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A multi-method approach for describing the contributions of student engagement on fifth grade students' social competence and achievement in mathematics

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ABSTRACT

Multiple perspectives of measuring engagement (i.e., student-, teacher-, and observer-report) were used to describe the contributions of engagement during mathematics instruction on fifth graders' ($N = 387$) social skills and achievement. Students completed questionnaires on their mathematics engagement. Teachers completed questionnaires on students' engagement and social skills. Researchers observed student engagement during math lessons. Students' scores on a standardized test were used to assess mathematics achievement. All three approaches to measuring engagement were significantly associated with students' social skills in math class. Teacher-reported student engagement and observer-reported student engagement were significantly associated with students' mathematics achievement, but student-reported engagement was not significantly associated with achievement. Moderation analyses revealed that associations between math engagement and outcomes were no different for boys than girls. Findings are useful when considering ways to identify engagement and promote social interactions and achievement during mathematics instruction.

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During fifth grade, students are typically culminating their elementary school experiences and preparing for the transition to middle school. Fifth grade teachers face challenges in their efforts to engage children in mathematics learning during this critical juncture. The purpose of the study is to improve our understanding of engagement in upper elementary school mathematics classes and help educators make decisions about how to assess student engagement in efforts to promote mathematics achievement and social skills. In this study, we use three approaches to measuring engagement (i.e., observed, student-reported, and teacher-reported) and build upon existing research (Rimm-Kaufman, Baroody, Larsen, Curby, & Abry, 2015) to consider how these approaches to measuring engagement relate to student outcomes.

1. Defining and measuring engagement

To effectively guide students' development of academic and social skills, teachers need to make daily decisions about what instruction and supports they are offering and what adjustments need to be made. Day to day teachers need to rely on indicators that they can see. One indicator of school success is students' engagement in learning (Connell, 1990; Connell & Wellborn, 1991; Skinner, Kindermann, Connell, & Wellborn, 2009).

Engagement is a complex construct (Fredricks, 2011; Reschly & Christenson, 2012; Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006). While there is a need to understand engagement and help teachers to engage students in content areas, such as mathematics, conceptualizing and reporting engagement can be challenging. In order for student engagement to be a meaningful indicator of school success, schools need tools to measure engagement in specific classroom contexts that predict important outcomes such as achievement and social skills. Accomplishing this task requires understanding the construct of engagement (i.e., what is being measured) and examining the relative contribution of different measurement approaches in the classroom setting.

Engagement is conceptualized as a multi-dimensional construct (Fredricks, 2011; Reschly & Christenson, 2012; Skinner, Kindermann, Connell, & Wellborn, 2009); however the number of dimensions varies by model. Most scholars agree that engagement consist of some type of participatory component (Reschly & Christenson, 2012). This refers to students' involvement and participation in tasks or activities (Fredricks, 2011; Fredricks, Blumenfeld, & Paris, 2004; Reschly & Christenson, 2012). Measures of engagement also differ by method and informant (e.g., questionnaire, observation; Fredricks et al., 2011). In this paper, we used three approaches to measuring engagement in

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fifth grade math classrooms: observation, student-report, and teacher-report. These three measures provide the perspectives of different informants on fifth grade students' mathematics engagement and capture the participatory aspect of engagement which involves thinking and focusing on math-related tasks.

2. Role of engagement and outcomes

2.1. Theoretical framework

The Self-Systems framework posits four main components: context, self, action, and outcomes (Connell, 1990; Connell & Wellborn, 1991; Skinner, Kindermann, & Furrer, 2009). *Context* refers to the opportunities and provisions afforded by the child's setting (e.g., the classroom). *Self* refers to the internal cognitive and emotional processes that occur within the child such as perceived competences and autonomy. *Action* stems from the context and self-processes and is displayed through engagement or disaffection. Lastly, *outcomes* refer to factors that are predicted by engagement such as academic achievement and social competence. For this study we focus on the latter half of the model, specifically the action (engagement) and outcome (achievement and social competence) components.

The most prevalent research on engagement focuses on students' engagement across academic domains or content areas (Fredricks et al., 2011; Reschly & Christenson, 2012). In this study, we specifically examine engagement in mathematics class. Beginning in early elementary school, children are able to distinguish between domains in terms of task value, task enjoyment, and task-related feelings of competence (Mantzicopoulos, French, & Maller, 2004; Marsh, Ellis, & Craven, 2002; Wigfield, Tonks, & Klauda, 2009). This means students can be more engaged in one area (e.g., mathematics) while being less engaged in another (e.g., social studies; Marks, 2000). In this study, we focus specifically on examining mathematics engagement.

2.2. Engagement, social skills, and achievement

According to the Self-systems framework, engagement within a high quality context produces two important school outcomes: social competence and academic achievement (Connell, 1990; Connell & Wellborn, 1991; Skinner, Kindermann, Connell, & Wellborn, 2009). Research suggests that both of these outcomes are important to school success.

2.2.1. Social skills

Students who are less engaged are more likely to display off-task behavior that disrupts class and learning. Social skills have been extensively studied in preschool and early elementary grades and are associated with indicators of school success (Domitrovich, Cortes, & Greenberg, 2007; McClelland, Acock, & Morrison, 2006; McClelland, Morrison, & Holmes, 2000). Furthermore, elementary and middle school curricula, programs, and interventions which focus on fostering positive interactions and prosocial behaviors are associated with positive student benefits (Brackett, Rivers, Reyes, & Salovey, 2012; Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011; Greenberg et al., 2003; Payton et al., 2008).

Upper elementary school teachers report that certain social skills (e.g., cooperation, self-control) are critical to school success and maintaining an effective learning environment (Lane, Givner, & Pierson, 2004; Lane, Pierson, & Givner, 2003; Meier, DiPerna, & Oster, 2006). Engagement is likely to promote more positive peer interactions that foster learning (Kindermann, 1993, 2007). Student cooperation, self-regulation, and positive peer interactions are especially important in mathematics classrooms in light of recent standards-based math instruction which emphasizes enhancing students' understanding of critical concepts through small group activities and discussions (Fuson, Kalchman, & Bransford, 2005; National Council of Teachers of Mathematics [NCTM], 2000). These activities require peer interactions, discussions, and resolution of differing viewpoints; all classroom experiences that rely on students' appropriate social skills.

2.2.2. Math achievement

Student engagement has been linked to students' general academic achievement in elementary and middle school (Bodovski & Farkas, 2007; Finn & Zimmer, 2012; Hughes, Luo, Kwok, & Loyd, 2008; Marks, 2000) and specifically to students' mathematics achievement in elementary school (DiPerna, Volpe, & Elliott, 2005; Hughes et al., 2008). Despite the growth of research on student engagement, little research focuses exclusively on mathematical engagement during math activities (Fredricks et al., 2004). Studies (e.g., DiPerna et al., 2005; Hughes et al., 2008) have assessed mathematical achievement as an outcome, but the engagement measure has not been math specific. It is likely that math specific engagement will also be significantly associated with mathematics performance, since general engagement is related to mathematics. However, this assumption needs empirical support. Engagement is recognized as an important component in mathematical learning as demonstrated by NCTM (2000) and the National Research Council [NRC] (2005) who press for greater understanding of the classroom conditions that foster engagement in mathematics.

2.2.3. Student gender

Several factors contribute to the associations between engagement, achievement and social skills. One potential moderator is student gender. Gender differences have been reported in engagement, mathematics achievement, and social interactions. Throughout elementary, middle, and high school, girls are more likely to be rated by themselves and teachers higher on engagement (Hughes et al., 2008; Lam et al., 2012; Roorda, Koomen, Spilt, & Oort, 2011). However, engagement in boys is a stronger predictor of academic outcomes compared to engagement in girls (Van de gaer, Pustjens, Van Damme, & De Munter, 2009). Elementary school girls, on average, have closer and lower conflict relationships with teachers compared to boys (Hughes et al., 2008), while boys, on average, have higher mathematics performance than girls (Robinson & Lubienski, 2011).

3. Current study

Our previous work has examined the contributions of teacher–student interaction quality and student gender on students' engagement in math classrooms (Rimm-Kaufman et al., 2015). The current study builds on this work by linking student engagement with student outcomes in math classrooms. Specifically, this study contributes to the field by considering the relative utility of three approaches to measuring engagement. Examining the relative contribution of each measure of engagement to students' social competence and math achievement in upper elementary math classrooms can help address practical questions including: How useful are teachers' reports of students' mathematical engagement in predicting students' social and math performance at the end of the year? Is it a better use of teachers' time and school resources to ask students directly about their engagement or bring in an outside observer at various points in the year to give a sense of what's working or not working? Are the associations between signs of engagement and social and math outcomes similar for boys and girls?

Specifically, we address two research questions: (a) To what extent does students' engagement in mathematics relate to students' social skills and mathematics achievement? (b) Does student gender moderate the association between student mathematics engagement and outcomes (i.e., social skills in math class and mathematics achievement)?

Common covariates (i.e., working memory, age, family income) were measured and included in models. Each of these covariates is likely to contribute to engagement and/or outcomes. Working memory is related to higher-order cognitive tasks (e.g., reasoning; Daneman & Carpenter, 1980). Poor working memory is associated with increases

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