Structural Equation Model Predicting Math Performance in Individualistic and Collectivistic Nations

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INTRODUCTION

- Examining factors related to academic success, researchers have focused on individual-level factors such as student self-efficacy, self-esteem, and intrinsic motivation (Usher, Li, Butz, & Rojas, 2018).
- Recently, studies have shown group-level factors that may be related to academic success such as:
  - Teacher collaboration predicting higher academic achievement (Karadag, Kilicoglu, & Yilmaz, 2014).
  - Greater parental involvement being significantly associated with higher academic achievement (Barger, Kim, Kuncel, & Pomerantz, 2019).
- When considering mathematical outcomes, cross-cultural research has shown higher math performance scores from participants who live in nations that have higher rates of egalitarianism (Chiu & Klassen, 2010).
- Additionally, both intrinsic and extrinsic motivation have predicted math performance in Canadian-based immigrants (Areepattamannil, 2014).
- These findings suggest that variations in academic performance, especially in math settings, may be related to individualism and collectivism; however, further research is needed.

Present Study

- In light of the theoretical considerations above, the current study aims to address three main hypotheses:
  - We expected that collective student motivation would significantly predict mathematical achievement.
  - We anticipated that parental support and teacher unity would mediate this relationship.
  - We expected to find differences across nations; however, given the exploratory nature of this study, we made no a priori hypotheses.

METHOD

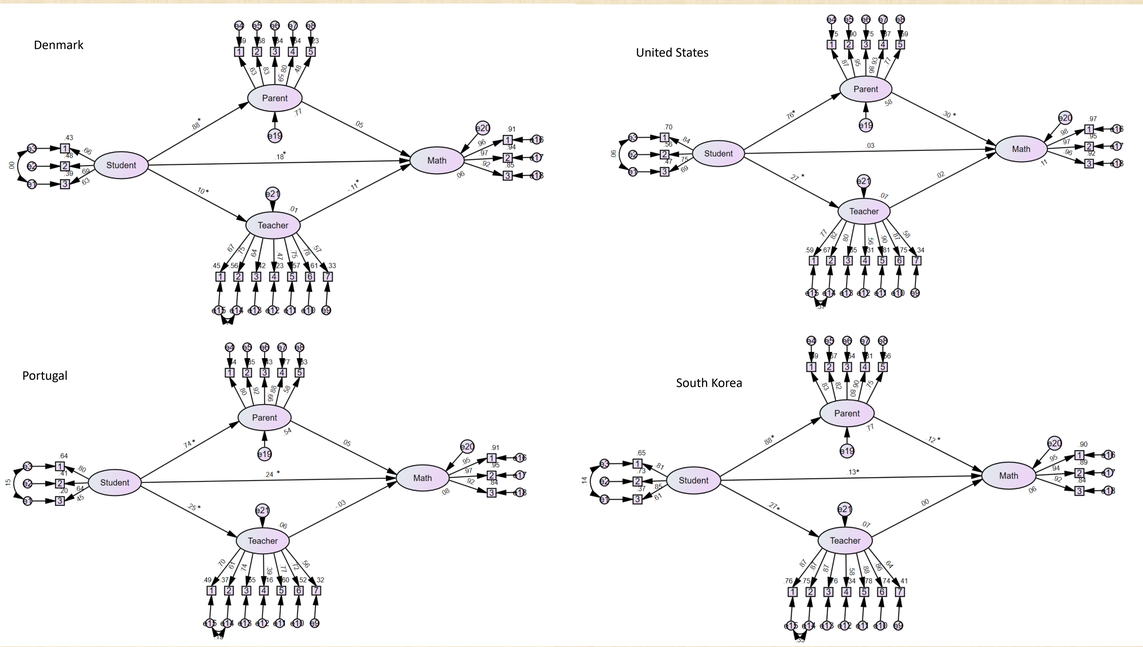
- To address the above hypotheses, the present research utilized data from the Trends in International Mathematics and Science Study (TIMSS; 2015).
  - The TIMSS contains data from around the world; however, the current research examines 4th graders from four different countries:
    - The United States (n = 10,414; male = 49.2%; female = 50.8%)
    - Portugal (n = 4,239; male = 50.8%; female = 49.2%)
    - Denmark (n = 4,953; male = 50.6%; female = 49.4%)
    - South Korea (n = 5,905; male = 51.6%; female = 48.4%)
- Participants completed a series of questionnaires including variables on collective student motivation (perceptions of motivation for students as a whole), parental support (parental involvement in school related activities), teacher unity (teacher's reported level of collaboration with other teachers), and math performance (estimates of students' international placement; see Table 1).
- Structural equation modeling was used to analyze the mediating ability of parental support and teacher unity in the relationship between collective student drive and teacher unity.

Results

Table 1.
Information for subscales used.

Subscale	Name (# of Items)	Item Example	α	Higher Scores indicate
Collective Student Motivation	Student (3)	How would you characterize each of the following within your school? Students' desire to do well in school.	.79	Higher perceptions of motivation for students as a whole.
Parental Support	Parent (5)	How would you characterize each of the following within your school? Parental involvement in school activities.	.92	Higher parental involvement in school related activities.
Teacher Unity	Teacher (7)	How often do you have the following types of interactions with other teachers? Discuss how to teach a particular topic.	.90	Higher levels of collaboration with other teachers.
Math Performance	Math (3)	Plausible value for the mathematics cognitive domain "Knowing."	.97	Higher predicted levels of math ability.

- Omnibus Model:
  - Model Fit:
    - X^2 (128) = 16759.670, p < .001; GFI = .929; CFI = .955; RMSEA = .07.
  - Significant Mediation:
    - Parental Involvement = 60.48%; Aroian z = 19.23, p < .001; Freedman-Schatzkin t = 19.84, p < .001.
    - Teacher unity = 3.10%; Aroian z = 5.62, p < .001; Freedman-Schatzkin t = 31.75, p < .001.
- Denmark Model:
  - Model Fit:
    - X^2 (128) = 3876.552, p < .001; GFI = .918; CFI = .921; RMSEA = .08.
  - Significant Mediation:
    - Teacher unity = -5.11%; Aroian z = -4.43, p < .001; Freedman-Schatzkin t = 1.99, p = .05.
- Portugal:
  - Model Fit:
    - X^2 (128) = 3318.613, p < .001; GFI = .921; CFI = .928; RMSEA = .08.



Results Continued

- South Korea
  - Model Fit:
    - X^2 (128) = 6561.344, p < .001; GFI = .890; CFI = .928; RMSEA = .09.
  - Mediation:
    - Parental Involvement = 45.65%; Aroian z = 3.11, p < .01; Freedman-Schatzkin t = 3.18, p < .01.
- United States
  - Model Fit:
    - X^2 (128) = 8734.598, p < .001; GFI = .951; CFI = .914; RMSEA = .08.
  - Mediation:
    - Parental Involvement = 85.44%; Aroian z = 16.74, p < .001; Freedman-Schatzkin t = 35.08, p < .001.
- Invariance Analysis:
  - High levels of misfit were found when assuming the unconstrained model is correct suggesting the model differs significantly across groups.
    - Measurement model: X^2 (42) = 4815.720, p < .001; NFI = .014; TLI = .009.
    - Structural Model: X^2 (42) = 5172.560, p < .001; NFI = .015; TLI = .008.

Discussion

- The results of the overall model indicated that both parental involvement and teacher unity partially mediated the relationship between collective student motivation and math achievement. These findings were consistent with our first two hypotheses. Furthermore, upon examining the model across the four countries, findings demonstrated that the models significantly varied. No significant mediation between either variable was found for Portugal.
- The relationship between collective student motivation and math performance for both the United States and South Korea was mediated solely by parental support.
- Interestingly for Denmark, teacher unity was found to be a suppressor variable. This suggests that the relationship between student motivation and student performance on math strength with the inclusion of teacher unity in the model.
- While prior research has demonstrated that both teacher unity and parental support are associated with student academic achievement (Karadag, Kilicoglu, & Yilmaz, 2014; Chen, 2005), the current study illustrates how the relationship between these variables vary when examined cross-culturally.
- A limitation is that researchers lacked sufficient data regarding assessment of the academic institutions attitudes towards gender roles.
- Future studies should examine other group-level factors such as perceived teacher support and perceived peer support as possible mediating variables.

Contact Information

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