

## Validation of competing structural models of inter-relationships in the teaching–learning ecosystem for two Malaysian STEM courses

### ABSTRACT

This study reported the results of Structural Equation Modelling (SEM) analyses on 13 competing structural models on the inter-relationships among academic achievement and student- and course-related attributes. The samples were Malaysian pre-university students enrolled in two STEM courses (biology,  $n = 326$ ; mathematics,  $n = 339$ ; biology only,  $n = 92$ ; mathematics only,  $n = 105$ ; biology and mathematics,  $n = 234$ ). For both courses, interdisciplinary cross-validation was observed for four models which hypothesized that current academic achievement could be predicted (1) directly by prior academic achievement (high school grades) and student approaches to learning (SAL), and (2) directly and/or indirectly by personality, intrinsic motivation and course experience (CE). For at least one course, all constructs (except intrinsic motivation, clear goals and standards, openness and conscientiousness) significantly and directly predicted current academic achievement. The strongest predictor of current academic achievement was prior (high school) academic achievement, with the largest effect sizes, followed by SAL. Current academic achievement was significantly and positively predicted by all CE constructs (except clear goals and standards) for only mathematics, with moderate and large effect sizes. Only one personality construct (neuroticism) significantly and moderately predicted current academic achievement (biology). SAL partially mediated relationships between current academic achievement with workload appropriateness, assessment for understanding and neuroticism for at least one course. Generally, the strongest predictors of SAL were assessment for understanding, workload appropriateness and intrinsic motivation. Multigroup invariance analysis revealed differences in five hypothesized paths, attributable almost entirely to significant paths found in mathematics but not biology (prior [high school] to current academic achievement, conscientiousness to surface approach to learning, intrinsic motivation to deep and surface approaches to learning). Therefore, this study is the first to report course-nuanced differences in the presence of reduced interpersonal differences. The implications of this study is that, besides the importance of prior high academic achievement which might not be within educators' control, factors in the teaching-learning ecosystem within educators' control which influence current academic achievement are strongly mediated by SAL, which is itself influenced most by assessment, workload and intrinsic motivation.

**Keyword:** Academic achievement; Student approaches to learning; Personality; Motivation; Course experience; Competing models; Structural equation modelling; Confirmatory factor analyses; Multigroup invariance analysis