



Bridging the U.S. Math and Science Achievement Gap: Multivariate Modeling of National and International Data

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Abstract

Background: Comparative international assessments of educational achievement consistently find that U.S. students trail behind many of their peers, particularly those from East Asia, in math and science. Traditional research efforts to elucidate the factors responsible for this alarming achievement gap have focused on numerous characteristics (e.g., institutional, curricular, pedagogical, socioeconomic, demographic), that might differentiate the U.S. from top-performing countries. Major limitations of this purely descriptive strategy include: (1) the context-dependence of the achievement predictors identified by cross-national comparisons (i.e., a particular characteristic, such as class size, might predict achievement in one country but fail to do so in a different country); (2) the ecological fallacy of assuming that relations among variables at the between-country level will hold at the within-country level of analysis; and (3) excessive reliance on methodological and analytic strategies that are inadequate given the complexity of the issues under examination. These limitations are addressed in the present research, which is expected to enhance our understanding of the U.S. math and science achievement gap by: (1) shifting the theoretical focus to context-invariant predictors (i.e., factors associated with achievement that are independent of national setting); (2) modeling mediators and moderators of the relation between those predictors and academic performance; (3) adopting analytic strategies that recognize the temporal precedence of predictors and mediators relative to the outcomes and are thus better suited for determining how change in antecedent conditions relates to change in later achievement. The ultimate goal of this work is to identify a set of context-invariant and malleable achievement predictors that could inform the development of effective interventions aimed at eliminating the U.S. math and science achievement gap.

Design and Measures: East Asian students outperform their White and Mexican peers, and Mexican students underperform their East Asian and White counterparts, not only when achievement is assessed in cross-national comparisons, but also when academic performance is measured within U.S. samples. As East Asians move from their native country to a host country, such as the U.S., they must bring with them something that explains the remarkable stability in their achievement levels. On the basis of the empirical literature reviewed, parental aspirations, student aspirations, value placed on effort and hard work, and self-perceptions (math and science self-concept and self-efficacy) are identified as important context-invariant predictors of East Asian achievement. Moreover, academic self-concept calibration accuracy emerges as an important moderator of the self-perception—achievement relation.

Data Analytic Strategy: Following the construction of a theoretically-based East Asian achievement model that incorporates those predictors, multiple mediator structural modeling of two cycles of international assessment data (PISA 2003 and PISA 2006), that include East Asian countries, the U.S., and Mexico, and multivariate latent growth modeling of longitudinal data from a nationally representative U.S. sample (NELS), that also includes East Asian, non-Hispanic White, and Mexican students, are used to gain insights into the troubling U.S. math and science achievement gap. These analyses should also shed light on the extent to which the process of acculturation moderates the relation between achievement predictors and actual academic performance.