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Special education and subject teachers' self-perceived readiness to teach mathematics to low-achieving middle school students

Student achievement and factors that affect academic success have been reported in many studies with most focusing on classroom instruction, curriculum, or the student (Hattie, 2013). While these aspects are all important, it has also been observed that the teacher factor is one of the strongest elements impacting student achievement (e.g., Buddin & Zamarro, 2009; Coltfelter, Ladd, & Vigdor, 2007; Hattie, 2013; Jepsen & Christopher, 2005; Kukla-Acevedon, 2009). Studies have also shown that the effect of teachers on student success increases by grade (Jepsen & Christopher, 2005). Not only external characteristics, such as certification status and experience, but also motivation, approaches to learning, attitudes, and pedagogical knowledge of teachers have been identified as key qualities influencing student achievement (Hattie, 2013).

Educational reforms during the last decade have led to a more inclusive environment for students with different needs and have shed light on teachers' readiness to teach diverse students in the general classroom (e.g., Boyd & Bargerhuff, 2010; Brownell, Sindelar, Kiely, & Danielson, 2010; DeSimone & Parmar, 2006a; DeSimone & Parmar, 2006b; Rosas & Campbell, 2010; Tara, 2012; Yeo, Ang, Chong, Huan, & Quek, 2008). Teachers today are expected to have the competence to successfully teach all types of students (e.g., Boyd & Bargerhuff, 2010; DeSimone & Parmar, 2006b; Rosas & Campbell, 2010). However, many teachers feel uncomfortable and unprepared to meet these demands (Bouck, 2005; Maccini & Gagnon, 2006). This study focuses on Finnish mathematics and special education teachers' self-perceived efficacy as well as their pedagogical and subject knowledge to teach students

struggling in mathematics.

Low-achieving students in mathematics

Basic competence in mathematics is more important than ever for managing routine day-to-day activities in the 21st century. Therefore, identifying and remediating students with low achievement in mathematics is highly necessary (Geary, Hoard, Nugent, & Bailey, 2012). According to the literature, low-achieving students are defined as a heterogeneous group who underperform their typically achieving peers in mathematics and constitute approximately the lowest 20% of an age group (Geary, 2013; Geary et al., 2012; Mazzocco, Devlin, & Kinley, 2008). This definition can be compared to the definition of students who do not reach Level 2 of the Programme for International Student Assessment (PISA) (Education, Audiovisual and Culture Executive Agency [EACEA], 2011; Organization for Economic Co-operation and Development [OECD], 2014) since Level 2 is the minimum required to fully participate in society (see OECD, 2014). International and national evaluations show that mathematics has the highest number of low-achieving students among all subjects in Europe as well as in the United States (National Center for Educational Statistics, 2014; OECD, 2014).

Researchers have reported that low-achieving students may make better progress if the teacher is highly educated (Hill, 2007; Neild, Farley-Ripple, & Byrnes, 2009). Especially in mathematics, this finding has been debated since special educators in middle and high school do not necessarily possess the required mathematical knowledge (van Gardener, Thomas, Stormont, & Lembke, 2013; Parmar & Cawley, 1997), whereas mathematics teachers often lack the pedagogical knowledge for teaching students with difficulties in mathematics (DeSimone & Parmar, 2006a; DeSimone & Parmar, 2006b; Parmar & Cawley, 1997).

Teacher Readiness

Due to the increasing popularity of inclusive education, teachers today are expected to have the readiness and capability to accommodate all students' needs in the mainstream classroom and should be prepared for a broad range of tasks at all levels. For the purpose of this study, teacher readiness has been defined as teachers' knowledge, skills, attitudes and practices to meet all students' individual needs (e.g., Adediwura & Tayo, 2007; Chen & Chang, 2006). Two important factors related to teacher readiness and student achievement are *teacher quality* (Bolyard & Moyer-Packenham, 2008; Feng & Sass, 2013; Hill, Rowan, & Ball, 2005; Tara, 2012) and teacher *efficacy beliefs* (Holzberger, Philipp, & Kunter, 2013; Tschannen-Moran & Hoy, 2001; Tschannen-Moran, Hoy, & Hoy, 1998).

Teacher quality

The importance of highly qualified teachers for all students (see No Child Left Behind Act [NCLB], U.S. Department of Education, 2002), especially in mathematics, has been a focus during the last decade (e.g., Bolyard & Moyer-Packenham, 2008; Brownell et al., 2010; Coltfelter et al., 2007; Flores, Patterson, Shippen, Hinton, & Franklin, 2011; Rosas & Campbell, 2010; Tara, 2012). Teacher quality can be defined from several points of view: the researcher's, policymaker's, or educator's. For the researcher, teacher quality is operationalized, and variables are identified in relation to student achievement. For the policymaker, teacher quality can be identified as meeting (or not meeting) a standard of quality, while a teacher may see a qualified teacher as one who has strong knowledge of content and pedagogy and pursues continuous professional development (Bolyard & Moyer-Packenham, 2008). According to NCLB, a highly qualified teacher holds at least a bachelor's degree and a full certification and demonstrates competence in subject knowledge and teaching skills. The National Council of Teachers of Mathematics (NCTM, 2005) defines a highly qualified teacher in mathematics as a teacher who has a deep knowledge in mathematics and the capability to guide the students to

understanding and learning in mathematics. Highly qualified teachers also use a wide range of learning strategies and understand how students can learn mathematics. Based on these definitions, teacher quality has been described in this study using four teacher quality characteristics: subject knowledge, pedagogical knowledge (i.e., mathematical knowledge for teaching), certification, and teacher experiences in instruction.

Several studies have reported that teachers' subject knowledge has a positive effect on student achievement, especially in mathematics and in the higher grades (middle and high school) (e.g., Bolyard & Moyer-Packenham, 2008; Coltfelter et al., 2007; Feng & Sass, 2013; Hill, 2007; Kukla-Acevedon, 2009; Telese, 2012). Deep subject knowledge in mathematics helps the teacher understand the underlying concepts in computations and algorithms as well as the process required for mathematical reasoning and communication about mathematical problems, which for low-achieving students is most relevant to develop (Boyd & Bargerhuff, 2010; Mevarech & Kramarski, 2014; Neild et al., 2009). Strong mathematical knowledge leads teachers to spend more time and focus on questioning, discussing, and reasoning about mathematical processes (Griffin, Jitendra, & League, 2009). Since low-achieving students tend to have a more passive role in the classroom, teachers' awareness of valid questions and student engagement is important to encourage students to participate in classroom discussions (Griffin et al., 2009). Communication also means using the 'right' language for different mathematical concepts as a natural part of the instructional practice (Seah, 2012). Maccini and Gagnon (2006) reported that teachers' familiarity in mathematical content predicted the number of instructional practices that the teachers provided for low-achieving secondary students in mathematics.

In order to make mathematical concepts understandable including how to introduce and teach them, the teacher needs pedagogical knowledge. In mathematics, this awareness can be defined as the teachers' mathematical knowledge for teaching (Hill et al., 2005). This knowledge may include how to use different manipulatives to represent mathematical concepts

and procedures, how to provide students with explanations of mathematical rules and procedures as well as how to analyse students' solutions and explanations (Hill et al., 2005).

Hill and her colleagues (2005) also found that the teachers' mathematical knowledge for teaching is positively correlated with students' mathematical gains during the first and third grades, which indicates that teachers' subject knowledge also affects students' performance even at the elementary level. This means that for even the most basic elements of the mathematical content (including content in grades 7–9), the teacher must be familiar with the subject and underlying theory.

Other factors influencing students' mathematical gain are teachers' certification status and teacher experience (Bolyard & Moyer-Packenham, 2008; Coltfelter et al., 2007; Hill, 2007). Research has indicated that teachers' certification status has a positive effect on student learning in mathematics on all educational levels (Coltfelter et al., 2007; Neild et al., 2009). Unfortunately, in several countries, the percentage of certified teachers, especially in mathematics, is lower in the middle grades than in high school (Neild et al., 2009; Kumpulainen, 2014b). The requirements for certification, such as the level of educational degree, vary among countries (see e.g. Ingersoll, 2007; Sahlberg, 2011b; Wang, Coleman, Coley, & Phelps, 2003). Teachers who major in mathematics or are certified to teach high school-level mathematics have a greater positive correlation to students' mathematical achievement in middle school than teachers with primary school or grade 4–9 certification (or other complementary certifications; Coltfelter et al., 2007; Neild et al., 2009; Hill, 2007). Bouck (2005) reported that a very low percentage of special education teachers in middle and high school had proper training for instruction at this level during their education despite being certified for both middle and high school.

Several studies have reported that teacher experience has a positive impact on student achievement (e.g., Bolyard & Moyer-Packenham, 2008; Coltfelter et al., 2007; Harris & Sass,

2011). There is evidence of strong positive development at the beginning of teachers' careers, which then levels off after 5 to 10 years (Bolyard & Moyer-Packenham, 2008, Feng & Sass, 2013; Harris & Sass, 2011). The positive effect of experience on student achievement is stronger for the middle and high school levels than for pre- and primary school (Bolyard & Moyer-Packenham, 2008). Hill (2007) noticed that teachers with more experience in instruction performed better than novice teachers in mathematical knowledge for teaching. Middle school teachers who had experienced teaching at the high school level reported having more mathematical knowledge for teaching compared to teachers without such experience (Hill, 2007). Teachers' experience with diverse learners also has a positive impact on teachers' attitudes and beliefs (Subban & Sharma, 2005).

Teacher efficacy beliefs

Teacher efficacy beliefs (teachers' self-efficacy) have been related to teaching strategies, instructions, and motivation (Holzberger et al., 2013; Kleinsasser, 2014; Midgley, Feldlaufer, & Eccles, 1989) as well as to student achievement (Austin, 2013). Teacher efficacy beliefs can be defined as a teacher's beliefs about his or her ability to teach the subject to students with different needs and abilities (Tschannen-Moran et al., 1998) and the capability to bring about desired outcomes regarding student engagement and learning (Bandura, 1977). Holzberger and her colleagues (2013) found a strong positive relationship between teachers' efficacy beliefs and instructional quality as well as connections to cognitive activation and learning support. Teachers with high efficacy beliefs also seemed to provide more student-centred instruction and stronger classroom management (Holzberger et al., 2013). These teachers also put more effort into implementing new teaching methods, strategies (Holzberger et al., 2013; Temiz & Topeu, 2013), and learning support (Holzberger et al., 2013) as well as exhibited higher efficacy in terms of classroom engagement and culture and in lesson design (Temiz & Topeu, 2013). In

addition, studies have indicated that teachers' mathematics self-efficacy is positively correlated to mathematics teaching efficacy beliefs (Bates, Kim, & Lathan, 2011; Swackhamed, Koeller, Basile, & Kimbrough, 2009).

Teacher readiness for low-achieving students

The performance of low-achieving students is affected by teacher quality and teacher efficacy beliefs, especially in mathematics (Midgley et al., 1989). Yeo and her colleagues (2008) reported that teachers' professional experience had a positive impact on teachers' efficacy beliefs for teaching low-achieving students. The researchers also found that teachers' positive relationships with low-achieving students resulted in higher teacher efficacy (Yeo et al., 2008). Since teacher efficacy affects competence in terms of instructional practices, classroom management, and student engagement, low-achieving students benefit from teachers having high teacher efficacy (Edmonds & Spradlin, 2010).

Teaching mathematics requires an understanding of mathematical concepts and knowledge about how students acquire and apply mathematical skills (Flores et al., 2011; Seah, 2012). Furthermore, special educators who teach mathematics often have to deal with a higher level of content than their pre-service training has prepared them for (Faulkner & Cain, 2013; Rosas & Campbell, 2010). For some teachers, this situation is very uncomfortable and may even cause anxiety (Bursal & Paznokas, 2006; Faulkner & Cain, 2013; Gerretson & McHatton, 2009; Humphrey & Hourcade, 2010; Rosas & Campbell, 2010), which can have a negative effect on instruction for students who most need support (Swars, Daane, & Giesen, 2007). DeSimone and Parmar (2006b) reported that many subject teachers seemed to lack a strong understanding of specific pedagogical strategies for teaching low-achieving students in mathematics despite the fact that half of the respondents perceived themselves as comfortable or very comfortable with their ability to instruct low-achieving students.

Educational support in Finland

Since 2011, Finland has used a three-tier model for educational support services (Finnish National Board of Education, 2011). The Finnish model is similar to the response to intervention (RTI) process commonly implemented in the United States (Fuchs, Fuchs, & Compton, 2012; Fuchs & Vaughn, 2012). In Finland, general teachers are expected to have knowledge to help all students by incorporating different instructional practices, differentiation, and accommodations in order to manage the common curriculum in the general classroom (general support). At the second tier (intensified support), the student receives intensified instruction from a general or special education teacher for a limited period. If this instruction is not enough, the student receives special support (third tier) most often from a special education teacher. However, educational support procedures (e.g., RTI and the Finnish model) present some challenges in middle school including the lack of school-wide processes and relevant assessment measures (Clarke, Lemke, Hampton, & Hendricker, 2011; Johnson & Smith, 2009), especially in mathematics (Lembke, Hampton, & Beyers, 2012).

In Finland, about 22% of students in compulsory education receive some type of special educational services (Kumpulainen, 2014a), which is one of the highest rates of service in the world (Kivirauma & Ruoho, 2007). The goal in providing such services is to prevent and minimize academic differences among students and to support the ideal of equal opportunities and outcomes for learning (Sahlberg, 2011a, 2012). The wide availability of educational services has also been labelled as a key factor impacting the country's top results in international studies (Haussäter & Takala, 2011; Kivirauma & Ruoho, 2007; Sahlberg, 2011a).

Research on teacher readiness for low-achieving students in middle school is scarce. Studies in this area usually discuss primary school teachers and their general efficacy beliefs. As a complement to the literature, this study focused on how subject and special education

teachers experienced their own readiness (teacher quality and self-efficacy) for teaching low-achieving middle school students in mathematics.

Present study

Educational reforms and the high number of low-achieving students in mathematics have made the learning environment challenging for teachers. Teachers must have skills in various instructional practices and mathematical knowledge for teaching as well as a strong belief in their capability to teach students who need support. The aim of this study was to investigate how mathematics and special education teachers in Swedish-speaking schools¹ in Finland perceived their own teacher efficacy and subject and pedagogical knowledge in order to teach mathematics to low-achieving students in middle school.

The following research questions were investigated: (a) Are teacher efficacy beliefs predicted by teacher group, experience, certification status, and/or gender? (b) How do mathematics teachers perceive their pedagogical knowledge for teaching mathematics to low-achieving students, and is the perceived level of pedagogical knowledge related to teacher experience, certification status, and/or gender? (c) How do special education teachers perceive their subject knowledge in mathematics, and is the perceived level related to experience, certification status and/or gender?

Method

Participants

The sample consisted of 27 special education teachers (26 women) and 42 mathematics teachers (21 women). Of the special education teachers, 78% had worked five years or more, and 72% were certified² teachers in special education. The mean age of the special education teachers was 43.7 years (age range: 26–62 years). Of the mathematics teachers, 71% were certified²

teachers in mathematics, and 73.5% had worked five years or more. The mean age of the mathematics teachers was 43.3 years (age range: 25–63 years).

Procedure and measurements

This study was part of a research project targeting special educational support for low-achieving students in middle school. An electronic questionnaire for special education teachers and mathematics teachers was sent to all principals of Swedish-speaking schools in Finland with grades 7 to 9 ($N = 55$). The questionnaires included items about the teachers' perceived efficacy beliefs as well as their subject and pedagogical knowledge for teaching mathematics to low-achieving students in grades 7-9.

Since teacher efficacy is context and situation specific, and none of the existing scales measure teachers' perceived efficacy for teaching mathematics to low-achieving students, a scale was constructed for the purpose of this study (Appendix 1). There were eight items included regarding personal teaching efficacy, for which teachers rated their confidence in teaching students with difficulties in mathematics. All items were answered on a 4-point, Likert-type scale (1 = *strongly disagree* to 4 = *strongly agree*). There was also one item about special education teachers' perceived mathematical content level and one item about the subject teachers' perceived their pedagogical knowledge for teaching low-achieving students in mathematics. These items were also judged on a Likert-type scale (1=*low* to 4 =*high*). The electronic questionnaire was sent in May 2013, and a reminder was sent twice—once in June and once in August.

Data analyses

The analyses were conducted in several stages using the *Mplus* program (Muthén & Muthén, 1998–2013) and SPSS statistical software. First, the quality and dimensionality of the measures

were investigated using an exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Second, a series of CFAs with covariates were run to analyse the first research question. In assessing the overall model fit, we followed the recommendations of Marsh et al. (2004) for a comparative fit index (CFI) around .90 and around 0.6 for the root mean square of error approximation (RMSEA). Finally, *t*-tests were conducted to analyse research questions b and c.

Results

We started the analyses by examining the dimensionality of the teacher efficacy beliefs scale (Appendix 1) with EFA, which showed that a one-factor model was to prefer. The CFA showed that a one-factor model fit the data well ($\chi^2(20) = 17.92$, $p = .59$, CFI = 1.00, RMSEA = 0.76). Factor loadings, correlations, means, and standard deviations are shown in Table 1. However, an examination of the factor loadings revealed that three items (F3, F4, and F7) did not load strongly on the factor. Therefore, they were discarded from subsequent analyses. Repeating the CFA with five indicators (items) gave an excellent model of fit ($\chi^2(5) = 5.45$, $p = .36$, CFI = 1.00, RMSEA = .04). Furthermore, Cronbach's alpha was computed (five variables), and the result was acceptable, .82. (The latent factor was labelled efficacy [teacher efficacy beliefs].)

<Table 1 here>

To investigate how teacher group, teacher experience, certification status, and gender explain variance in teacher efficacy beliefs, a series of CFAs with covariates were conducted. The covariates (teacher group, teacher experience, certification, and gender) were first allowed to predict teacher efficacy beliefs, one covariate at a time (Table 2). Teacher group, certification status, and gender all individually predicted teacher efficacy beliefs. Special education teachers, female teachers, and certified teachers reported higher teacher efficacy beliefs compared to subject teachers, male teachers, and noncertified teachers. The only covariate that did not

predict teacher efficacy beliefs ($p = 0.41$) was teacher experience. The full model was then fitted with all significant covariates from the previous models ($\chi^2(21) = 36.15, p = 0.02, CFI = 0.90, RMSEA = 0.10$). In the full model, the only significant predictor of teacher efficacy beliefs was teacher group ($\beta = 0.70, z = 7.07, p < .001$). This model explained 51% of the variance in teacher efficacy beliefs. Beta values for the non-significant covariates of gender, experience, and certification were 0.10, 0.10, and 0.15, respectively.

<Table 2 here>

In addition, two specific items were answered—one by the mathematics teachers and one by the special education teachers. The responses were analysed with t -tests for the four covariates (teacher group, experience, certification, and gender [mathematics teachers]).

The mathematics teachers answered a question about their pedagogical knowledge for teaching low-achieving students in mathematics on a 4-point, Likert-type scale (1= *low* to 4 = *high*). Based on the results, the mathematics teachers felt that they had a high level of pedagogical knowledge for teaching low-achieving students in mathematics ($M = 3.8, SD = 0.60$). There were no significant differences in gender ($p = 0.33, d = 0.32$), experience ($p = 0.16, d = 0.45$), or certification status ($p = 0.11, d = 0.56$).

Special education teachers were asked how they rated their mathematical knowledge on a 4-point, Likert-type scale (1= *low* to 4 = *high*). The results indicated that the special education teachers perceived themselves as having moderate mathematical knowledge ($M = 3.30, SD = 0.61$). No difference in mathematical knowledge for the special education teachers was noted as related to teacher experience ($p = .73, d = 0.13$) or certification status ($p = .34, d = -.71$). As there was only one male respondent in the special education group, gender differences could not be tested.

Discussion

The aim of this study was to investigate how special education and mathematics teachers experienced their readiness to teach mathematics to low-achieving students in the middle school general classroom. Results indicated that when compared to mathematics teachers, special education teachers had higher efficacy beliefs regarding the teaching of mathematics to low-achieving students. No significant differences in teacher efficacy beliefs were found for gender, teacher experience, or certification status. In addition, the special education teachers perceived themselves as having moderate mathematical knowledge (3.3 of 4), and the mathematics teachers saw themselves as having a high (3.8 of 4) level of pedagogical knowledge for teaching mathematics to low-achieving students.

Student achievement has frequently been investigated with focus on instruction (see Hattie, 2009). However, teachers make the decisions about how to successfully carry out instruction in the classroom; therefore, the teacher is a key factor impacting student achievement (Hattie, 2013). Teachers' subject knowledge, efficacy beliefs, experience in instruction, and certification status have strongly influenced student achievement in mathematics (Coltfelter et al., 2007; Feng & Sass, 2013; Hannula & Oksanen, 2013; Holzberger et al., 2013). Low-achieving students would profit from having highly qualified teachers who also have strong teacher efficacy beliefs (Edmonds & Spradlin, 2009; Hannula & Oksanen, 2013). In this study, the mathematics teachers felt that they were well-prepared to teach low-achieving students in mathematics. Since a high number of students in need of special support (third tier) are included (partly or totally) in the general classroom in Finland (74% in Swedish-speaking schools and 54% in Finnish-speaking schools; Svedlin et al., 2013), both general and subject teachers are quite experienced at teaching diverse learners. This factor could be a reason for the high level of perceived readiness to teach mathematics to low-achieving students. In Finland, middle and high school teachers usually have a master's degree from a university and

are certified in one or two subjects (see Sahlberg, 2011b), which means they are specialized in teaching mathematics, which may also contribute to the high perception of readiness.

Teacher experience did not predict teacher efficacy beliefs in this study. Foss and Kleinsasser (1997) found that teacher experience negatively affected teachers' self-efficacy for teaching low-achieving students, where pre-service teachers reported more readiness for teaching mathematics than in-service teachers. This has been described in the literature as a result of the theory of behavioural change (Bandura, 1977) in which, for example, positive or negative experiences affect a person's self-efficacy. Furthermore, the relationship between self-efficacy and teacher experience is reported as nonlinear and complex (Kim, Sihn & Mitchell, 2014; Klassen and Chiu, 2010), influenced by the psychological context of the work environment (Klassen and Chiu, 2010).

In this study, certification status or gender did not predict teacher efficacy for teaching mathematics to low-achieving students when the effects of all the other covariates were accounted for. However, when studied separately, gender, and certification status, significantly predicted higher teacher efficacy beliefs with a positive effect for special education teachers, certified teachers, and female teachers. The small sample used in the study may be a reason for this difference. For gender differences, a variety of results are reported. Klassen and Chiu (2010) observed efficacy beliefs to be less positive for women, while Yeo et al. (2008) and Tejeda-Delgado (2009) did not find any differences between women and men on efficacy beliefs for teaching low-achieving students. In previous researches the impact of certification on teachers efficacy beliefs is also varying. For example, Voris (2011) did not find any differences in teacher efficacy between alternatively and traditionally certified special education teachers, while Kim, Sihn and Mitchell (2014) observed positive relations between certification and teachers mathematics efficacy beliefs. These wide results may be a reason for further research on the impact on teacher efficacy beliefs.

The importance of special education teachers' subject knowledge in mathematics has been discussed in several studies (e.g., Flores et al., 2011; Griffin et al., 2009; Rosas & Campbell, 2010). In this study, special education teachers reported that they possessed moderate mathematical knowledge (3.3 on a 4-point, Likert-type scale). This outcome can be compared to a study by Rosas and Campbell (2010), who observed that pre-service teachers lacked knowledge of basic mathematical content, but at the same time had high confidence in their own mathematical knowledge. These results are interesting and should be investigated in future studies. What level of mathematical content is enough for special education teachers? In this study, the special education teachers perceived that they only had moderate mathematical knowledge. The question remains: is that enough?

Today's diverse classroom needs teachers who have deep content knowledge as well as pedagogical knowledge (Coltfelter et al., 2007; Hill, 2007; Hill et al., 2005). Teaching mathematics requires an understanding of mathematical concepts and knowledge about how students learn and practice mathematical skills, especially for low-achieving students (e.g., Bouck, 2005; Flores et al., 2011; Maccini & Gagnon, 2006). As special education and mathematics teachers are specialized in different areas, it is important to develop ways of organizing the educational support in a fruitful way and take advantage of both teacher groups knowledge. To guarantee high-quality education for all students, collaboration and co-teaching between special education and mathematics teachers may be necessary (Brownell et al., 2010). It is also important to make teachers aware of the qualities expected for the future classroom and to give them support and opportunities for successful collaboration.

If good inclusion practices are to be implemented in future classrooms, this must begin during pre-service teacher education (Boyd & Barherhuff, 2010; DeSimone & Parmar, 2006a; Parker, McHatton, & Allen, 2012). As Bouck (2005) observed, fewer than half of special education teachers in high school felt prepared for their current position, and only a little more

than half of the teachers reported that they had practicum experience with a secondary population. Maccini and Gagnon (2006) suggested that secondary mathematical content should be integrated in special education pre-service teachers' education programs and that more courses on how to teach mathematics to low-achieving students for pre-service general teachers are needed.

Limitations and further studies

This study has some limitations. First, the number of participating teachers was quite low. When it comes to electronic questionnaires, it is difficult to get a sample of participants, which represents a whole teacher group (Wright, 2005). Perhaps the teachers who responded to the questionnaire were interested in mathematics and inclusion and may not represent the average teacher, thus affecting the study results. Even if there were no significant differences for the covariates according to mathematical and pedagogical knowledge, the effect sizes for certification status in particular were quite high. This divergence might have been caused by the small sample of teachers, thereby justifying the need for future studies with a bigger sample.

As widely supported by research, teachers' mathematical knowledge is important for student achievement. In this study, the special education teachers' mathematical knowledge was self-reported and not compared to any objective measure of mathematical knowledge. In future studies, it would be interesting to investigate the actual strength of teachers' mathematical knowledge for teaching middle school mathematics in practicum. The student voice is an additional important factor. It would be very interesting to conduct research about how the students in need of support in mathematics perceive the teachers' (mathematics and special education) mathematical and pedagogical knowledge.

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Notes

1. In Finland, approximately 5.5% of the population speaks Swedish as their native language.

This segment of the population is mostly people living in the west and southwest coastal areas. Parents can choose whether their child will start in a Swedish- or Finnish-speaking school and the school systems are equal. About 6.2% of an age group go to a Swedish-speaking school, and this number has increased over the last few years.

2. In Finland, a certified special education teacher has a master's degree with either a major in special education or a major in another subject with a complementary minor in special education (including practice). Approximately, it takes five years to receive a certification to be a special education teacher.

3. To be certified in Finland to teach mathematics in middle school, the requirement is a master's degree with at least minor in mathematics and education (including practice) as well as a major in another subject (if not in mathematics or education). It takes approximately five years to get a teacher certification.

Table 1. *Correlation, Factor Loading, Mean, and Standard Deviation for Items F1 to F8*

	Correlation								Factor loading
	F1	F2	F3	F4	F5	F6	F7	F8	
F1	1.000								-.721
F2	-.466	1.000							.628
F3	-.247	.151	1.000						.256
F4	-.002	.023	.031	1.000					.041
F5	-.404	.448	.141	.0138	1.000				.618
F6	-.601	.488	.197	-.125	.571	1.000			.842
F7	-.113	.080	.084	.299	.008	.135	1.000		.174
F8	-.520	.458	.144	.064	.324	.582	.206	1.000	.684
<i>M</i>	3.07	1.82	2.60	2.81	1.97	1.95	2.40	2.31	
<i>SD</i>	0.58	0.67	0.63	0.58	0.88	0.80	0.79	0.82	

Table 2. *Model of Fit for Single Covariates*

Model of fit	X²(df)	p	CFI	RMSEA
Teacher group	15.06(9)	0.09	0.96	0.10
Experience	10.18(9)	0.34	0.99	0.04
Certification	13.30(9)	0.15	0.96	0.08
Gender	17.30(9)	0.04	0.96	0.10

Appendix 1. Questionnaire for teachers

Statements about teaching students with difficulties in mathematics (1 = *strongly agree*, 4 = *strongly disagree*). Translation from the original Swedish-language questionnaire.

F1: I have enough knowledge about difficulties in mathematics and know what to do.

F2: I have a feeling of hopelessness.

F3: I often ask for advice.

F4: It is challenging, but I manage well.

F5: I seldom teach low-achieving students; the mathematics/special education teacher takes care of them.

F6: I feel doubtful, but with help I manage.

F7: I get too little help from colleagues (extra resources).

F8: I need more knowledge about difficulties in mathematics.

Mathematical content (special education teachers)

What is your perceived mathematical content level for teaching middle school students? (1 = *low*, 4 = *high*)

Pedagogical knowledge for teaching low-achievement students (mathematics teachers)

How do you perceive your knowledge for teaching low-achieving students in mathematics? (1 = *low*, 4 = *high*)