JOURNAL OF
MATHEMATICS
EDUCATION
AT TEACHERS COLLEGE

A Century of Leadership in Mathematics and Its Teaching

Promoting Equitable Practices in Mathematics Education

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JOURNAL OF **MATHEMATICS EDUCATION** AT TEACHERS COLLEGE | SPRING 2020 | VOLUME 11, ISSUE 1

Effects of Student Help-Seeking Behaviors on Student Mathematics Achievement

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ABSTRACT Using the nationally representative sample from the United States in the 2012 Programme for International Student Assessment ($N = 7{,}429$ students from 240 schools), the present study examined the effects of student help-seeking behaviors on eight measures of student mathematics achievement. To account for the multilevel structure of the data with students nested within schools (i.e., students attending different schools), a two-level hierarchical linear model was used in the data analysis. Student help-seeking behaviors showed statistically significant positive effects on all eight measures of mathematics achievement, even after controlling for student characteristics and school characteristics. Furthermore, for all eight measures of mathematics achievement, the positive effects of student help-seeking behaviors on student mathematics achievement are independent of which schools students attend.

KEYWORDS *help-seeking behaviors, mathematics achievement, Programme for International Student Assessment (PISA)*

Despite the vast amounts of educational resources that have been invested into K-12 education in the United States (U.S.), students in the U.S. are continually outperformed by their international peers in mathematics achievement (Duncan, 2013). According to the 2012 Programme for International Student Assessment (PISA), even though the U.S. spends more money per student than all but four of the 34 Organisation for Economic Co-operation and Development (OECD) countries, it ranks only 27th in mathematics (OECD, 2013). Numerous educational reforms have been implemented with the aim of improving the performance of U.S. students in mathematics (see Dossey et al., 2016). We joined these national efforts by examining the relationship between student help-seeking behaviors and student mathematics achievement, as a way to improve mathematics instruction.

Review of Literature

Student Help-Seeking Behaviors in General

Regardless of their knowledge or ability, students encounter problems too difficult for them to solve on their own. Being able to recognize when external assistance is needed and seeking the most appropriate assistance out of the available options are integral components of the learning process and fundamental aspects of cognitive development (Kominsky et al., 2018; Vredenburgh & Kushnir, 2015). Student help-seeking behaviors are defined as the ways in which students search for and make use of external resources when attempting to solve problems (Ogan et al., 2015). These behaviors include such actions as asking someone for help, reading a textbook, and searching online for example problems or instructional videos. Unlike other skills involved in the process of cognitive development such as goal-setting and time management, help-seeking is unique in that it is not only a self-regulation strategy but typically involves social interaction as well. This social dimension has the added benefit of improving the cognitive and social abilities of both helpers and seekers (Mueller & Kamdar, 2011). There is some evidence that constructive help-seeking behaviors have positive effects on learning outcomes (Schenke et al., 2015). Overall, help-seeking behaviors aimed at learning and not just producing correct answers are appropriate because they lead to the cultivation of transferrable knowledge and skills that can be applied to future problems (Roll et al., 2011).

Researchers recognize the resistance among some students to seek help. Low-achieving students, who would benefit the most from seeking help, tend to be the least likely to actually do so (Amemiya & Wang, 2017). Although, by early adolescence, students have developed the cognitive skills required for determining when and which help-seeking behaviors are necessary, they often choose to avoid help-seeking due to personal autonomy concerns, perceptions of cognitive and social incompetence, lack of competent helpers, and an unwelcoming classroom environment (Kiefer & Shim, 2016). In some cases, students are advised to avoid help-seeking behaviors because they tend to produce dependency on external resources and, as a result, are viewed as impediments to the learning process (Amemiya & Wang, 2017). Some students struggle to determine whether the reward for solving a problem outweighs the risk of appearing incompetent in front of others (White & Bembenutty, 2013). A direct consequence of deriving self-worth primarily from the opinion of others is for students to avoid help-seeking even when they realize the need for it (Reeves & Sperling, 2015). Some students choose not to seek external assistance because they believe no one available is capable of providing the help they need (Kiefer & Shim, 2016).

A distinction has been made between executive and instrumental help-seeking behaviors (Inbar-Furst & Gumpel, 2015). Executive help-seeking behaviors lead to correct answers as quickly as possible with little to no regard as to whether learning actually happens. Conversely, instrumental help-seeking behaviors aim at learning and not just producing correct answers. Classroom goal structure plays a role in student help-seeking behaviors (Schenke et al., 2015). A classroom with a mastery-goal orientation emphasizes the intrinsic value to learning and leads students to recognize the need to understand the knowledge and skills (Amemiya & Wang, 2017). Because the focus is on gaining understanding and not just getting correct answers, students often engage in instrumental help-seeking behaviors (White & Bembenutty, 2013). A classroom with a performance-goal orientation creates an atmosphere of competition by emphasizing individual performance relative to peer performance (Ryan et al., 2005). The need to constantly prove they are smarter than their peers encourages students to engage in executive help-seeking behaviors (White & Bembenutty, 2013).

Student Help-Seeking Behaviors in Mathematics

Since mathematics can be one of the most difficult subjects for some students to learn (Fleming, 2019), help-seeking should naturally be a critical component of mathematics learning and teaching. Unfortunately, few studies have examined the relationship between student help-seeking behaviors and student mathematics achievement. Of these, some do not directly relate student help-seeking behaviors to any outcome measures in mathematics. Ryan and Shim (2012) concluded that students are more likely to seek help from the teacher than classmates; further, they are more likely to seek help from the teacher if they perceive the teacher as being encouraging of asking questions. Mehdizadeh et al. (2013) reported that invoking cooperative learning in mathematics classrooms increases students' willingness to seek help.

Other studies have attempted to identify some direct correlations between student help-seeking behaviors and student mathematics achievement. Students who have low prior mathematics achievement are more likely to avoid seeking help (Newman, 2002; Ryan & Pintrich, 1997). In contrast, Beal et al. (2008) revealed that in the context of geometry problem solving, students with low prior mathematics achievement are just as likely as students with high prior mathematics achievement to engage in appropriate help-seeking behaviors; in fact, both groups are more likely to seek help than the group of students with average prior mathematics achievement. This inconsistency in findings may be a result of differences in resources of help: computer software in Beal et al. (2008) versus teacher and peers in both Ryan and Pintrich (1997) and Newman (2002).

After controlling for prior mathematics achievement, Ryan et al. (2005) found that students who engage in instrumental help-seeking behaviors score higher than students who either engage in executive help-seeking behaviors or avoid help-seeking altogether. Schenke et al. (2015) also reported that students who engage in instrumental help-seeking behaviors experience larger gains in mathematics achievement over the course of a year than students who engage in executive help-seeking behaviors. The most "dramatic" finding comes from Ogan et al. (2015). After examining students in Costa Rica, the Philippines, and the U.S., the researchers found that student help-seeking behaviors (with a computer-based tutoring system as the resource of help in this case) are even better than student mathematics pretest scores for predicting student mathematics posttest scores, regardless of geographical location.

Method

To explore the relationship between student help-seeking behaviors and student mathematics achievement, we sought to address the following research questions:

1. Do student help-seeking behaviors have any effects on student mathematics achievement, with control over student and school characteristics?
2. Do the effects of student help-seeking behaviors on student mathematics achievement vary across schools? If yes, what school characteristics contribute to this variation?

PISA 2012 provided sufficient data that could be used to answer these research questions.

Data

PISA is an international assessment of 15-year-old students conducted every three years by OECD. While seeking to measure students' mathematics, reading, and science literacy, the intent of PISA is not as focused on assessing students' knowledge of content-related facts as it is on how well students can apply their content knowledge to real-world problem-solving situations (OECD, 2014a). PISA implemented a two-stage, stratified, random probability sampling procedure. At the first stage, a random sample of schools was selected in proportion to school enrollment size from all public and private schools containing 15-year-old students in grade 7 or higher. At the second stage, within each sampled school, a random sample of students was selected from a list of all eligible students. In addition to the standardized paper-and-pencil achievement tests, students and their school principals completed questionnaires to provide information about student and school background characteristics. For the present study, we utilized the national sample of the U.S. with 7,429 students from 240 schools from PISA 2012 because it is the latest cycle with a focus on mathematics.[1]

Dependent Variables

PISA 2012 contained 85 items in its assessment of mathematics measuring student mathematical literacy (OECD, 2013). These items measured four mathematical literacy areas: change and relationship; space and shape; uncertainty and data; and quantity. Change and relationship involves using equations, inequalities, functions, and graphs to model changes that occur over time, as well as how one object changing affects another object. Space and shape involves using geometry and measurement to understand the visual and physical world. Uncertainty and data involves using probability and statistics to produce models, interpret data, and make inferences in situations involving uncertainty, chance, and variation. Quantity involves applying knowledge of numbers and number operations, along with quantitative reasoning, to a broad range of real-world scenarios.

In addition, these items also tapped into three mathematical processes: *formulating*, *employing*, and *interpreting*. Formulating involves identifying real-world problems that can be solved using mathematics and then developing mathematical structures that can be used to determine solutions. Employing involves applying mathematical reasoning and concepts to produce solutions to mathematically-formulated problems. Interpreting involves reflecting upon mathematical solutions and then interpreting them in view of the context of the real-world problems. To have a comprehensive examination of the relationship between student help-seeking behaviors and student mathematics achievement, we selected as dependent variables scores on (a) the overall mathematical literacy (a combination of the four literacy areas), (b) the four mathematical literacy areas, and (c) the three mathematical processes. These eight measures were analyzed separately. "There is theoretically no minimum or maximum score in PISA; rather, the results are scaled to fit approximately normal distributions, with means around 500 score points and standard deviations around 100 score points" (OECD, 2019, p. 43). Consequently, all eight measures of mathematics achievement had a mean of 500 and a standard deviation *(SD)* of 100.

[1] PISA devotes extra attention to one of the three subject areas in each three-year cycle. The focus of PISA 2012 was on mathematics; therefore, additional space was allocated to tests and questionnaires for important issues in mathematics. Although PISA 2015 and 2018 contained a mathematics component (thus providing newer data), the student help-seeking scale concerning mathematics was absent in both cycles because mathematics was not the focal subject area.

Independent Variables

The independent variables came from student and school questionnaires (see Kastberg et al., 2014). The key independent variable was student help-seeking behavior measured on the student questionnaire (see OECD, 2014b). From a number of items, we selected three to construct a composite variable to measure student help-seeking behavior (see Table 1). These items were selected because they all involve an individual seeking help by interacting with another person, which fits well with the PISA definition of student help-seeking behavior (a propensity to depend on the knowledge and intellect of other people, including both peers and teachers, when attempting to solve problems) (OECD, 2014b). The response options for these items were recoded so that a higher value is indicative of more proactive seeking of help. We aggregated scores on these items to create the composite measure of student help-seeking behavior.[2]

Table 1

Description of Items for Construction of Composite Variables

Variable	Possible Responses
Student Help-Seeking Behavior	
Scenario 1: Suppose you have been sending text messages from your phone for several weeks, but today you can't send text messages. You want to you do? • I would ask a friend for help. Scenario 2: Suppose you arrive at a train station. There is a ticket machine that you have never used before. You want to buy a ticket. What would you do? • I would ask someone for help. • I would try to find a ticket office at the station to buy a ticket.	1 = I would definitely do this. 2 = I would probably do this. 3 = I would probably not do this. 4 = I would definitely not do this.
Teacher-Directed Instruction	
How often do these things happen in your mathematics lessons? • The teacher sets clear goals for our learning. • The teacher asks me or my classmates to present our thinking or reasoning at length. • The teacher asks questions to check whether we have understood what was taught. • At the beginning of a lesson, the teacher presents a summary of the previous lesson. • The teacher tells us what we have to learn.	1 = never or hardly ever 2 = some lessons 3 = most lessons 4 = every lesson
Student Orientation	
How often do these things happen in your mathematics lessons? • The teacher gives different work to classmates who have difficulties learning and/or to those who can advance faster. • The teacher assigns projects that require at least one week to complete. • The teacher has us work in small groups to come up with solutions to a problem or task. • The teacher asks us to help plan classroom activities or topics.	1 = never or hardly ever 2 = some lessons 3 = most lessons 4 = every lesson
Formative Assessment	
How often do these things happen in your mathematics lessons? • The teacher tells me about how well I am doing in my mathematics class. • The teacher gives me feedback on my strengths and weaknesses in mathematics. • The teacher tells us what is expected of us when we get a test, quiz, or assignment. • The teacher tells me what I need to do to become better in mathematics.	1 = never or hardly ever 2 = some lessons 3 = most lessons 4 = every lesson
Note. For each bulleted item, students were instructed to choose one of the possible responses.	

[2] PISA 2012 originally constructed a composite variable measuring student help-seeking behavior with several items; however, we were concerned with the level of internal consistency (Cronbach's α = .54). Table 1 presents the three items we used to construct our own composite variable which resulted in a higher internal consistency (Cronbach's α = .58). Although this is still not optimal, we decided to use our composite for two reasons. First, it represented a small improvement in internal consistency over the PISA composite (also with a more efficient structure of only three items). Second, the three items are conceptually clear and consistent, all emphasizing interactions of students with real people.

Other independent variables functioned as control variables to account for their effects on the relationship between student help-seeking behaviors and student mathematics achievement. At the student level, the control variables included gender, socioeconomic status (SES) (indexed from parental education, parental occupation, and family possessions), family structure (single parent versus other structure), and home language (English versus other language). At the school level, the control variables included school enrollment size; proportion of girls; school location (city or large city versus village, small town, or town); school mean SES (aggregated from SES of students within a school); school type (public versus private); and proportion of mathematics teachers with a bachelor's or master's degree majoring in mathematics, statistics, physics, or engineering. These student- and school-level variables are exogenous in nature. We also controlled for three teacher instructional practices: teacher-directed instruction, student orientation, and formative assessment (see OECD, 2014b). PISA 2012 used information obtained from the student questionnaire to create these three composite variables (see Table 1). Each teacher instructional practice was aggregated within each school to generate measures at the school level.

Statistical Analyses

We used a two-level hierarchical linear model (HLM) to account for the multilevel structure of the U.S. data with students nested within schools. The HLM analysis was performed in three stages. The first stage was the null model, which included no independent variables at either level. This model was used to determine the means for the eight (dependent) measures of student mathematics achievement and the variance in these outcomes at both levels. At the second stage, the variable of student help-seeking behavior was added to the null model to determine the absolute effects of student help-seeking behaviors on the eight measures of student mathematics achievement. The variable of student help-seeking behavior was treated as random at the school level to examine the variance across schools in the effects of student help-seeking behaviors on student mathematics achievement.[3] The results obtained at this stage were used to address the second research question. At the third stage, student- and school-level variables were added to the model developed at the previous stage to determine the relative effects of student help-seeking behaviors on the eight measures of student mathematics achievement. The results obtained at this stage were used to address the first research question.

Results

With the descriptive statistics for student- and school-level variables presented in Table 2, we focus on the results from various HLM analyses. For the key independent variable of student help-seeking behavior, the (U.S. national) mean was 2.21 (on a scale of 1 to 4) with an *SD* of 0.73.

The null model estimated the mean and partitioned the variance for each mathematics achievement measure (see Table 3). In Table 3, the fixed effects indicate average mathematics achievement, and the random effects indicate the variation in mathematics achievement across

Table 2

Descriptive Statistics for Student-Level Variables and School-Level Variables

Variable	*M*	*SD*
Student-level variables		
Student help-seeking behavior (on a scale of 1 to 4)	2.21	0.73
Gender (1 = male, 0 = female)	0.50	0.50
Socioeconomic status (SES) (a standardized variable)	0.22	0.97
Family structure (1 = single parent, 0 = other structure)	0.21	0.41
Home language (1 = English, 0 = other language)	0.88	0.33
School-level variables		
School enrollment size (in hundreds)	13.37	8.70
Proportion of girls	0.49	0.07
Location (1 = city or large city; 0 = village, small town, or town)	0.38	0.49
School mean SES	0.21	0.54
Public vs private (1 = public, 0 = private)	0.91	0.29
Proportion of mathematics teachers with math-related degree	0.67	0.37
Teacher-directed instruction (a standardized variable)	0.30	0.52
Student orientation (a standardized variable)	0.26	0.47
Formative assessment (a standardized variable)	0.32	0.48

Note. A standardized variable has a mean of 0 and an *SD* of 1. For dichotomous variables, the mean indicates the percentage for the category that is coded as 1 (e.g., English is the home language for 88% of the students).

[3] In case the variance is statistically significant across schools, school-level variables can be used to explain this variance.

schools. While PISA mathematics achievement is scaled to have a mean of 500 and an *SD* of 100, for the eight measures of student mathematics achievement, the mean for the U.S. students ranged from 468.72 to 494.41. The partition of variance for the eight measures showed that between 76% and 79% of the variance was attributable to students, while 21% to 24% was attributable to schools. The variance at the school level was statistically significant ($p < .05$) for all eight measures, indicating that the U.S. schools were significantly different in terms of various measures of student mathematics achievement. For example, in the U.S., the mean for the overall mathematical literacy was 486.32. Meanwhile, 78% of the variance in the overall mathematical literacy was attributable to students, while 22% was attributable to schools (which was statistically significant).

Table 3

Means and Partition of Variance for Multiple Measures of Mathematics Achievement

Variable	Fixed Effects	
	Coefficient	*SE*
Intercept (mathematics achievement)		
Overall	486.32*	4.52
Change and relationship	492.03*	4.59
Space and shape	468.72*	5.01
Uncertainty and data	494.41*	4.46
Quantity	484.69*	5.07
Formulating	481.22*	5.13
Employing	485.45*	4.41
Interpreting	494.02*	4.60
Variable	**Random Effects**	
	Variance	***df***
Between-school variability		
Overall	1772.02*	137
Change and relationship	1874.71*	137
Space and shape	2077.15*	137
Uncertainty and data	1839.98*	137
Quantity	2201.20*	137
Formulating	2230.16*	137
Employing	1682.15*	137
Interpreting	1920.38*	137
Within-school variability		
Overall	6123.07	
Change and relationship	6816.64	
Space and shape	7247.03	
Uncertainty and data	5845.28	
Quantity	7420.53	
Formulating	7410.57	
Employing	6232.59	
Interpreting	6806.72	

*$p < .05$

Absolute Effects of Student Help-Seeking Behaviors

Table 4 presents the results on the absolute effects of student help-seeking behaviors on the eight measures of student mathematics achievement. In this table, the fixed effects refer to the effects of student help-seeking behaviors on student mathematics achievement, and the random effects refer to the variation in the effects of student help-seeking behaviors on student mathematics achievement across schools. Student help-seeking behaviors showed statistically significant absolute effects on all eight measures of student mathematics achievement. Specifically, a 1-point increase in student help-seeking behavior was associated with an increase of between 7.24 and 10.18 points in student mathematics achievement. Because PISA mathematics achievement has a mean of 500 and an *SD* of 100, we can easily turn our effects into an effect size measure. The corresponding effect sizes ranged from 7.24% to 10.18% of an *SD*. For example, a 1-point increase in student help-seeking behavior was associated with an increase of 8.17 points in the overall mathematical literacy, with a corresponding effect size of 8.17% of an *SD*. According to Cohen (1988), 20% of an *SD* is a small effect, 50% of an *SD* is a medium-size effect, and 80% of an *SD* is a large effect. Therefore, in the U.S., student help-seeking behaviors demonstrated statistically significant positive, though relatively small, effects on all eight measures of student mathematics achievement.

On the other hand, the effects of student help-seeking behaviors on student mathematics achievement did not vary statistically significantly from school to school for any of the eight measures of student mathematics achievement; that is, the effects of student help-seeking behaviors on student mathematics achievement were quite similar for all U.S. schools. Because the effects of student help-seeking behaviors on student mathematics achievement did not vary from school to school, it was not necessary to model the effects of school-level variables.

Table 4

Absolute Effects of Student Help-Seeking Behaviors on Multiple Measures of Mathematics Achievement

Variable	Fixed Effects	
	Coefficient	*SE*
Overall	8.17*	2.37
Change and relationship	7.24*	2.37
Space and shape	8.37*	2.80
Uncertainty and data	7.42*	2.42
Quantity	9.35*	2.56
Formulating	10.18*	2.70
Employing	7.93*	2.39
Interpreting	9.13*	2.40
Variable	Random Effects	
	Variance	*df*
Overall	27.46	135
Change and relationship	15.80	135
Space and shape	79.24	135
Uncertainty and data	64.72	135
Quantity	57.02	135
Formulating	38.72	135
Employing	24.57	135
Interpreting	38.29	135

*$p < .05$

Table 5

Relative Effects of Student Help-Seeking Behaviors on Multiple Measures of Mathematics Achievement

Variable	Fixed Effects	
	Coefficient	*SE*
Overall	6.61*	2.17
Change and relationship	5.99*	2.43
Space and shape	7.41*	2.73
Uncertainty and data	6.02*	2.36
Quantity	7.52*	2.49
Formulating	8.63*	2.90
Employing	6.59*	2.36
Interpreting	6.92*	2.32

*$p < .05$

Relative Effects of Student Help-Seeking Behaviors

Finally, student- and school-level variables were introduced as the control variables to estimate the relative effects of student help-seeking behaviors. Student help-seeking behaviors showed statistically significant relative effects on all eight measures of student mathematics achievement, even after controlling for student- and school-level variables (see Table 5).

In Table 5, the fixed effects refer to the effects of student help-seeking behaviors on student mathematics achievement; random effects were omitted from the table because the effects of student help-seeking behaviors on student mathematics achievement did not vary from school to school. Specifically, a 1-point increase in student help-seeking behavior was associated with an increase of between 5.99 and 8.63 points in student mathematics achievement; the corresponding effect sizes ranged from 5.99% to 8.63% of an *SD*. For example, a 1-point increase in student help-seeking behavior was associated with an increase of 6.61 points in the overall mathematical literacy, with a corresponding effect size of 6.61% of an *SD*. Therefore, in the U.S., even after control over student and school characteristics, student help-seeking behaviors still demonstrated statistically significant positive effects on all eight measures of student mathematics achievement.

HLM Performance

A statistical model often helps to explain the variance in a dependent variable. The proportion of variance explained by such a model is often used as a means of assessing the performance of the model. Across the eight measures of student mathematics achievement, our final models (see Table 6) accounted for between 8% and 11% of the total variance in student mathematics achievement at the student level and between 60% and 73% of the total variance in student mathematics achievement at the school level (see Table 6). Overall, across the eight measures, our final models accounted for between 20% and 25% of the total variance in student mathematics achievement. For example, for the overall mathematical literacy, our final model accounted for 11% of the total variance at the student level and 72% of the total variance at the school level. Overall, our final model accounted for 24% of the total variance in the overall mathematical literacy. According to the common standards in the social sciences (see Gaur & Gaur, 2006), these numbers indicate

Table 6

Proportion of Variance in Mathematics Achievement Explained by the Models

Variables	Student level	School level	Overall
Overall	.107	.715	.244
Change and relationship	.106	.661	.226
Space and shape	.084	.597	.198
Uncertainty and data	.088	.726	.241
Quantity	.100	.667	.230
Formulating	.086	.691	.226
Employing	.096	.684	.221
Interpreting	.108	.730	.245

a sound performance of our final models, providing confidence for our analytical claims.

Discussion

Revisiting Research Literature

Although the research literature concerning the relationship between student help-seeking behaviors and student mathematics achievement is limited, the small number of empirical studies all concluded that there is a positive association between the two (e.g., Ogan et al., 2015; Schenke et al., 2015). The populations for these studies involved students between the ages of 12 and 17. These studies employed nonrandom samples that were either small in size or selected from small geographical regions (or both). The statistical methods used in these studies included multiple regression analysis and ANOVA, with only one study employing HLM.

The present study provides stronger evidence than previous studies that student help-seeking behaviors are positively associated with student mathematics achievement. The term "stronger" reflects the fact that the present study employed a large, nationally representative, random sample to assess the issue. Further, we adopted multilevel techniques to account for the fact that students are nested within schools. Taken together, these represent a substantial improvement in research methodology. As a result, the present study makes unique contributions to the research literature with far more credible and precise generalizability.

Two major contributions of the present study can be made with confidence. First, the help-seeking behaviors of 15-year-old students (in the U.S.) have positive effects on their mathematics achievement. Although these effects are relatively small, they are robust (or stable) across all eight measures of mathematics achievement (even after controlling for student and school characteristics). Thus, for a wide range of domains in mathematics, an increase in student help-seeking behaviors contributes to an improvement in mathematics achievement. Not only does this conclusion provide further support for the relatively small number of previous empirical studies on this issue, but it also adds further evidence that the effects of student help-seeking behaviors on student mathematics achievement are rather comprehensive (or systematic).

Second, although students' help-seeking behaviors have positive effects on their mathematics achievement, these effects do not vary statistically significantly from school to school (in the U.S.). In other words, the relationship between student help-seeking behaviors and student mathematics achievement is independent of which schools students attend. As a result, student help-seeking behaviors can have positive effects on student mathematics achievement in any school regardless of school characteristics. This conclusion has not been reported in previous studies and is thus very unique in the research literature.

Educational Implications

The robust finding that students' help-seeking behaviors are positively associated with their mathematics achievement calls for efforts to educate teachers on how to encourage their students to be more proactive in seeking help in the learning of mathematics. The issue of student help-seeking behaviors may become an integral component of teacher professional development for the specific purpose of improving the help-seeking behaviors of students both inside and outside the mathematics classroom. Such professional development opportunities may emphasize a sound understanding of help-seeking behaviors (e.g., the nature, the unique relationship with mathematics as opposed to other school subjects, individual and cultural differences, related affective and cognitive conditions, and the role of technology) and effective techniques for creating an educational environment (both inside and outside the mathematics classroom) that invites and welcomes students to seek help.

The finding that the relationship between student help-seeking behaviors and student mathematics achievement is independent of which schools students attend is a piece of positive news.

Schools have a context (e.g., location, available resources, socioeconomic and racial-ethnic compositions of the student body, and education and experience levels of the teacher body) and a climate (e.g., administrative policies, instructional organization, and attitudes and expectations of students, parents, and teachers) (see Ma et al., 2008). It is challenging for educators to change school climate and nearly impossible for them to change school context. With that in mind, it is encouraging to find that, regardless of the school contextual and climatic characteristics, student help-seeking behaviors can have positive effects on student mathematics achievement. Therefore, improving students' help-seeking behaviors can be a good strategy in any school for the purpose of improving students' mathematics achievement.

Finally, although the present study supports the robust importance of student help-seeking behaviors to student mathematics achievement, the effect sizes are small. This finding implies that improving students' help-seeking behaviors by itself in an isolated fashion may not generate dramatic improvement in their mathematics achievement. Instead, it should be more beneficial to combine efforts at improving students' help-seeking behaviors with other educational reforms aimed at improving their mathematics achievement. For example, Everyday Mathematics, a national reform-based curriculum that is widely used throughout the U.S. (http://everydaymath.uchicago.edu/), provides a good opportunity for mathematics educators to promote students' help-seeking behaviors. Specially designed student help-seeking activities can be implemented within the Everyday Mathematics curriculum framework as instructional strategies to address specific topics in mathematics, especially those that are traditionally considered to be difficult (e.g., fractions).

Limitations and Suggestions

The primary weakness of the present study is the relatively low internal consistency of the composite variable measuring student help-seeking behavior. Although the index we constructed did yield a better internal consistency than the index constructed by PISA, Cronbach's α is still not optimal. Ultimately, the decision was made to use our index because it is conceptually clear and consistent, emphasizing interactions of students with real people (as opposed to either books or machines). This emphasis is good in the sense that interacting with people is a common way to seek help; however, this emphasis seems to have focused on a very specific or unique aspect of student help-seeking behaviors. Further research may seek to improve the measurement, especially if researchers intend to design their own surveys.

By conducting secondary data analysis, we were limited to data collected by PISA. Ideally, more control variables at the student and school levels would be considered to improve the HLM analysis. For example, because information on race-ethnicity was not available in PISA, the racial-ethnic background of students and schools could not be controlled for, thus ignoring the importance of racial-ethnic differences in student mathematics achievement (Parks & Schmeichel, 2012). Further research that seeks to improve control over student and school characteristics may better reveal the robust nature of student help-seeking behaviors in relation to student mathematics achievement.

Although it is reasonable for us to use data from PISA 2012, ideally we would prefer to have more current information. Considering this, our results may provide more of a historical examination on the issue of student help-seeking behaviors. The next PISA cycle with a focus on mathematics will occur in 2021. Given that we have shown clearly that this is a worthy issue to explore in mathematics education, researchers may want to follow up with PISA 2021 for any updated measures on student help-seeking behaviors.

Many research extensions are possible with newer (or even 2012) PISA data. We offer two suggestions. One is to examine the interactions between student help-seeking behaviors and other student characteristics (e.g., gender, attitude toward mathematics). The interest is in whether, say, one gender shows stronger effects of student help-seeking behaviors on student mathematics achievement. The other suggestion is to link student help-seeking behaviors with other outcomes in mathematics (e.g., mathematics anxiety, motivation to learn mathematics). It is informative to examine whether student help-seeking behaviors can, say, reduce student mathematics anxiety.

Finally, modern forms of communication may have fundamentally changed the primary ways in which people seek help. Previously, help-seeking concerning mathematics relied almost exclusively on the availability of physical resources such as textbooks and teachers. Now, in addition to these (which are still quite important), help-seeking has a growing reliance on the availability of electronic resources such as online homework systems and instructional videos, adding further complexity to the conceptual structure of student help-seeking behaviors. Further research that taps into these new avenues of help-seeking can bring a more comprehensive understanding of the relationship between student help-seeking behaviors and student mathematics achievement.

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