



Learning Outcomes in Math as a Function of Type of University: An Application of Multilevel Structural Equation Modeling

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Purpose

- The purpose of the present study was to model math achievement at both the person and university level and predict that achievement from person level variables (age and gender) and university level variable (old versus new establishment).

Participants

- Participants were 5,445 individuals who took the math teacher test during a national examination.

Measure

- Math Achievement: the four mathematical competencies measured fully by the test were numbers and operations,
- algebra,
- Geometry, and,
- Probability and statistics

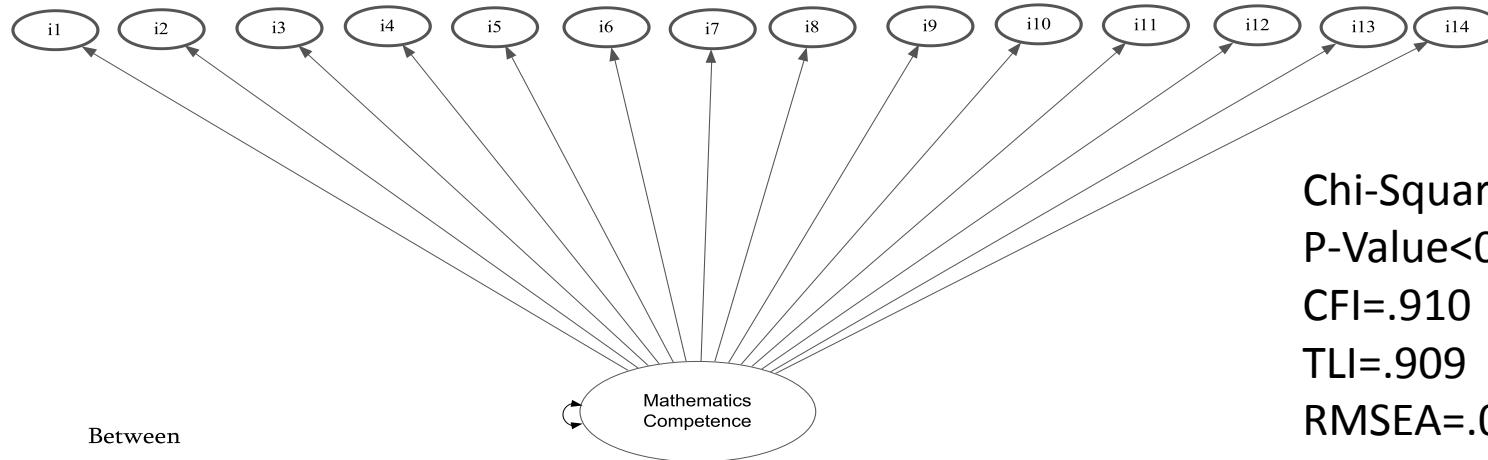
Data Analysis

- Data were analyzed by means of Multilevel Structural Equation Modeling (MSEM) with the goal of testing: (a) the optimal simple structures of math achievement at both levels in the analysis (person and university), and, (b) predicting math achievement as a function of students' gender, age, and type of university (old versus new).

Theoretical Model

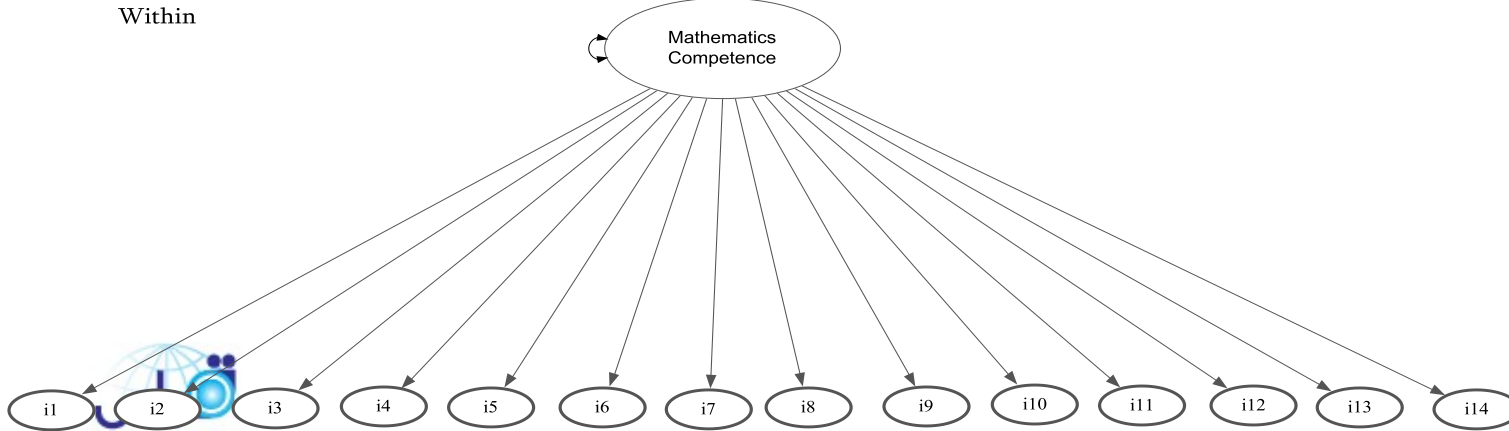
- Math Achievement predicted by participant gender, age and type of university (new-old)

Results: Unidimensional or Multidimensional Structure?



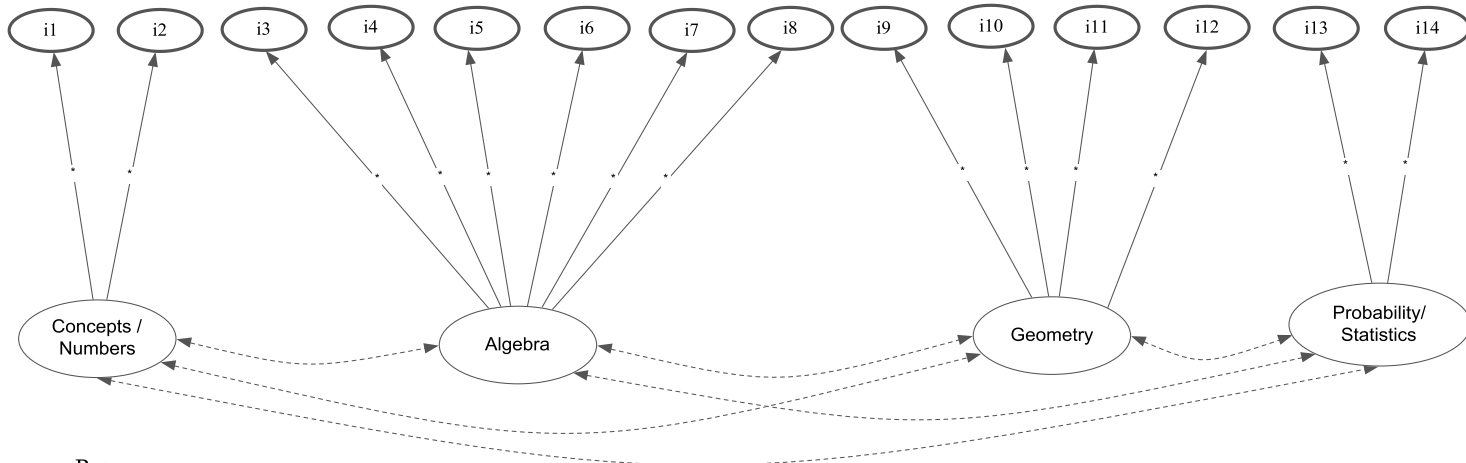
Chi-Square (181) = 797.377*
P-Value < 0.0001
CFI = .910
TLI = .909
RMSEA = .025

Within



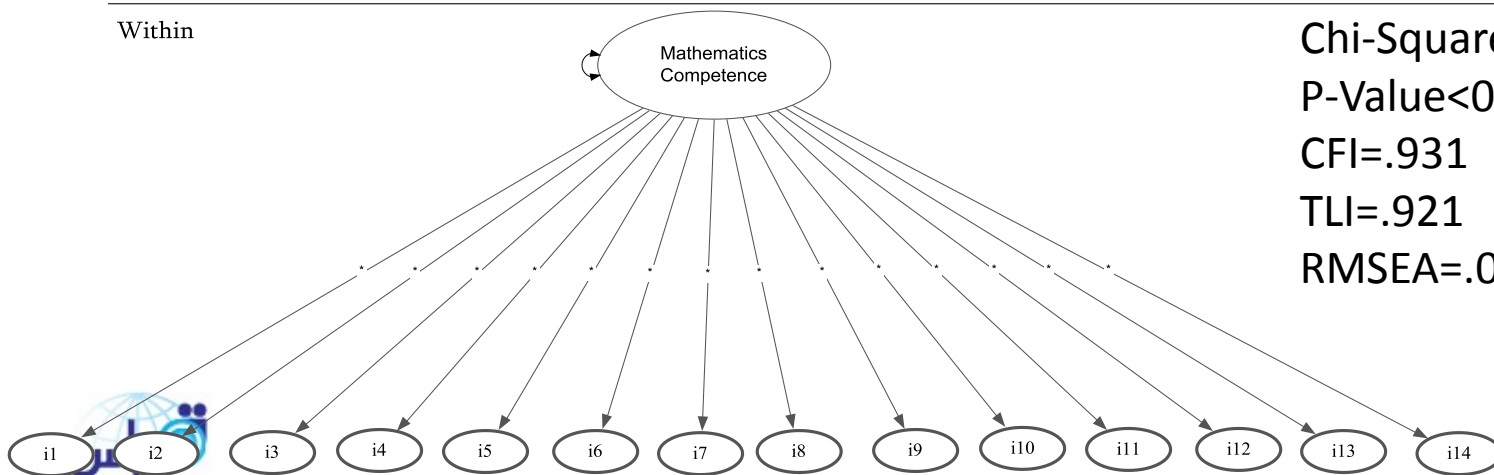
All measurement paths were significant at both the within and the between person level

Results: Unidimensional or Multidimensional Structure?



Between

Within



Chi-Square (158) = 629.158*
P-Value < 0.0001
CFI = .931
TLI = .921
RMSEA = .023

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All measurement paths were significant at both the within and the between person level

Results: Unidimensional or Multidimensional Structure?

- Δ chi-square test (23)=168.051* in favor of the multidimensional model. Critical value=35.172
- $AIC_{uni}=18,5204$
- $AIC_{multi}=18,5147$
- All comparison results favored the unidimensional model at the within level (person) and the multidimensional model at the between (university) level

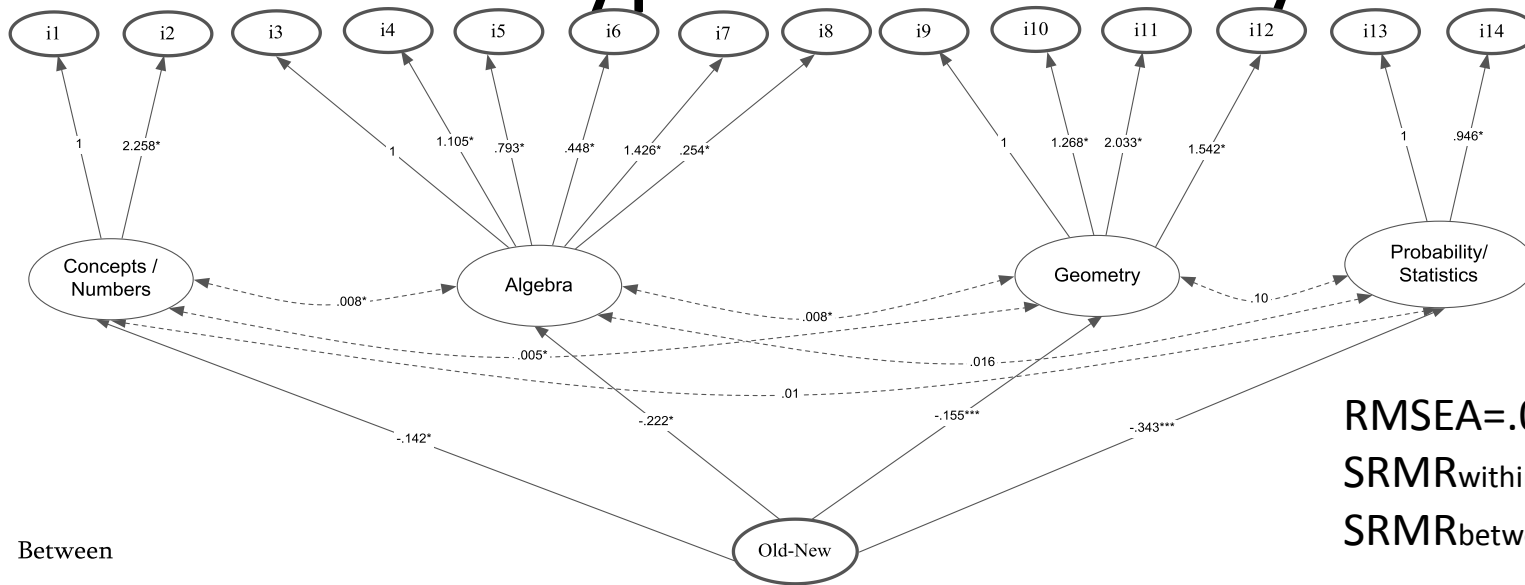
Intraclass Correlation Coefficients

$$ICC = \frac{\psi_{11}}{\psi_{11} + \Psi_{11}} = \frac{\text{between}}{\text{between} + \text{within}}$$

Measurement model variables

Y1	0.020	Y8	0.009
Y2	0.063	Y9	0.015
Y3	0.035	Y10	0.025
Y4	0.039	Y11	0.056
Y5	0.020	Y12	0.023
Y6	0.009	Y13	0.061
Y7	0.058	Y14	0.045

Results: Predicting Math from Gender, Age, and Type of University



RMSEA=.028
 SRMR_{within}=.023
 SRMR_{between}=.070

Conclusions

- At the person level a unidimensional structure fit the data best, suggesting that individuals were knowledgeable equally well across subject matters
- At the university level, however, the simple structure supported, involved the four mathematical competencies measured fully by the test (numbers and operations, algebra, geometry and probability/statistics)

Conclusions-cont.

- At the person level neither gender nor age were significant predictors of the unidimensional math achievement
- At the university level, type of university was a significant predictor of multidimensional math achievement with older institutions being associated with enhanced performance across all math domains, compared to newer institutions



Thank you

