**Structural Equation Modeling**

“Structural equation modeling can be defined as a class of methodologies that seeks to represent hypotheses about the means, variances, and covariances of observed data in terms of a smaller number of ‘structural’ parameters defined by a hypothesized underlying conceptual or theoretical model.”

[(Kaplan, 2001)](Kaplan,%20D.%20(2001).%20Structural%20equation%20modeling.%20In%20N.%20J.%20Smelser%20&%20P.%20B.%20Baltes%20(Eds.),%20International%20encyclopedia%20of%20the%20social%20&%20behavioral%20sciences%20(Vol.)

The intended model in this study is structural equation modeling (SEM), a modeling that is generated from combining two components, namely, measurement (factor analysis) and structural (path analysis) ([SC](Kaplan,%20SEM%20p.2)).

**Factor Analysis**

1. Inasmuch as PISA applies IRT (item response theory) approach to measure latent constructs ([SC](Chapter%2016%20Scaling%20procedures%20and%20construct%20validation%20of%20context%20questionnaire%20data)) such those used in this study,
2. it is appropriate to conducted a secondary a) confirmatory factor analysis (CFA) to validate the construct(s) of the independent variables ([SC](M.%20Y.%20-C.%20Jiang,%20M.%20S.%20-Y.%20Jong,%20W.%20W.%20-F.%20Lau%20and%20E.%20T.%20-H.%20Luk,%20%22Does%20ICT%20Use%20Matter%20between%20Socioeconomic%20Status%20and%20Academic%20Performance?,%22%202019%20International%20Symposium%20on%20Educational%20Technology%20(ISET),%202019,%20pp.%2083-86,%20doi:%2010.1109/ISET.2019.00026.)) and b) exploratory factor analysis (EFA) to identify the distinct latent construct(s) underlying the ICT use at school (USESCH) observed variables as several literature indicates that this usage is—as in outside school context— can be for leisure or schoolwork ([SC](https://bera-journals.onlinelibrary.wiley.com/doi/full/10.1111/j.1467-8535.2008.00876.x)).
3. Taking into consideration that the items are of categorical/ordinal nature, it is recommended to choose robust weighted least squares mean and variance (WLSMV) estimator when conducting measurement models ([SC](https://books.google.no/books?hl=en&lr=&id=Q61ECgAAQBAJ&oi=fnd&pg=PP1&ots=jFgg2ox7rn&sig=sBYK2fmTyCMwUQsQFSiZnrtpXtY&redir_esc=y#v=onepage&q&f=false)). Lavaan package (SC) of R (SC) provides this estimator by choosing estimator = WLSMV.

**Path Analysis**

1. After assessing the measurement model, the structural part follows.
2. To specify structural model it is constructive to describe the model using path diagrams first introduced by ([SC](Wright,%20S.%20(1934)%20The%20method%20of%20path%20coefficients.%20The%20Annals%20of%20Mathematical%20Statistics,%205,)). Path coefficients specify and assess the relationships between *a*) predictors (X) and mediators (M), *b*) mediators and outcome variable (Y), *c*) predictors (X) and outcome variable (Y). In this context, *a* and *b* are considered indirect effects while *c* is direct.
3. By using MODEL INDIRECT command, Mplus will, by default, implement multivariate delta method ([SC](https://books.google.no/books/about/Structural_Equation_Modeling.html?id=xQzRdnJWgvoC&source=kp_book_description&redir_esc=y))suggested by ([Sobel](Sobel,%20M.E.%20(1982).%20Asymptotic%20confidence%20intervals%20for%20indirect%20effects%20in%20structural%20equation), 1982) which produce more accurate results for large samples ([SC](MacKinnon,%20D.P.,%20Lockwood,%20C.M.,%20Hoffman,%20J.M.%20et%20al.%20(2002).%20A%20comparison%20of%20methods%20to)).
4. Figure 1. Shows the equations for the path analysis in the model, to elaborate the equations figure 2. Shows the matrix of the model.