the less anxious the students are the higher their mathematics achievement. At Level 2, two variables significantly affect students' achievement with EATP having a direct and positive effect; MTOE shows significant cross-level interaction with mathematics anxiety. This means that the strength of the relationship between MAS and mathematics achievement is influenced by MTOE.

Discussion and Conclusion

- Most studies relating to gender and mathematics achievement have shown that males generally perform better. In this study, however, gender (both at Level1 and Level 2) did not appear to be a factor in students' achievement. This result is contrary to what Demir and Kilic (2010) have found in their study involving Turkey students who participated in the Programme for International Student Assessment (PISA).

- This study reveals that the father's highest level of education positively influences students' achievement in mathematics as compared to their mother's educational level. This implies that the father's highest level of education tends to influence more their children to perform better in mathematics. Contrary to this result, Lockheed, Fuller, & Nyirongo (1989) found that mothers' higher levels of education had a positive effect on mathematics achievement among eighth-grade students in Thailand. It was revealed further that it is the fathers' professional occupations that positively influence students' achievement.

Discussion and Conclusion

- Students who found learning mathematics with ease (less anxiety) performed better in mathematics class. Although the effect is not as strong as the teacher-level factors, the effect, however, remains significant which may be contributed by the cross-level effect of MTOE.

- The cross-level interaction between MAS and MTOE is statistically significant, which means that mathematics teachers belief (MTOE) had influenced the degree of relationship between MAS and mathematics achievement. This implies further that the higher the teacher's belief that their teaching skills and abilities and the efforts they put to facilitate students' learning will result into positive learning outcome, the stronger the effects of MAS will be on mathematics achievement.

Discussion and Conclusion

- Lastly, the EATP shows the strongest positive and direct effect on students' achievement. This indicates that students achieve higher if they are given the opportunities to learn by themselves (independent learning) using enhanced activities in the classroom.
- This, however, does not imply that the more independent learning activities, the higher the performance.
- This likewise implicates what mathematics teachers should focus in terms of their teaching and assessment practices.
- Educators and policymakers should likewise make this as a tool in revisiting and redesigning educational and curriculum policies in the mathematics classroom.

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