Mathematics Capital as a Latent Factor

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Students bring their individual characteristics and identities into the classroom, which ultimately impacts their learning experiences and success in mathematics (Cribbs et al., 2015, 2021, 2022; Gutiérrez, 2009; NCTM, 2014). We seek to identify student backgrounds and characteristics that impact their success in mathematics education by analyzing data from students in undergraduate mathematics courses via structural equation modeling (SEM). Our goal is to study a novel theoretical construct, defined as *mathematics capital* (Anderson, 2023, 2024, Anderson et al., 2024, Williams & Choudry, 2016; cf, Bourdieu, 1977, Archer et al., 2014, 2015). Undergraduate students have a plethora of prior mathematical experiences. These past experiences can inform their choice of a college major and set them on a semi-fixed trajectory. Thus, we study undergraduate mathematics students because we view their course enrollment as a marker of their mathematical outcomes.

We use a Bourdieusian lens (Bourdieu, 1977; Bourdieu & Wacquant, 1992) to frame the construct of mathematics capital. Following the work of Bourdieu, we argue that mathematics capital is a unique variable that relates to and acts as a bridge between other constructs in mathematics education such as social factors, cultural capital, emotions, and personal experiences (Anderson, 2024). Like Archer and colleagues (2014, 2015) who have applied Bourdieu's ideas to study science capital, we extend this work into the field of mathematics education (Anderson et al., 2024, c.f. Dewitt et al., 2016).

We collected quantitative data in Fall 2023. A previously validated Qualtrics survey containing items related to mathematics capital (MC), mathematics mindset (MIND), self-efficacy (SE), cultural capital (CC), and mathematics teaching and learning experiences (TEAC) was distributed via email to all students enrolled in any mathematics course at an urban university. We received a total of 685 responses out of 2594 students for a response rate of 26.4%. Only participants who completed the entire survey were included in the analysis for a total of 674 participants. Variables of MIND, SE, CC, and TEAC were used with alpha values ranging from .75 to .94. To create a latent factor of the MC measure, six items were used. A single-factor confirmatory factor analysis was tested using structural equation modeling (M-Plus Ver. 7, Muthén & Muthén, 2012), resulting in a poor fit to the data. Thus, a correlation was added between item 6 and item 7) (as suggested by modification indices). The resulting model was then an acceptable fit to the data ($\chi2(8) = 32.06$, $p < .05$, CFI = .99; RMSEA = .07, SRMR = .01). The internal reliability of the latent factor of mathematics capital was acceptable ($\omega = .90$). We also tested alternative models in which either item was removed, and none were acceptable.

A full model with all other scale scores was tested to elucidate how each were related to the other, but more importantly to the latent factor of mathematics capital. The final model (visual figure on poster) remained a good fit to the data ($\chi2(31) = 103.35$, $p < .05$, CFI = .98; RMSEA = .03, SRMR = .01). This model details the positive relationships between self-efficacy, mathematics mindset, teaching and learning experiences, cultural capital to mathematics capital and reinforces mathematics capital as a separate construct as it is measurably distinct from all other variables (with existing scales) used in this study. This model supports findings from a previous pilot study and provides avenues for future research.

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