Mathematics Teachers' Perceptions of their Students' Mathematical Competence: Relations to Mathematics Achievement, Affect, and Engagement in Singapore and Australia

Shaljan Areepattamannil
National Institute of Education, Singapore
<shaljan.a@nie.edu.sg>

Berinderjeet Kaur
National Institute of Education, Singapore
<berinderjeet.kaur@nie.edu.sg>

This study, drawing on data from the Trends in International Mathematics and Science Study (TIMSS) 2011, examined whether mathematics teachers' perceptions of their students' mathematical competence were related to mathematics achievement, affect toward mathematics, and engagement in mathematics lessons among Grade 8 students in Singapore and Australia. Structural equation modelling (SEM) analyses revealed that mathematics teachers' perceptions of their students' mathematical competence were positively linked to eighth-graders' mathematics achievement, affect toward mathematics, and engagement in mathematics lessons in both Singapore and Australia. Implications of the findings are briefly discussed.

Teachers' perceptions and expectations of their students' academic abilities and skills generally play a crucial role in enhancing student achievement, motivation, and engagement (Archambault, Janosz, & Chouinard, 2012). A growing corpus of research has examined the relationships between teachers' perceptions of students' academic abilities and students' actual academic performance (e.g., Begeny, Eckert, Montarello, & Storie, 2008; Rubie-Davies, 2010; Sparks & Ganschow, 1996). However, the lion's share of these studies focused solely on students' reading abilities. Only a small body of research has specifically examined the relationships between mathematics teachers' perceptions of their students' abilities and skills in mathematics and student achievement in mathematics.

For example, Archambault et al. (2012), using hierarchical linear modelling with a longitudinal sample of 79 mathematics teachers and their 1,364 secondary school students (Grades 7–11) from 33 schools in Canada, examined whether or not mathematics teachers' beliefs and expectations about their students' ability to succeed in mathematics had any effects on students' achievement in mathematics and cognitive engagement in mathematics. The authors found that mathematics teachers' expectations about their students' ability to succeed in mathematics had a positive impact on students' achievement in mathematics. However, mathematics teachers' expectations about their students' ability to succeed in mathematics had no effect on students' cognitive engagement in mathematics. Similarly, Hughes, Gleason, and Zhang (2005) found that teachers' perceptions of 607 first-graders' academic abilities in mathematics were linked to children's mathematics achievement in South West Texas, United States.

However, no study to date has examined the relationships of mathematics teachers' perceptions about their students' mathematical competence to students' attitudes toward mathematics and engagement in mathematics lessons. Hence, the purpose of the present study was to examine the relationships of mathematics teachers' perceptions of their students' mathematical competence to students' achievement in mathematics, attitudes toward mathematics, and engagement in mathematics lessons. Specifically, the study addressed the following research question: Do mathematics teachers' perceptions of their students' mathematical competence significantly predict students' achievement in mathematics, attitudes toward mathematics, and engagement in mathematics lessons? We

In V. Steinle, L. Ball & C. Bardini (Eds.), Mathematics education: Yesterday, today and tomorrow (Proceedings of the 36th annual conference of the Mathematics Education Research Group of Australasia). Melbourne, VIC: MERGA.

hypothesized that mathematics teachers' perceptions of their students' mathematical competence would be significantly and positively associated with students' achievement in mathematics, attitudes toward mathematics, and engagement in mathematics lessons.

Method

Data

Data for the study were drawn from the fifth cycle of the Trends in International Mathematics and Science Study (TIMSS 2011). TIMSS assesses fourth- and eighth-graders' competencies in mathematics and science. In 2011, 63 countries and 14 benchmarking entities took part in TIMSS. The present study is based on the TIMSS 2011 Grade 8 sample. The Singaporean Grade 8 sample comprised of 5,927 students from 165 schools and the Australian sample included 7,556 students from 277 schools. We chose the Singaporean and Australian TIMSS 2011 samples for the present study because there were statistically significant differences between Singaporean and Australian students in terms of their performance on the TIMSS 2011 mathematics assessment.

Measures

Mathematics teachers' perceptions of their students' mathematical competence. Two explanatory variables were used to measure mathematics teachers' perceptions of their students' mathematical competence ("My teacher thinks I can do well in mathematics <programs/classes/lessons> with difficult materials" [BSBM16G] and "My teacher tells me I am good at mathematics" [BSBM16H]). These two items were rated on a 4-point Likert-type scale ranging from 1 (disagree a lot) to 4 (agree a lot).

Mathematics achievement. The TIMSS 2011 Grade 8 overall mathematics achievement scale (BSMMAT01 to BSMMAT05) was used as a measure of mathematics achievement in the current study. This scale was based on 217 mathematics items (Martin & Mullis, 2012). The Cronbach's alpha reliability coefficients for the scale were 0.91 and 0.90 in Singapore and Australia, respectively (Martin & Mullis, 2012).

Students like learning mathematics. The TIMSS 2011 students like learning mathematics scale was based on five items ("I enjoy learning mathematics"; "I wish I did not have to study mathematics" [reverse coded]; "Mathematics is boring" [reverse coded]; "I learn many interesting things in mathematics"; and "I like mathematics"). These items were rated on a 4-point Likert-type scale ranging from 1 (disagree a lot) to 4 (agree a lot). The Cronbach's alpha reliability coefficients for the scale were 0.90 and 0.88 in Singapore and Australia, respectively (Martin & Mullis, 2012). In the present study, we used the TIMSS 2011 index of students like learning mathematics (BSDGSLM), an index created using the students like learning mathematics scale (see Martin & Mullis, 2012).

Students value learning mathematics. The TIMSS 2011 students value learning mathematics scale was based on six items ("I think learning mathematics will help me in my daily life"; "I need mathematics to learn other school subjects"; "I need to do well in mathematics to get into the university of my choice"; "I need to do well in mathematics to get the job I want"; "I would like a job that involves using mathematics"; and "It is important to do well in mathematics"). These items were rated on a 4-point Likert-type scale ranging from 1 (disagree a lot) to 4 (agree a lot). The Cronbach's alpha reliability coefficients for the scale were 0.80 and 0.82 in Singapore and Australia, respectively

(Martin & Mullis, 2012). In the current study, we used the TIMSS 2011 index of students value learning mathematics (BSDGSVM), an index created using the students value learning mathematics scale (see Martin & Mullis, 2012).

Students engaged in mathematics lessons. The TIMSS 2011 students engaged in their mathematics lessons scale was based on five items ("I know what my teacher expects me to do"; "I think of things not related to the lesson" [reverse coded]; "My teacher is easy to understand"; "I am interested in what my teacher says"; and "My teacher gives me interesting things to do"). These items were rated on a 4-point Likert-type scale ranging from 1 (disagree a lot) to 4 (agree a lot). The Cronbach's alpha reliability coefficients for the scale were 0.77 and 0.77 in Singapore and Australia, respectively (Martin & Mullis, 2012). In the present study, we used the TIMSS 2011 index of students engaged in mathematics lessons (BSDGEML), an index created using the students engaged in mathematics lessons scale (see Martin & Mullis, 2012). The descriptive statistics for all variables in the study are presented in Table 1.

Table 1
Descriptive Statistics

Measures	Singapore		Australia	
	M	SD	M	SD
Mathematics achievement	610.99	84.10	504.80	85.42
Students value learning mathematics	1.67	0.65	1.68	0.71
Students like learning mathematics	1.91	0.74	2.29	0.72
Students engaged in mathematics lessons	2.09	0.63	2.17	0.65
My teacher thinks I can do well in mathematics	2.23	0.84	2.17	0.87
My teacher tells me I am good at mathematics	2.55	0.92	2.34	0.96

Results

To address the purpose of the study, separate structural equation modelling (SEM) analyses were conducted for Singapore and Australia using Mplus Version 7.0 (see Figures 1 and 2). In Singapore, mathematics teachers' perceptions of their students' mathematical competence were positively associated with mathematics achievement (BSBM16G: β = 0.17, p = 0.000; BSBM16H: β = 0.04, p = 0.023); students like learning mathematics (BSBM16G: β = 0.22, p = 0.000; BSBM16H: β = 0.27, p = 0.000); students value learning mathematics (BSBM16G: β = 0.21, p = 0.000; BSBM16H: β = 0.16, p = 0.000); and students engaged in their mathematics lessons (BSBM16G: β = 0.20, p = 0.000; BSBM16H: β = 0.23, p = 0.000). The fit indices (CFI = 1.00; TLI = 1.00; RMSEA = 0.01; and SRMR = 0.00) suggested a good fit between the model and the observed data.

In Australia, mathematics teachers' perceptions of their students' mathematical competence were also positively linked to mathematics achievement (BSBM16G: β = 0.25, p = 0.000; BSBM16H: β = 0.10, p = 0.000); students like learning mathematics (BSBM16G: β = 0.24, p = 0.000; BSBM16H: β = 0.26, p = 0.000); students value learning mathematics (BSBM16G: β = 0.22, p = 0.000; BSBM16H: β = 0.14, p = 0.000); and students engaged in their mathematics lessons (BSBM16G: β = 0.18, p = 0.000; BSBM16H: β = 0.31, p = 0.000). The fit indices (CFI = 1.00; TLI = 1.00; RMSEA = 0.00; and SRMR = 0.00) suggested a good fit between the model and the observed data.

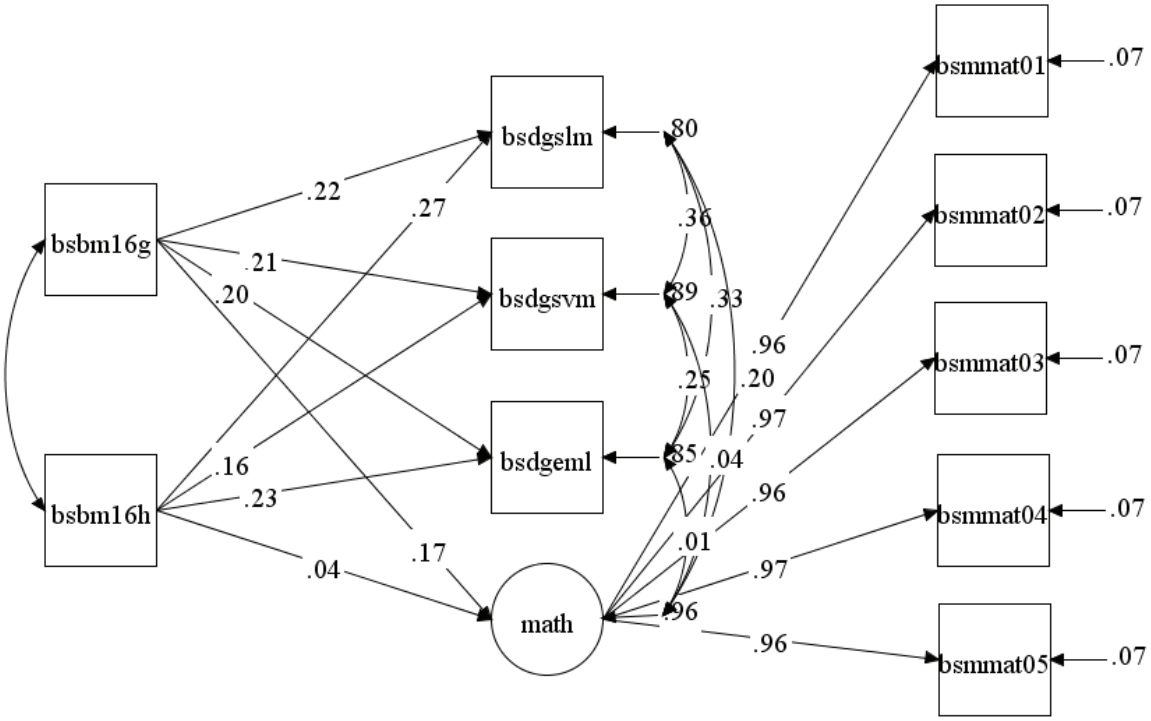

Figure 1. Structural equation modelling analyses predicting mathematics achievement, affect, and engagement in Singapore.

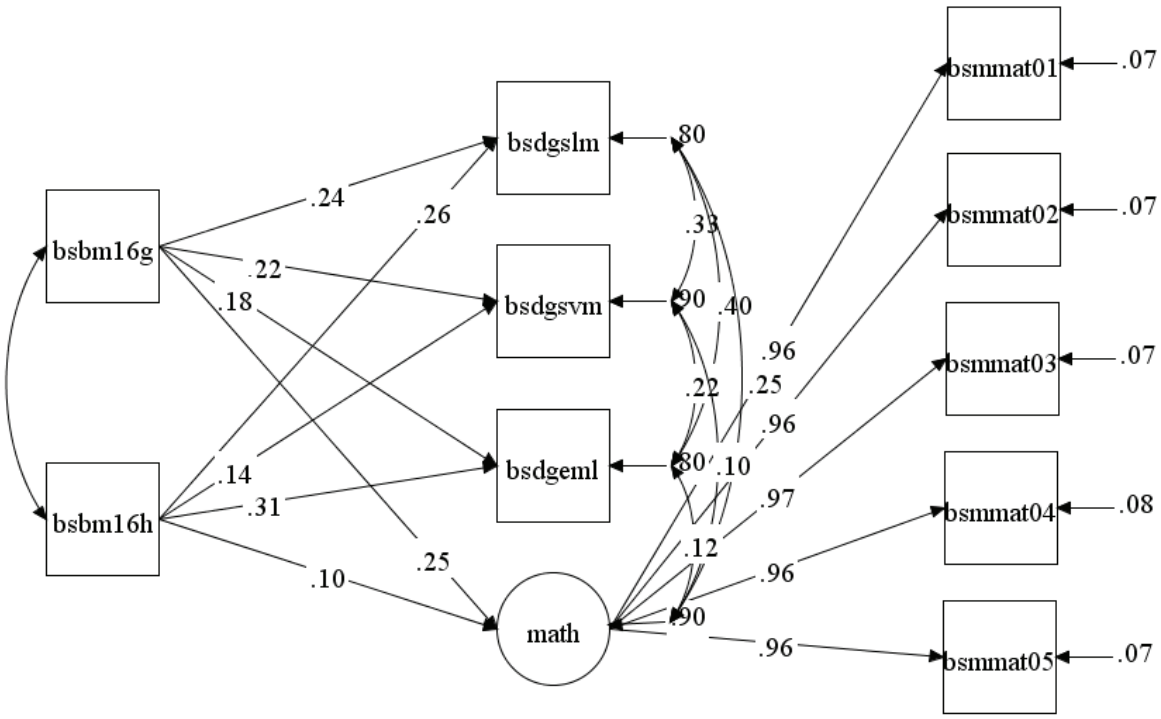

Figure 2. Structural equation modelling analyses predicting mathematics achievement, affect, and engagement in Australia.

Discussion

The present study aimed to examine the relationships of mathematics teachers' perceptions of their students' mathematical competence to students' mathematics achievement, attitudes toward mathematics, and engagement in mathematics lessons. Structural equation modelling analyses revealed that both Singaporean and Australian mathematics teachers' perceptions of their students' mathematical competence were positively linked to students' achievement in mathematics, attitudes toward mathematics, and engagement in mathematics lessons.

In other words, students whose mathematics teachers held more positive perceptions about their students' mathematical competence scored significantly higher in mathematics than did their peers whose mathematics teachers held less positive perceptions about their students' mathematical competence. Similarly, students whose mathematics teachers held more positive perceptions about their students' mathematical competence reported significantly higher levels of positive attitudes toward mathematics than did their counterparts whose mathematics teachers held less positive perceptions about their students' mathematical competence. Furthermore, students whose mathematics teachers held more positive perceptions about their students' mathematical competence reported significantly higher levels of engagement in mathematics lessons than did their peers whose mathematics teachers held less positive perceptions about their students' mathematical competence.

These findings underscore the critical role that mathematics teachers' positive perceptions about their students' academic abilities and skills in mathematics may play in boosting students' achievement in mathematics, positive attitudes toward mathematics, and engagement in mathematics lessons. As Jussim, Robustelli, and Cain (2009, p. 377) posit, "High expectations are not, by themselves, a solution for underachievement. However, when coupled with an understanding of the teaching practices well-established at enhancing student motivation, commitment, and involvement in school, high expectations can be one powerful tool for redressing some educational inequalities."

References

Archambault, I., Janosz, M., & Chouinard, R. (2012). Teacher beliefs as predictors of adolescents' cognitive engagement and achievement in mathematics. *The Journal of Educational Research*, 105, 319-328.

Begeny, J. C., Eckert, T. L., Montarello, S. A., & Storie, M. S. (2008). Teachers' perceptions of students' reading abilities: An examination of the relationship between teachers' judgments and students' performance across a continuum of rating methods. *School Psychology Quarterly*, 23, 43-55.

Hughes, J. N., Gleason, K. A., & Zhang, D. (2005). Relationship influences on teachers' perceptions of academic competence in academically at-risk minority and majority first grade students. *Journal of School Psychology*, 43, 303-320.

Jussim, L., Robustelli, S., & Cain, T. R. (2009). Teacher expectations and self-fulfilling prophecies. In Wentzel, K., & Wigfield, A. (Eds.), *Handbook of motivation at school* (pp. 349-380). New York, NY: Routledge.

Martin, M. O., & Mullis, I. V. S. (Eds.). (2012). *Methods and procedures in TIMSS and PIRLS 2011*. Chestnut Hill, MA: TIMSS & PIRLS International Study Centre, Boston College.

Rubie-Davies, C. M. (2010). Teacher expectations and perceptions of student attributes: Is there a relationship? *British Journal of Educational Psychology*, 80, 121-135.

Sparks, R. L., & Ganschow, L. (1996). Teachers' perceptions of students' foreign language academic skills and affective characteristics. *The Journal of Educational Research*, 89, 172-185.