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Examining the association between school connectedness and use of self-regulation strategies in middle childhood

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ABSTRACT

Schools are increasingly incorporating the teaching of social emotional learning (SEL)-informed self-regulation strategies. However, little is known about the social context that facilitates the use of these skills. The current study investigated whether students' popularity (indegree), perceived number of friends (outdegree), or school connectedness, are related to their practice of self-regulation strategies. The sample was 92 2nd through 5th graders (49% girls, 48% boys, 3% non-binary) at an elementary school. Using multilevel models to account for students nested within classrooms, we found that 2nd graders who were lower in school connectedness reported greater mean use of self-regulation strategies, but this association was not evident for third through fifth graders. By contrast, students who were more popular among their peers (i.e. higher indegree) reported using self-regulation strategies on a greater proportion of school days. Findings indicate that grade level, popularity, and connectedness to schools may impact students' use of said skills.


Introduction

Teaching social emotional learning (SEL)-informed skills in schools effectively promotes positive academic and interpersonal outcomes for elementary school children by teaching students skills to promote their self-regulation (Cipriano et al., 2023; Elias et al., 1997). However, the benefits of teaching SEL-informed self-regulation skills for student academic and interpersonal outcomes likely varies by the extent to which students practice and use the taught strategies. There are considerable differences in students' use of skills learned through SEL-informed teaching of self-regulation skills, based on characteristics like overall school economic disadvantage and teacher buy-in (Bierman et al., 2010; Hughes et al., 2005). Student characteristics, such as high levels of independence and interpersonal skills are associated with better use of self-regulation strategies, whereas students who experience more negative affect are less effective at self-regulation (Zimmerman, 1989, 1990). We build on this research to add to gaps in the literature by examining student factors that contribute to students' daily application of self-regulation strategies

in school. Specifically, the goal of this study is to test whether children's school and peer connectedness are linked to their use of self-regulation strategies taught in an elementary school.

Social emotional learning

Social emotional learning (SEL) is an approach to develop social and emotional skills, particularly in youth. More specifically, it is designed to promote competencies in emotion regulation and prosocial skills that contribute to positive developmental trajectories and educational outcomes (Cipriano et al., 2023). Formal SEL interventions typically include content to develop skills across four core domains: (1) life skills and social competencies, (2) health promotion and problem-prevention skills, (3) coping skills and social support for transitions and crises, and (4) positive, contributory service (Elias et al., 1997). Universal SEL programs have developed a strong evidence base documenting their effectiveness in promoting social skills, emotional regulation, and academic outcomes

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among school age children (Cipriano et al., 2023; Mahoney et al., 2018; Masten & Coatsworth, 1998).

Although SEL programs are found to be effective in randomized trials, their impact in real world settings is tempered by implementation quality. Indeed, fidelity to program curricula—the degree to which schools implement evidence-based programs consistent with the original design—is associated with better outcomes for students; when schools implement programs with low fidelity they may not achieve the desired outcomes (Jones et al., 2018). Yet, there are several barriers to school adoption of SEL programs in their entirety, including organizational elements, school characteristics, and teacher characteristics (Durlak, 2016). In addition, teachers often report having limited time to implement the full intervention, and often express low confidence in implementing SEL programs with fidelity; both of these factors can lead to incomplete implementation of SEL interventions (Dane & Schneider, 1998). Thus, although many teachers and schools want to provide SEL programming for students, they also must contend with limitations imposed by competing demands on their time. As a result, it is relatively common for teachers (and schools) adopt components of SEL interventions and incorporate them into their lessons to improve children's social emotional well-being.

In the prosocial classroom model, which articulates the logic model by which SEL programs are sustained and impact child outcomes, children's self-regulation skills are a primary mechanism by which the teaching of social and emotional learning-informed skills support students' social, emotional, and academic outcomes (Jennings & Greenberg, 2009). Moreover, the prosocial classroom model has brought much-needed attention to the importance of the broader context in supporting self-regulation skills training in schools. The prosocial classroom model has been illuminating about the role of context for teacher implementation of self-regulation skills training (Jennings et al., 2013); however, guided by this model, we anticipate that children's uptake and practice of self-regulation skills also is impacted by a number of contextual factors.

Enactment, the practicing of new skills in relevant contexts, is a key behavior change tool (Dishion & Kavanagh, 2003). In schools, teachers often intervene to support effective student self-regulation in challenging peer interactions (Jennings & Greenberg, 2009), making peer networks a key context for self-regulation skill development. In addition, children's feelings of school connectedness also may also facilitate their openness to learning and adopting new self-regulation strategies.

Peer relationships

Forming and maintaining positive peer relationships is one of the foremost developmental tasks in childhood (Alexander et al., 1988; Lynch & Cicchetti, 1997). Peer relationships are a key context in which children learn and refine social skills and practice self-regulation. Children who have more friends or are popular tend to be more socially competent (Gottman et al., 1975). Similarly, children who are accepted by their peers show more consistently strong self-regulation (Burke et al., 2023). In the present study we focus on popularity and a child's perceived number of friends as potential factors for understanding self-regulation skill use.

Sociometric popularity refers to social acceptance and being liked by one's peers (LaFontana & Cillessen, 2002), and it can be measured by methods capturing how many peers identify a student as their friend. Popular students tend to be more kind and cooperative with peers. They tend to have more social competence and better academic outcomes (Litwack et al., 2012; Rubin et al., 2015). A powerful tool in assessing popularity is social network analysis (SNA), which uses a peer nomination assessment to identify the number of peers who identify a child as one of their friends (Wasserman & Faust, 1994; Zhang, 2010). This creates an SNA metric that reflects individual differences in students' popularity in the school context.

Perceived number of friends is another metric reflecting how socially connected a student is. Using SNA methods, youth identify how many of their peers they regard as friends. While popularity reflects the number of peers identifying a target child as a friend; perceived number of friends provides a measure of social connectedness from the target student's perspective, (Zhang, 2010). Children who have a greater number of friends benefit in a number of ways: they tend to be higher in positive affect, cognitive flexibility, and motivation to engage with classroom activities (Connell, 1990; Kindermann, 1993). In addition, youth who have more friends that participate in interventions may benefit by learning from their peers as well as the intervention (Rulison et al., 2015; Yang et al., 2018).

Connection to peers, in terms of both popularity and perceived friendships, may facilitate student's openness to learning self-regulation skills at school in several ways. First, as self-regulation strategies are taught in the classroom, having more friends who are also exposed to the same content would promote new norms around self-regulation behavior, and a context in which positive self-regulation strategies may be more accepted, which is consistent with the widely accepted social learning theory (Bandura & Walters,

1977). Second, in schools where SEL-informed strategies are inconsistently implemented, having more friends may increase the possibility of learning self-regulation skills indirectly through the peer relationships (Rulison et al., 2015). Third, students and their friends may positively reinforce each other's practice of self-regulation strategies through affirmations of shared values. Thus, the current study examines whether students' connectedness to peers are related to their practice of such self-regulation strategies taught at school. Indeed, previous work has shown that both popularity and perceived number of friends are associated with intervention participation. Lindsey et al. (2010) found that for African American adolescents, larger social networks, suggesting greater numbers of friends, were related to increased use of school-based mental health services. Molloy Elreda et al. (2016) also found that higher levels of popularity and perceived number of friends, as measured by indegree and outdegree, were related to positive outcomes (i.e. positive behavioral functioning). These studies demonstrate that peer relationships are important for engagement in school services and may contribute to self-regulation strategy use.

School connectedness

School connectedness refers to feelings of closeness to people at school, happiness, and belonging at school (ADDHealth, 1996) and is a promotive factor for a number of positive outcomes in youth from higher educational motivation to better school attendance (McNeely et al., 2002; Resnick et al., 1997; Wingspread Declaration on School Connections, 2004). Youth who are higher in school connectedness exhibit better academic outcomes (Croninger & Lee, 2001), and less delinquent peer relationships (Wingspread Declaration on School Connections, 2004). Moreover, youth who are higher in school connectedness also exhibit better emotional and behavioral health, indicated by lower rates of delinquency, increased academic motivation, and less emotional distress (Croninger & Lee, 2001; Resnick et al., 1997).

There is promising evidence that school connectedness may also have important implications for self-regulation skill uptake in school settings. For example, school connectedness is associated with higher rates of classroom participation (Croninger & Lee, 2001; Klem & Connell, 2004; Resnick et al., 1997), suggesting school connectedness may promote student engagement and motivation to learn. If students are already bought in to the school community and academics,

they may be more likely to engage in skill uptake. Especially given that the same instructors and counselors who already administer academic content are the ones teaching and encouraging self-regulation skills.

The current study

Guided by the prosocial classroom model (Jennings & Greenberg, 2009), this study investigated popularity, perceived number of friends, and school connectedness as three key factors that may contribute to elementary school students' uptake of self-regulation skills. In this study, students' use of self-regulation strategies was operationalized in two ways. The first metric of self-regulation strategy use was the *mean number of different self-regulation strategies* a student used across all days, indicating the diversity of skills students are choosing to use. The second metric of self-regulation strategy use was the *proportion of days* the students used at least one strategy, indicating the frequency at which they engage in any strategy. We hypothesized that greater levels of popularity, perceived number of friends, and school connectedness would be associated with a greater diversity of strategies and frequency of use.

We also tested two potential moderators in our analyses. First, we considered whether findings might differ as a function of students' grade level (as an indicator of developmental differences). We hypothesized that the association between school and peer connectedness and self-regulation strategy use would be stronger among students in higher grade levels and that they would likely experience school connectedness and peer relationships with greater salience than younger students. Students in higher grades, with higher levels of school and peer connectedness would demonstrate higher self-regulation strategy use as compared to students in the same grade with lower levels of school and peer connectedness due to a compounding effect of greater social engagement and therefore skill buy-in. Second, we evaluated whether findings differed as a function of child gender. We expect that elevated levels of school connectedness and peer relationships will serve as an influential factor for promoting higher self-regulation skill use among girls. This expectation is grounded in prior research which underscores that girls exhibit a higher propensity for forming strong connections with both their school environment and peers (Rasmussen et al., 2005; Shochet et al., 2006). School connectedness and peer relationships may act as a compounding force

conducive to the development of self-regulation skills in girls.

Method

Participants

The participants were 2nd through 5th graders from an elementary school in central Pennsylvania. There was a total of 265 students at the elementary school, all of whom provided data as part of a large school-wide evaluation of self-regulation activities. There were thirteen classrooms with a mean of 18.07 students in each classroom. According to parent report data, 14.15% of parents identified as working class and 85.85% of the parents identified as middle class. Of the 265 students, 100 students had parental consent and student assent for their data to be used for research purposes. Of the 100 students, 1 student was missing the school connectedness measure, and 7 students did not complete any measure of the dependent variable, yielding an analytical sample of 92 students. The final analytical sample was primarily White (84%), and evenly divided across grade: 28% 2nd grade, 24% 3rd grade, 21% 4th grade, and 27% 5th grade. They were 48% boys, 49% girls, and 3% non-binary students. This study was approved by the Pennsylvania State University Institutional Review Board (Study #00015603).

Procedures

The school actively facilitated the instruction of SEL regulation strategies for students, aiming to enhance both student well-being and academic performance. The school counselor, school administrators, and teachers implemented different self-regulation activities, such as mindfulness, provision of relaxation spaces, and lessons about emotion awareness, with students daily. Several programs informed their activities without adhering to one in particular. These programs included Mindful Schools (Mindful Schools, 2023), Positive Behavioral Interventions and Supports (Sugai & Horner, 2002), and the Second Step Program (Beland, 1988).

The current study uses data from a baseline survey that students completed in November 2020 and daily afternoon surveys that were completed at the end of the school day just before students went home that students completed from December 2020 to May 2021. Among students in our sample, students completed an average of 53.4 daily afternoon surveys ($SD = 31.93$; Range = 6 to 115). Despite the frequent

sampling interval, past studies, involving a minimum of five surveys a day, have not found evidence that ecological momentary assessment elicits participant reactivity (i.e. changes in responses or behaviors based on the salience of survey items) (Cohen, 2021; Hufford et al., 2002; Stone et al., 2003). All of the surveys were administered online via Qualtrics and completed on individual laptop computers to which students had access at school; students attended school in person.

Measures

School connectedness

School connectedness was assessed at baseline with three items adapted from the National Longitudinal Study of Adolescent to Adult Health (ADDHealth, 1996). Participants indicated how strongly they agreed with the following statements: “I feel close to people at this school,” “I am happy to be at this school,” and “I feel like I am part of this school” from 1 (“strongly disagree”) to 5 (“strongly agree”). There was no item-level missing data, so we summed the scores to create a total school connectedness score, with higher scores indicating higher connectedness ($\alpha = 0.86$).

Peer relationship measures: SNA

To assess student popularity and perceived number of friendships, participants listed the first name and last initial of up to five close friends in their school during the baseline assessment. We cross checked these names with a school roster and replaced them with a random four-digit identifier to anonymize the data. We were able to match 90.68% of the peer nominations.

From these data we used the *igraph* package in R (Csardi & Nepusz, 2006) to compute the two network metrics. *Popularity* was assessed using indegree, which refers to the number of friendship nominations that a target child received (i.e. how many peers identified the target child as their friend). *Perceived number of friends* was assessed using outdegree, indicating the number of people a target child identified as friends. When calculating SNA metrics, data from all 265 students were used. Analyses using these computed scores were only conducted using data from participants whose parents provided consent. Because of the high match rate (90.68%) and the availability of the full population to calculate SNA metrics we were sufficiently powered to assess peer relationships using SNA.

Self-regulation strategy use

Once daily, in the afternoon, students completed a checklist of self-regulation strategies they used that day. These listed strategies were “belly breathing”, “noticing and naming my feelings”, “positive self-talk”, “mindfulness”, “problem solving”, “using the calm down corner”, “taking a walk or getting a drink”, “talking to someone”, “paying attention to my heart rate”, and “paying attention to my body signals.” *Mean number of strategies* a student used was computed by taking the average number of strategies a student used across all days that they engaged in at least one strategy. Thus, this metric reflects the breadth of in the self-regulation skills each student used on days when students used any skill; higher values indicate greater breadth of self-regulation skill use. The second metric, *proportion of days* the student used at least one strategy, was computed as the total number of days a target child used one or more strategies divided by the total number of days they completed an afternoon survey. This metric reflects the frequency of days when students used self-regulation strategies; higher values reflected greater frequency of any self-regulation strategy use.

Covariates

We controlled for students’ self-reported gender: “boy,” “girl” or “something else fits better,” and grade level obtained from the school roster. For our analyses, youth gender was dummy coded (reference group = boy), and grade was treated as a continuous variable.

Analysis

First, we computed bivariate correlations between key variables, as described in Table 1. We then computed intraclass correlation coefficients (ICC) to determine the proportion of variance accounted for at the classroom level, and at the individual level for the outcomes of interest. A meaningful proportion of variance for students’ mean number of SEL strategies ($ICC = 0.20$, or 20% of the variance), and for proportion of days students used SEL strategies ($ICC = 0.09$,

or 9% of the variance) was found at the classroom level. Multilevel models were used to account for classroom-level effects (i.e. nesting) on student self-regulation strategy use.

To evaluate our primary hypotheses, we estimated two sets of three multilevel regression models with random intercepts by regressing the two outcomes (mean number of self-regulation strategy use and proportion of days using self-regulation strategies) on each of three independent variables (tested in separate models). In all six multilevel regression models, grade and youth gender were included as covariates, and students were nested in classrooms to account for classroom-level effects (Cohen et al., 2003). Popularity, perceived number of friends, and connectedness predictors were grand-mean centered. Grade level was centered such that second grade was zero. Youth gender identity was boy, girl, and non-binary (reference group = boy), using two dummy-coded variables. Six additional models tested whether grade level or gender identity moderated the effects in the main model. Significant interactions were probed using simple slope analysis following guidance by Preacher et al. (2006). In all models, standardized beta coefficients and their confidence intervals are reported to facilitate interpretation of effect size.

Results

Table 1 presents variable means, standard deviations, ranges, and correlations. Multilevel models were computed as two sets of analyses. The first set of analyses focused on predicting the mean number of self-regulation strategies used (see Table 2). In these models, popularity, perceived number of friends, and school connectedness were not associated with use of strategies; although, students in younger grades reported using a larger number of self-regulation strategies on average (Table 2, Model A).

We then tested the moderating effects of students’ gender and grade level in our models. Findings did not differ as a function of child gender identity. However, tests of grade as a moderator yielded significant results (See: Table 2, Model B). Specifically, the

Table 1. Descriptive statistics and bivariate correlations of study variables.

Variable	M	SD	Min	Max	1	2	3	4	5
1. Popularity	3.93	2.42	0	10					
2. Perceived # of Friends	3.75	1.43	0	5	.44**				
3. Connectedness	12.38	2.99	3	15	.27**	.15			
4. Grade	3.47	1.17	2	5	.17	.21*	.11		
5. Proportion of strategy days	0.47	0.35	0.02	1	.18	.02	.02	.15	
6. Mean strategies	1.44	1.74	0.02	7.5	.11	−0.01	−0.22*	.04	.67**

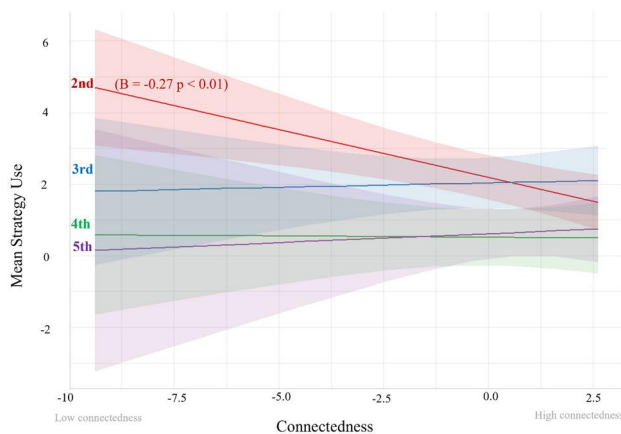
Note. SD = standard deviation, * $p < .05$. ** $p < .01$.

Table 2. Student factors predicting mean number of self-regulation strategies used.

	Model A: Main effects			Model B: Including interaction terms		
	B (SE)	95% CI	β (CI)	B (SE)	95% CI	β (CI)
Popularity	.12(.07)	(-0.01, .26)	.16(-0.03, .35)	.13(.12)	(-0.08, .36)	.16(-0.04, .36)
Girl	.16(.34)	(-0.48, .82)	.09(-0.29, .48)	.16(.34)	(-0.48, .82)	.09, (-0.30, .48)
Non-binary	-0.83(.95)	(-2.64, 1.02)	-0.48(-1.56, .61)	-0.84(.96)	(-2.68, 1.01)	-0.48(-1.58, .62)
Grade	-0.63(.16)**	(-0.92, -0.36)	-0.42(-0.63, -0.21)	-0.62(.16)**	(-0.92, -0.35)	-0.42(-0.63, -0.21)
Popularity x Grade	—	—	—	-0.01(.06)	(-0.13, .11)	-0.01(-0.22, .19)
Perceived # Friends	.08(.12)	(-0.15, .32)	.07(-0.13, .27)	-0.05(.18)	(-0.40, .30)	.10(-0.11, .30)
Girl	.12(.35)	(-0.55, .79)	.07(-0.33, .46)	.09(.35)	(-0.58, .77)	.05(-0.35, .45)
Non-binary	-1.04(.96)	(-2.90, .80)	-0.60(-1.70, .50)	(-1.05, .96)	(-2.91, .77)	-0.61(-1.70, .49)
Grade	-0.60(.17)**	(-0.92, -0.26)	-0.40(-0.63, -0.17)	-0.67(.18)**	(-1.01, -0.31)	-0.43(-0.66, .20)
Mean # Friends x Grade	—	—	—	.11(.11)	(-0.10, .33)	.11(-0.11, .32)
Connectedness	-0.11(.06)	(-0.22, .00)	-0.19(-0.38, .00)	-0.22(.08)**	(-0.37, -0.08)	-0.11(-0.31, .10)
Girl	.21(.33)	(-0.43, .89)	.12(-0.26, .50)	.13(.33)	(-0.51, .77)	.07(-0.31, .45)
Non-binary	-1.21(.94)	(-3.04, .60)	-0.69(-1.77, .38)	-1.02(.93)	(-2.81, .76)	-0.59(-1.66, .48)
Grade	-0.55(.16)**	(-0.85, -0.24)	-0.37(-0.58, -0.16)	-0.61(.14)**	(-0.88, -0.32)	-0.41(-0.60, -0.22)
Connectedness x Grade	—	—	—	.11(.05)*	(.01, .21)	.22(.1, .44)

Note. There are six multilevel models presented here, β coefficient is a standardized measure with corresponding confidence intervals which together demonstrate effect size.

* $p < .05$, ** $p < .01$, *** $p < .001$, Reference group for girl and non-binary is boy.

**Figure 1.** Predicted values of mean strategy use by grade and connectedness.

interaction term for connectedness*grade was statistically significant ($B = 0.11$, $SE = 0.05$, $p = 0.049$). As shown in Figure 1, 2nd grade students with lower levels of school connectedness used more strategies ($B = -0.27$, $p < 0.01$) but there was no association between school connectedness and strategy use for 3rd, 4th, or 5th grade students which was inconsistent with our hypothesis.

The second set of analyses focused on predicting the proportion of days when youth used at least one self-regulation strategy (Table 3), following the same procedures as above. Students who were more popular indicated a higher proportion of days when at least one strategy was used ($B = 0.03$, $SE = 0.01$, $p = 0.017$). However, students' perceived number of friends and connectedness were not associated with this outcome. The main effect of grade was significant across all models such that younger students were using strategies on a larger proportion of days.

Models were computed to include tests of moderation. Student gender identity was not a statistically significant moderator of popularity, mean number of friends, or school connectedness. Similarly, grade was not a statistically significant moderator of popularity, mean number of friends, or school connectedness.

Discussion

The current study was guided by the prosocial classroom model (Jennings & Greenberg, 2009) and evaluated whether peer relationships (popularity, perceived number of friends), and feelings of school connectedness were related to self-regulation strategy use among elementary school students. Self-regulation strategy use was conceptualized in two ways: the mean number of self-regulation strategies used over the course of the school year and the proportion of days when students used any self-regulation strategies. We focused on self-regulation strategies that were taught within the school context, by the school principal, counselor, and teachers as part of the school-wide effort to promote students' socioemotional well-being.

This study used a multi-method measurement approach: using a measure of school connectedness, SNA methods to assess popularity and number of friends, and daily diary methods throughout the school year to assess self-regulation strategy use. Although our sample was a subset of the school population, SNA metrics were calculated from the full population, ensuring the accuracy of our measures of popularity and number of friends. Additionally, daily diary methods offer a more reliable and robust measure of self-regulation strategy use, minimizing the

Table 3. Student Factors Predicting Proportion of Days Students Used Self-Regulation Strategies.

	Model A: Main effects			Model B: Including interaction terms		
	B (SE)	95% CI	β (CI)	B (SE)	95% CI	β (CI)
Popularity	.03(.01)*	(.01, .06)	.23(.03, .43)	.02(.02)	(-0.03, .06)	.23(.03, .43)
Girl	.12(.07)	(-0.02, .25)	.34(-0.06, .73)	.12(.07)	(-0.01, .25)	.34(-0.06, .74)
Non-binary	-0.03(.19)	(-0.40, .35)	-0.08(-1.19, 1.04)	-0.01(.20)	(-0.39, .36)	-0.04(-1.16, 1.08)
Grade	-0.09(.03)**	(-0.15, -0.03)	-0.31(-0.51, -0.11)	-0.09(.03)**	(-0.15, -0.04)	-0.31(-0.51, -0.11)
Popularity x Grade	—	—	—	.01(.01)	(-0.01, .04)	.09(-0.11, .30)
Perceived # Friends	.01(.03)	(-0.04, .06)	.05(-0.16, .26)	-0.03(.04)	(-0.10, .04)	.09(-0.12, .31)
Girl	.11(.07)	(-0.03, .25)	.33(-0.09, .75)	.10(.07)	(-0.03, .24)	.30(-0.12, .72)
Non-binary	-0.08(.20)	(-0.47, .30)	-0.24(-1.39, .90)	-0.09(.20)	(-0.47, .29)	-0.26(-1.40, .87)
Grade	-0.08(.03)**	(-0.14, -0.02)	-0.28(-0.49, -0.07)	-0.10(.03)**	(-0.17, -0.04)	-0.31(-0.52, -0.10)
Perceived # x Grade	—	—	—	.04(.02)	(.00, .08)	.17(-0.05, .40)
Connectedness	.00(.01)	(-0.02, .03)	.04(-0.16, .24)	.00(.02)	(-0.03, .03)	.07(-0.16, .29)
Girl	.12(.07)	(-0.02, .26)	.35(-0.06, .76)	.11(.07)	(-0.02, .25)	.33(-0.08, .74)
Non-binary	-0.07(.20)	(-0.45, .32)	-0.19(-1.34, .95)	-0.06(.20)	(-0.44, .33)	-0.16(-1.32, 1.00)
Grade	-0.08(.03)**	(-0.14, -0.02)	-0.27(-0.48, .07)	-0.08(.03)**	(-0.14, -0.02)	-0.28(-0.49, -0.08)
Connectedness x Grade	—	—	—	.01(.01)	(-0.02, .03)	.07(-0.16, .30)

Note. There are six multilevel models presented here, β coefficient is a standardized measure with corresponding confidence intervals which together demonstrate effect size.

* $p < .05$, ** $p < .01$, *** $p < .001$, Reference group for girl and non-binary is boy.

impact of recall bias than is possible in a single-measurement approach (Shiffman et al., 2008).

Across our analyses, a different pattern of results emerged when predicting the mean number of self-regulation strategies used and the proportion of days using self-regulation strategies. School connectedness was associated with higher mean numbers of self-regulation strategies used and this finding was only statistically significant for younger students. However, students who were more popular used self-regulation strategies on a greater proportion of study days across the study period. This pattern of differential prediction raises an important question about differences in what is captured in our two metrics of self-regulation use (i.e. learning multiple strategies and using strategies more often). It may be helpful to think of these indices as capturing the range of self-regulation strategies learned (mean number) and the utilization of self-regulation strategies (proportion of days used) when interpreting the results.

Youth who were more popular reported using self-regulation strategies on a greater proportion of school days, reflecting greater utilization of their self-regulation strategies. This finding is consistent with past research that suggests that self-regulation strategy use is associated with peer acceptance (Grusec & Davidov, 2010). Indeed, other work suggests that youth who are more accepted and liked by peers tend to exhibit greater levels of social competence, and greater engagement with academics and school-based activities (Delgado et al., 2016; Mihaly, 2009). Taken together, it may be that self-regulation promotes peer acceptance and popularity, which further works to fortify self-regulation strategies. Thus, our findings suggest that student popularity may promote self-

regulation strategy utilization over the course of a year; however, it also suggests that students who are less popular may need additional support in implementing self-regulation strategies in SEL programs.

When predicting the mean number of self-regulation strategies used, our findings suggest that *lower* school connectedness was associated with greater mean self-regulation strategy use for younger students (in Grade 2), but this association was not statistically significant for older children (Grades 3–5). Thus, contrary to our hypothesis that school connectedness might facilitate greater self-regulation skill uptake, our findings suggest a different process. It may be that younger students who feel less connected with their school may have greater need for self-regulation strategy use, whereas younger students who feel more connected to their school may be less distressed and be less reliant on their self-regulation skills. This underscores the importance of scaffolding and social integration for students in elementary school (Denham et al., 2012; Stage & Quiroz, 1997).

Low school connectedness may also reflect other underlying challenges for students, such as behavior problems (Juvonen, 2007). Youth who have behavioral difficulties may be eliciting greater external supports to use their self-regulation strategies from teachers (Stage & Quiroz, 1997). Therefore, teacher-directed scaffolding may be particularly prevalent among younger students who are actively practicing these skills and requiring adult guidance, because younger students may be in obvious need of reminders to use these skills, and therefore may be also getting more frequent reminders (Denham et al., 2012). Older students may not benefit from the same level of structural support a younger student, and as developmental

expectations increase (and behavior problems often are more severe among older students), they may be more likely to be disciplined for problem behaviors, rather than coached around self-regulation strategy use (Nieman et al., 2004). Additionally, older students may also be more resistant to teachers' coaching for self-regulation strategy use. Thus, our findings may reflect a process in which children with behavioral difficulties may be underserved by universal self-regulation strategy use, calling for additional supports, or more comprehensive SEL curriculum implementation.

Limitations

The study findings must be interpreted in the context of several limitations. Our study sample was majority White students, which limits the study's generalizability to other races and ethnicities. Although all students provided data, only 38% of students had parents who provided consent for research publications, limiting our analytic sample and thus potentially limiting the generalizability of our findings. While only 92 participants were used for analyses, the network variables were calculated using peer nomination information from all students in the 2nd to 5th grade. Additionally, students were limited to listing five friends and there was minimal variation in how many friends they listed, impacting our outdegree score. However, for our models overall our small sample size is a limitation and would benefit from replication with a larger sample.

There are a number of other contextual outcomes that may influence our findings. Previous work suggests that teachers influence not only students' academic outcomes, but also their self-regulation (Sáez-Delgado et al., 2022). Though we were able to account for classroom differences in our multilevel models, it would be valuable to systematically evaluate classroom-level factors in students' self-regulation strategy use in future work. For example, individual differences in teachers' modeling and teaching self-regulation strategies and potential scaffolding of skill application for their students may be an important consideration for SEL programs (Schunk & Zimmerman, 2007). Teacher emotional support is another pathway that may influence student self-regulation and resulting the use of self-regulation skills. Merritt and colleagues (2012) found that students in more emotionally supportive classrooms were more likely to exhibit behavioral regulation than students in less emotionally supportive classrooms. Future explorations of not only student and peer factors, but also the aforementioned teacher and

classroom factors, are crucial for improving student use of self-regulation strategy skills.

Despite these limitations, the findings illuminate how self-regulation strategy use varies by grade, popularity, and feelings of connectedness to schools. Younger students who feel the least connected to the school are using self-regulation strategies the most. School connectedness and school climate are potentially powerful pathways to increase self-regulation strategy use in middle childhood. Additionally, given that students who were more often nominated as friends reported greater use of self-regulation strategies, targeting students' connections to peers is an important strategy for bolstering their use.

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Disclosure statement

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Data availability statement

The data for this study are available upon request from the corresponding author.

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