Educational Applications of Multilevel Structural Equations Modeling using xxM

The session will introduce a general framework for Multilevel Structural Equations Modeling (ML-SEM) and a software package xxM for analyzing complex educational data.

Educational data inherently involve complex dependencies. A student may receive language-related instruction from multiple instructors (e.g. tutors or paraprofessionals) in one class and/or a different set of teachers across grades. A teacher may have multiple classes within a given grade and classes across grades. Student language outcomes may be assessed multiple times within a year and over time. A teacher’s influence on a student performance may persist beyond the year in which the instruction occurred. Classrooms and teachers may be nested hierarchically or non-hierarchically within schools, neighborhoods, and districts. Systematic formulations of research questions about teacher effects (e.g., value-added models) should attempt to account for multiple sources of influence. Until recently, analysis of such data presented multiple challenges.

Model frameworks that may accommodate complex dependencies are necessary to formulate research questions and analyze data. This session will introduce a framework for Multilevel Structural Equations Modeling (ML-SEM) that allows models with latent variables and random effects to be formulated in a WYSIWYG fashion. A software package (xxM) for estimating ML-SEM models will be introduced. Key features of the framework and the software package include:

(a) A model may include any number of levels including combinations of cross-classified and hierarchically structured data.
(b) Observed and latent variables may be present at any level.
(c) Conventional SEM measurement and structural relationships may be specified within a given level and across any two levels.
(d) Random-effects are specified as ordinary latent variables. Random-effects of predictors may be specified across any two levels.
(e) Novel model constructs such as a virtual-level and role-models permit models for multivariate social-network data. For example, each student may rate their classmates on multiple attributes such as “helpfulness”. In this case, each student plays the role of a rater and a target within different dyads. Such social relations models can be specified easily using the new multilevel modeling constructs where person is a virtual level, and the model for the two roles “rater” and “target” are called role models. Such models are difficult to specify using conventional MLM packages.

Empirical applications illustrating these features of xxM will be presented.