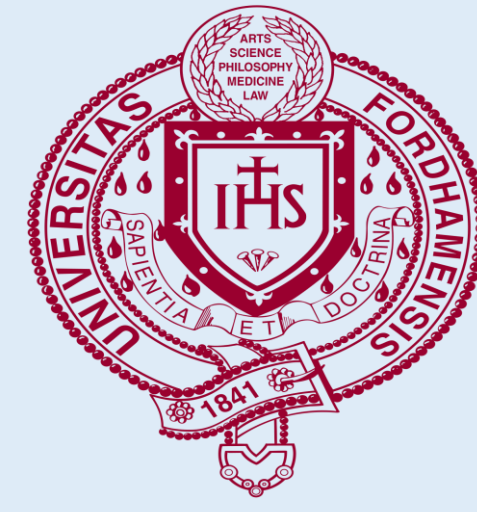


Multilevel SEM of Factors Influencing Mathematics Achievement



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INTRODUCTION

- Students' academic achievement can be influenced by various factors
- Individual context: social skills, climate, motivation, perceived difficulty, or belief in the value of the subject.
- School context: school characteristics (e.g., school location, class size), resources, or teacher's characteristics.
- Previous studies showed mixed results on the factors influencing academic achievements.
- Limited research examined factors affecting students' math achievement using Multilevel Structural Equation Modeling (MSEM).
- This study aims to investigate influential factors on students' math achievement using MSEM.

METHODS

Data

- Trends in International Mathematics and Science Study (TIMSS) 2019 US Data
- 8th grade students (Level-1): 5,068
- Schools (Level-2): 225
- Average number of students in schools [Range]: 22.5 [3, 47]

Analysis

- SEM in each level to explore factors that affect students' math achievement
- Multilevel SEM (MSEM) with both Student and School Sampling Weights
- Maximum Likelihood estimation with Robust standard error (MLR)

Statistical Software

- Mplus ver. 8.9 (Muthén & Muthén, 2017)
- R ver. 4.3.0 (R Core Team, 2022)
- Dire ver. 2.1.1 (Bailey et al., 2023)
- EdSurvey ver. 3.1.0 (Bailey et al., 2023)

Figure 1
MSEM model

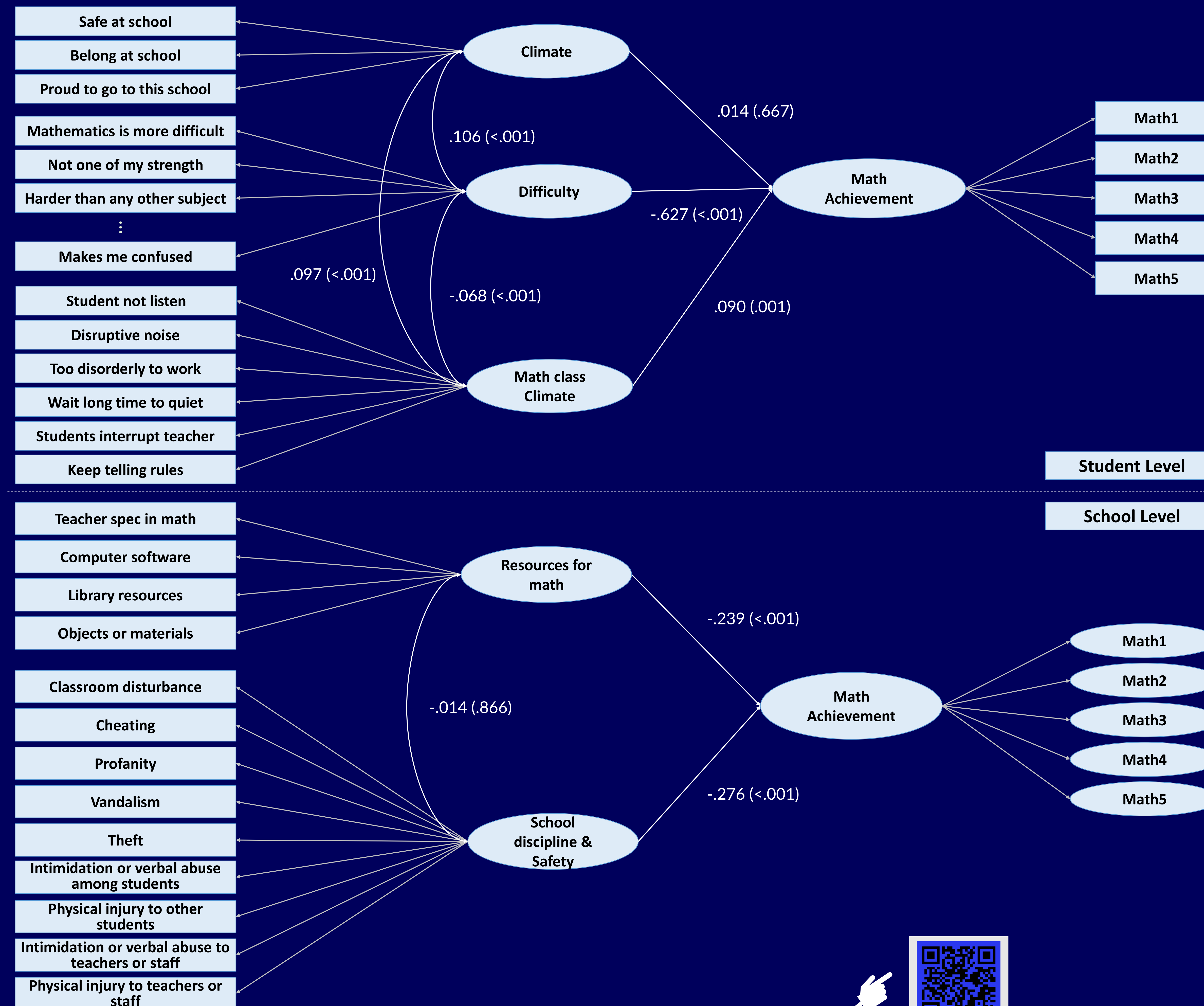


Table 1
Fit Indices of MSEM model

Model	value	χ^2	p	CFI	TLI	RMSEA	SRMR	
		df					within	between
MSEM	2020.538	335	<.001	.951	.944	.032	.037	.063

Items & Mplus Code!



RESULTS

- Using SEM for each level, five influential factors were found in US 8th grade students' math achievement.
- Student level factors (3): school climate, perceived difficulty in math, and math class climate
- School level factors (2): school resources for math and school discipline and safety
- Intraclass Correlation Coefficients for math achievement ranged from .265 to .281.
- Global fit indices of the MSEM model are shown in Table 1.
- Student Level
 - The relation between math achievement and perceived difficulty in math was statistically negative.
 - The relation between math achievement and class climate was statistically positive.
- School Level
 - Shortage of school resources and more problems in school safety had a negative relation with students' math achievement.

DISCUSSION

- MSEM approach can reduce measurement error.
- The data structure (students are nested in their schools) is taken into account in MSEM.
- Limitations
 - Small sample size of the teacher level (65 teachers)
 - Convergence issue when the variables were defined as categorical

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