THE IMPACT OF TEACHER CHARACTERISTICS ON EDUCATIONAL DIFFERENTIATION PRACTICES IN LOWER SECONDARY MATHEMATICS INSTRUCTION

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Abstract This study aimed to investigate how teachers' certification status, experience in instruction, and teachers' efficacy beliefs for teaching lower secondary students in mathematics are related to differentiated instruction practices. A total of 42 mathematics teachers and 27 special education teachers answered an electronic questionnaire regarding mathematics teaching efficacy beliefs and their frequency of use of differentiation practices. The results indicated that teachers' efficacy beliefs were related to differentiation in content, flexible examination models, and co-teaching. Neither certification status nor teacher experience in instruction was related to the frequency of use of differentiation practices. As teacher efficacy beliefs seem to have an effect on the use of differentiation practices, and especially on co-teaching, it should be important for teacher education to focus on developing pre-service teachers' efficacy beliefs as well as implementing a strong collaboration between different teacher groups.

***Keywords**:* differentiation, educational support, mathematics, teacher efficacy beliefs

1 Introduction

Today's teachers are expected to be capable of adapting instruction to all kind of learners with different needs. This is also an important aspect of the Finnish National Core Curriculum, in which educational support highlights the possibilities of differentiation and differentiated instruction in the general classroom and is a strong component of all tiers of the Finnish three-tier educational support model (National Board of Education, 2011, 2015). Research on teacher quality has shown that there are several teacher characteristics, such as subject knowledge, certification status, experience in instruction and teacher efficacy beliefs, that affect instruction (Bolyard & Moyer-Packenham, 2008; van Garderen, Newman Thomas, Stormont, & Lembke, 2013; Hill, 2007; Maccini & Gagnon, 2006). Since teacher characteristics impact teaching strategies and instructions (Holzberger, Philipp, & Kunter, 2013; Midgley, Feldlaufer, & Eccles, 1989; Thoonen, Sleegers, Peetsma, & Oort, 2011), it can be assumed that teacher characteristics also impact the frequency of use of differentiated instruction in mathematics. To increase knowledge on how teacher characteristics affect teachers' use of differentiated instruction, this study will examine how the frequency of use of differentiation practices

in mathematics instruction is related to teacher efficacy beliefs, certification status and experience in teaching mathematics to lower secondary students.

1.1 The three-tier educational support model

The Finnish three-tier support model for educational support focuses on early identification of students with learning difficulties and early intervention (National Board of Education, 2011, 2015). It has much in common with the *Responsiveness to Intervention* (RtI) model, widely used in the United States (Fuchs, Fuchs & Compton, 2012; Fuchs & Vaughn, 2012), although many differences exist according to both the theoretical and pedagogical frameworks (Björn, Aro, Koponen, Fuchs & Fuchs, 2016). RtI is defined as a school-wide process that integrates instruction, intervention and assessment, and that should be based on evidence-based research (Johnson & Smith, 2008) and has been developed to support low-performing students through early identification and multitier (commonly three-tier) intensified instruction (Lembke, Hampton & Beyers, 2012). The first tier provides instruction for all students and includes differentiated instruction and flexible student grouping as common instructional practices while the second tier offers additional educational support in additional small groups or in-class support for those students not responding to instruction in tier one. The third tier offers intensive instruction for students in need of more specialised support.

Assessment is an important part of RtI to guarantee students' gains and performances (Riccomini & Smith, 2011). However, as most of the research-based intervention programs focus on early grades, RtI has some challenges in secondary education (Johnson & Smith, 2008) caused by, for example, lack of school-wide processes and relevant assessment measures (Clarke, Lembke, Hampton, & Hendricker, 2011). The importance of teachers' professional skills for a successful implementation of RtI has also been noted (Brownell, Sindelar, Kiely & Danielson, 2010; Hoover & Patton, 2008).

In the Finnish three-tier support model the first tier, *general support*, aims to offer educational support as soon as possible to students not responding to average classroom education in order to prevent the rise of possible learning problems (Finnish National Board of Education, 2015). The target group for this level of support is the whole student population (Thuneberg et al., 2013a). General support can be organized by, for example, differentiated instruction, meaning that the teacher takes the students' diversity into account during instruction (Finnish National Board of Education, 2015). At this level of support shorter periods for tutoring outside the school day (i.e. remedial instruction) can be included and the support is most often provided by class or subject teachers.

If a student receiving general support continues to perform below expected levels, he or she is then provided *intensified support*, or the second tier of the three-tier support model (Finnish National Board of Education, 2015). Approximately 8% of the students in Finnish comprehensive education receive intensified support (Official Statistics of Finland, 2016). At this level of support, part-time special education in class (e.g. co-teaching) or outside the classroom (e.g. pull-out lessons) plays an important role (Björn, Aro & Koponen, 2015; Thuneberg et al., 2013b). The students' need of support should be evaluated regularly to be sure the support is efficient (Finnish National Board of Education, 2015).

Students who fail to respond to instruction during intensified support are evaluated (pedagogical statement), and an official decision concerning *special support* (tier three) is made by the school administrator (usually the principal) as necessary (Finnish National Board of Education, 2015; Thuneberg et al., 2013b). Students receiving special support should have an individual student plan and can study according to either a general or an individual curriculum in either general or special classes (Finnish National Board of Education, 2015).

In Finland, approximately 22% of all students receive (extra) educational support at some level (Official Statistics of Finland, 2016). In lower secondary education, mathematics is the subject in which the most students need extra support (Official Statistics of Finland, 2011). Furthermore, variations in students' mathematics performance tend to increase (Harju-Luukkainen & Nissinen, 2011; Metsämuuronen, 2013; Rautopuro, 2012). This means that mathematics teachers are more likely than other subject teachers to teach students who have been identified as low-performing and in need of extra educational support. Moreover, special education teachers working with lower secondary students deliver most of their instruction in mathematics (Takala, Pirttimaa, & Törmänen, 2009), meaning that, in addition to having knowledge in special education, they also need strong knowledge in how to support secondary students in mathematics.

1.2 Differentiated instruction

Differentiation can be defined as '… a systematic approach to planning curriculum and instruction for academically diverse learners' (Tomlinson & Strickland, 2005, p. 6). Teachers' ability to adjust educational work to respond to the varied needs of the student group is the basis for successful differentiated instruction (Kaonstantinou-Katzi et al., 2013). There are several elements of instruction that teachers can modify to support students in their learning process according to the students' readiness, interest and learning profile: content, process (i.e. methods of practice and performance), product (i.e. evaluation and assessment) and learning environment (Tomlinson & Strickland, 2005, UNESCO, 2004). Research has found that differentiated instruction has a positive impact on student learning and attitudes towards mathematics (Kaonstantinou-Katzi et al., 2013). Furthermore, students who receive instruction, are assigned tasks on a suitable personal level and, as a result, experience success are more likely to be motivated and to maintain their self-esteem (Tomlinson, 2008), which is important for students in need of support (Linnanmäki, 2002). Differentiated instruction requires teachers to have experience in different ways of teaching and learning, as well as strong knowledge of their students, including their backgrounds, experiences, interests and learning profiles (Kiley, 2011; Taylor, 2015; Tomlinson, 2008).

The National Council of Teachers of Mathematics (NCTM) (2000) has also recognized the need for differentiation, particularly in mathematics. Differentiated instruction is not a new idea; however, in the last decade, it has been more common among mathematics teachers. The teacher must be aware of what each individual student needs and plan instruction that takes different educational needs into account. To differentiate instruction in mathematics, a teacher may, for example, differ the learning tempo, the depth of the content and homework, the frequency of calculator and computer use, the time

allotted for tests or to solve word problems, the use of different manipulative tools or flexible student groupings (National Board of Education, 2011, 2015; Tomlinson & Strickland, 2005). Differentiating mathematics teaching has been found to be more challenging in middle and high school than in earlier grades (Maccini & Gagnon, 2006; Mageira, Smith, Zigmond & Gebauer, 2005). This is mostly due to deep-rooted differences in students' mathematical levels, which begin as far back as kindergarten or grade 1 and continue to pose challenges for teachers throughout all grades (Small & Lin, 2010).

1.3 Teacher characteristics

Teacher characteristics are features that vary among teachers. They include, for example, teacher knowledge, certification, experience, attitudes and beliefs (e.g., Blömeke & Delaney, 2012; Clotfelter, Ladd & Vigdor, 2007; Holzberger et al., 2013; OECD, 2009). Teacher characteristics have typically been studied in the context of their relations with teacher effectiveness (Anthony & Walshaw, 2009; Holzberger et al., 2013; Kai, Caiser, Perry & Wong, 2009) and student achievement (e.g. Baumert et al., 2010). Traditionally, teacher characteristics have been measured by characteristics that are easy to measure and control such as certification, experience and subject knowledge. However, more recent research has shown that many other characteristics such as self-beliefs, motivation and interest have an impact on student performance, but they are much harder to measure (Hattie, 2015; Bong & Skaalvik, 2003; Bursal, 2010; Gresham, 2008; Kim, Sihn & Mitchell, 2014; Swars, 2005; Woodcock & Reupert, 2016).

Teacher certification

Earlier research has reported that teachers' certification status may have a positive effect on students' mathematics learning at all educational levels (Clotfelter et al., 2007; Neild, Farley Ripple, & Byrnes, 2009). However, the percentage of certified teachers, especially in mathematics, is noted to be lower in the middle grades than in high school (Neild et al., 2009; Kumpulainen, 2014). There are different requirements for certification, such as the level of educational degree, which vary between countries (see e.g. Ingersoll, 2007; Sahlberg, 2011; Wang, Coleman, Coley, & Phelps, 2003).

Earlier studies have found that teachers who major in mathematics or are certified to teach high school-level mathematics seems to have a greater positive correlation with students' mathematical achievement in middle school than teachers with primary or middle school certifications (or other complementary certifications; Clotfelter et al., 2007; Neild et al., 2009; Hill, 2007). Bouck (2005) also found that a low percentage of special education teachers in secondary education had proper pre-service training for instruction at this educational level, despite being certified for secondary education.

In Finland, to be certified to teach mathematics in lower secondary education, a teacher must have a master's degree with at least 60 ECTS (European Credit Transfer and Accumulation System) in mathematics and education (including teaching practice), as well as a major (120 ETCS) in another subject (if not mathematics). Furthermore, for a certification in special education (K–12), a teacher must have a master's degree with at least 60 ECTS in Special Education (including teaching practice) and a major in another subject (if not Special Education). It takes approximately five years to earn a teacher certification.

Teacher experience in instruction

In this study, teacher experience is defined as a teacher's cumulative experience in instruction. Several studies have reported that teacher experience has a positive impact on student achievement (Bolyard & Moyer-Packenham, 2008; Clotfelter et al., 2007; Harris & Sass, 2011); however, the results are somewhat inconsequential. Studies have found evidence of strong positive development at the beginning of teachers' careers; however, this tends to level off after 5 to 10 years (Bolyard & Moyer-Packenham, 2008, Feng & Sass, 2013; Harris & Sass, 2011). In addition, 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). A study by Hill (2007) indicated that teachers with more experience in instruction performed better than novice teachers in mathematical teaching knowledge. Furthermore, middle school teachers who had experience teaching at the high school level reported having more mathematical teaching knowledge than teachers without such experience (Hill, 2007). Teachers' experience with diverse learners is also noted to have a positive effect on teachers' attitudes and beliefs (Subban & Sharma, 2005).

Self-efficacy

Self-efficacy has its origins in social cognitive theory, and it can be defined as a person's subjective perception of his or her capability to achieve a preferred outcome in a specific context (Bandura, 1977). Self-efficacy is formed through experiences and includes what individuals believe they can do with their existing skills, rather than the actual skills themselves (Bandura, 1977; Bong & Skaalvik, 2003). One's belief in one's own efficacy is developed through four main sources of influence: mastery experience, physiological factors, vicarious experiences and social persuasion (Bandura, 1994/1998). Of these factors, the most important contributing to an increase in self-efficacy is the experience of mastery: specifically, success increases self-efficacy, while failure decreases it. Bandura (1997) also found that self-efficacy is affected by processes and emotions that impact individuals' motivation and are skill-, task- and domain-specific. Furthermore, people with high beliefs in their capabilities usually approach difficult tasks as challenges to be mastered, rather than as threats to be avoided. Such an efficacious approach fosters deep interest and involvement in activities (Bandura, 1994/1998).

Teacher efficacy beliefs (i.e. teacher self-efficacy) are defined as teachers' beliefs and perceptions about their ability to teach students with varying needs and qualifications (Tschannen Moran, Woolfolk Hoy, & Hoy, 1998). They also include the teachers' beliefs about their ability to achieve desired student engagement and learning outcomes (Bandura, 1977, 1997; Skaalvik & Skaalvik, 2007). This means that teachers with high teacher efficacy beliefs trust his or her skills to instruct students with different needs, while teachers with low teacher efficacy beliefs are uncertain of his or her skills to teach students with varying needs. Earlier research has shown that teacher efficacy beliefs are connected to teachers' capability to organize and execute teaching tasks in specific contexts (Skaalvik & Skaalvik, 2007). Studies have also shown that teacher efficacy beliefs tend to vary between contexts and over time (Tschannen-Moran et al., 1998). Bandura (1997) reported that pre-service teachers and novice teachers establish their teacher efficacy beliefs at an early stage. He also indicated that, once established, teacher efficacy beliefs can be hard to change.

Teacher efficacy beliefs have been shown to be related to teaching strategies, instructions and motivation (Holzberger et al., 2013; Midgley, Feldlaufer, & Eccles, 1989; Thoonen et al., 2011) and to student achievement (Austin, 2013). Holzberger and colleagues (2013) reported that teachers with high efficacy beliefs tend to provide more student-centred instruction and invest more effort into implementing new teaching methods, strategies and personalised learning support. They also demonstrate greater flexibility in classroom engagement and lesson design (Temiz & Topeu, 2013). King-Sears and Baker (2014) indicated that teachers working with low-achieving students seem to benefit from having high self-beliefs, which help them maintain high levels of interest, motivation and beliefs in their own work.

Mathematics teaching efficacy can be defined as a teacher's belief in his or her ability to teach mathematics effectively (Enochs, Smith, & Huinker, 2000). Several studies have reported that mathematics teaching efficacy is a significant predictor of teachers' instructional strategies for mathematics and that teachers with high mathematics teaching efficacy are more effective in their teaching (Enochs et al., 2000; Gresham, 2008; Swars, 2005). Teachers' mathematics performance and mathematics self-efficacy have also been shown to be positively correlated with mathematics teaching efficacy (Bates, Latham & Kim, 2011; Newton, Evans, Leonard, & Eastburn, 2012; Swackhamer, Koeller, Basile, & Kimbrough, 2009). Furthermore, a teacher with high mathematics teaching efficacy is more likely to be deeply involved in student instruction and classroom engagement, as well as in the implementation of new teaching methods and strategies (Bates et al., 2011; Swackhamer et al., 2009; Takahashi, 2011; Temiz & Topeu, 2013).

1.4 Present study

Research on educational support in secondary mathematics is scarce. As a complement to the literature concerning factors affecting teacher differentiation in instruction, this study will focus on how teacher characteristics are related to the use of differentiation practices. The research questions are: How is teachers' use of differentiation practices in secondary education mathematics related to (1) teacher certification status, (2) teacher experience and (3) teacher efficacy beliefs.

2 Methods

2.1 Participants

The participants in this study were 42 mathematics teachers (21 women and 21 men) and 27 special education teachers (26 women and 1 man) working in Swedish-speaking lower secondary schools (students aged 13 to 15) in both rural and urban areas of Finland. Of the mathematics teachers, 71% were certified mathematics teachers and 74% had worked for five years or more. The mean age of the mathematics teachers was 43.3 years (age range: 25 to 63 years). Of the special education teachers, 72% were certified in special education, and 78% had worked for five years or more. The mean age of the special education teachers was 43.7 years (age range: 26 to 62 years).

2.2 Procedure and measure

This study was part of a research project targeting educational support for low-performing students in lower secondary mathematics education. An electronic questionnaire for special education teachers and mathematics teachers was sent to all of the principals of Swedish-speaking schools in Finland with education in grades 7 through 9 (N = 55). The principals were asked to forward the questionnaire to their schools' special education and mathematics teachers. Unfortunately, since it is impossible to know how many teachers actually received the questionnaire, response percentages could not be calculated.

The teachers' use of differentiated instruction was studied using a 5-point Likert-type scale (1 = *not at all* to 5 = *often*) for their frequency of use of nine differentiation practices: differentiation in content, use of calculators, manipulative tools, flexible examination models, part-time special education, homework support, complementary oral examinations, co-teaching and remedial education. The variables for the use of differentiation practices were one-item questions (see Table 2 in Appendix). The choice of differentiation practices for the questionnaire was based on suggestions for differentiation in educational support in the Finnish National Core Curriculum (National Board of Education, 2011, 2015).

There are several instruments for measuring teacher efficacy beliefs (e.g., The Teacher Sense of Efficacy Scale [Tschannen-Moran & Woolfolk Hoy, 2001] and Norwegian Teacher Self-Efficacy Scale [Skaalvik & Skaalvik, 2007]) but, since teacher efficacy is context- and situation-specific, and there is no such existing instrument in Swedish for the Finnish-Swedish population, a scale was constructed by author (and piloted on six teachers) for the particular purposes of this research project. The scale included eight items, for example 'I have enough knowledge about difficulties in mathematics and know what to do', addressing teacher efficacy beliefs, on which the teachers rated their perceived confidence in teaching low-performing students in mathematics. All items were answered on a 4-point Likert-type scale (1 = *strongly disagree* to 4 = *strongly agree*) and are shown in Table 2 (Appendix) (for more information about the scale, see Authors, 2017). The electronic questionnaire was sent to the schools in May 2013, and reminders were sent twice: once in June and once in August.

2.3 Data analysis

The data analyses were conducted in several stages. To measure teacher efficacy, earlier research with the used instrument has shown that a one-factor model (including five items, since a three of the items did not fit the model) of the teacher efficacy beliefs variable described the data best and gave an excellent model of fit ($x^2(5) = 5.45$, $p = .36$, CFI = 1.00, RMSEA = .04) (Authors, 2017). Furthermore, for the reliability confirmation Cronbach's alpha (five items) was calculated, and the result was acceptable (.82). The five items addressing teacher efficacy were recoded and summed to analyse of the teachers' efficacy beliefs levels. Correlations are shown in Table 2 (Appendix). A MANOVA was conducted to analyse the research questions and effect sizes, Cohen´s d, were calculated for the significant variables. The risk of committing a Type II error is elevated in studies with small sample size, thus, we decided to use a 90% level of significance to decrease the Type II error risk. This of course

increases the risk of Type I error in the study but given the sample size, is arguably an acceptable trade-off.

The teachers were first divided into three groups based on their total teacher efficacy beliefs scores. The cutoff point was above 80th and lower than 20th percentile. Accordingly, the low teacher efficacy group had 13 teachers, the moderate teacher efficacy group had 39 teachers, and high teacher efficacy group had 13 teachers, four teachers did not answer all the items for teacher efficacy beliefs. Of the 14 *non-certified* teachers, six (43%) were in the low teacher efficacy group, seven (50%) were in the moderate group and one (7%) was in the high group of teacher efficacy beliefs. Of the 51 *certified* teachers, 13% (7) were included in the low level group, 63% (32) were included in the moderate level group and 24% (12) were in the high level group (Figure 1). The distribution for *teacher experience* (< 10y and ≥10 y) was similar for teacher experience: approximately 20% (low), 60% (moderate) and 20% (high), respectively.

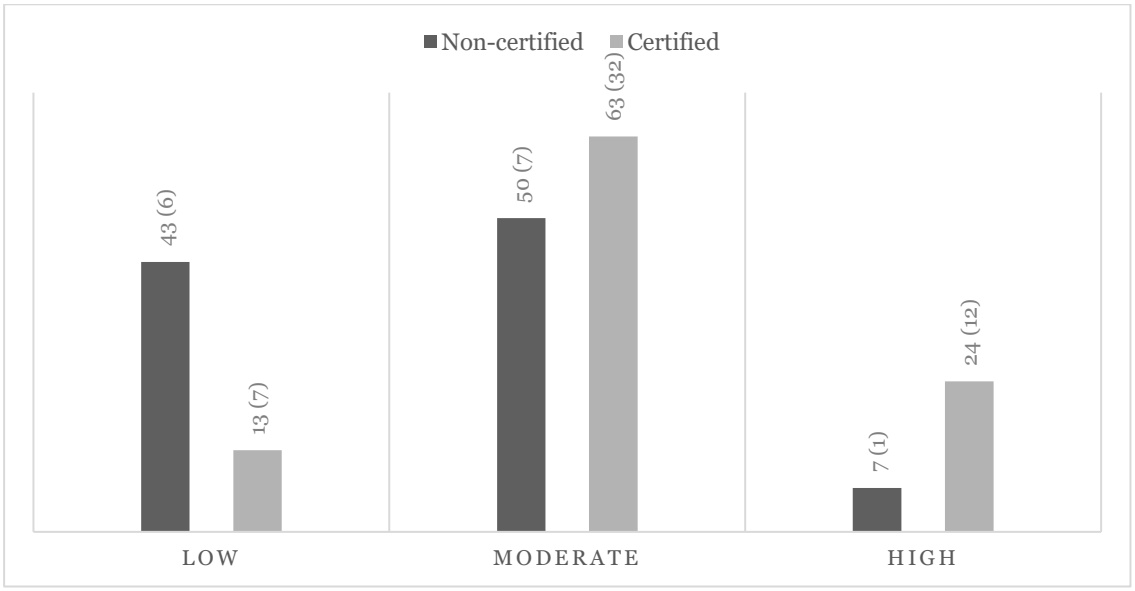

Figure 1. *Distribution (% and frequency) of certification status across different levels of teacher efficacy beliefs.*

3 Results

To analyse how teacher efficacy beliefs, certification status and teaching experience were related to the frequency of use of differentiation practices in mathematics, a MANOVA test was conducted. First, the three variables of teacher efficacy beliefs, experience and certification were tested separately. The preliminary results (Pillai's Trace) showed no significant (p >.1) differences for years of experience and certification status (p = .990 and p = .901) on differentiation practices. However, the p-value for teacher efficacy beliefs was .100 (η^2 = .214), and the between-subject test showed significant differences between teacher efficacy beliefs groups for three of the differentiation practices: *differentiation in content* (F(2,61) = 5.681, p = .006, η^2 = .166), *flexible examination models* (F(2, 61) = 2.461, p = .094,

$\eta^2 = .079$) and *co-teaching* ($F(2, 61) = 4.543$, $p = .015$, $\eta^2 = .137$). The results for all other variables were non-significant: use of calculators ($p = .334$), part-time special education ($p = .490$), homework support ($p = .156$), complementary oral examinations ($p = .431$) and remedial education ($p = .848$). Means for the three groups of teacher efficacy beliefs for the nine differentiation practices are shown in Figure 2.

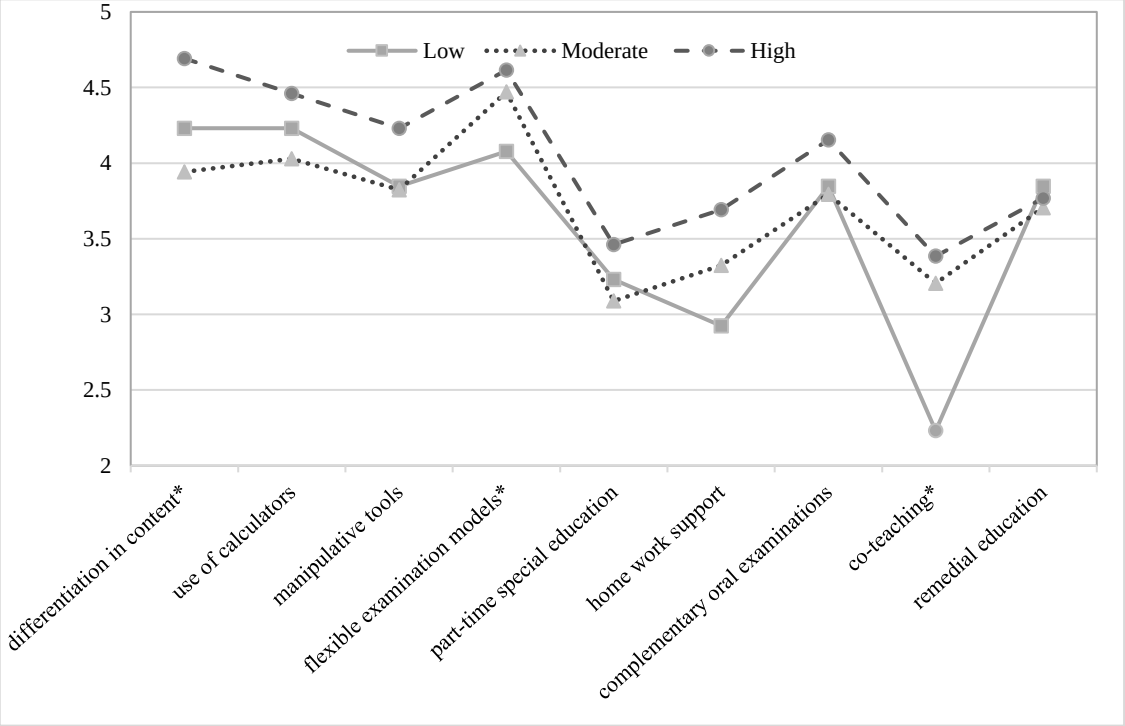

Figure 2. *Frequency of use (1 = not at all* to *5 = often) of differentiation practices for levels of teacher efficacy beliefs (low, moderate and high). Significant differences (*) were noted for differentiation in content, manipulative tools, and co-teaching*

To examine how the different groups of teacher efficacy beliefs differed for the significant variables, a post-hoc test was conducted. For differentiation in content there was a significant difference between the high and the other two (moderate and low) groups of teacher efficacy beliefs ($p_{\text{low-high}} = .093$, $d = .748$ and $p_{\text{moderate-high}} = .001$, $d = 1.207$). The results for flexible examination models showed that the high and moderate groups of teacher efficacy had a significant more frequent use than the teachers in the low teacher efficacy group ($p_{\text{low-high}} = .041$, $d = .835$ and $p_{\text{low-moderate}} = .071$, $d = .553$). The results also indicated that teachers with low teacher efficacy beliefs used co-teaching significantly less than teachers with high ($p_{\text{low-high}} = .010$, $d = .978$) and moderate ($p_{\text{low-moderate}} = .009$, $d = .951$) teacher efficacy beliefs. Means and standard deviations for all differentiation practices are shown in Table 1 (Appendix).

4 Discussion

This study examined how teacher efficacy beliefs (low, moderate and high), certification status (certified or non-certified) and teaching experience (years of teaching) are related to the frequency of use of educational differentiation practices in lower secondary mathematics instruction. The results indicated that teachers with high teacher efficacy beliefs for teaching mathematics to low-performing students are statistically significantly more likely to use differentiation in content, flexible examination models, and co-teaching than teachers with low teacher efficacy beliefs. With respect to teacher experience and certification, no notable significant differences between years of experience and certification status on groups of teacher efficacy beliefs were found. However, nearly half of the non-certified teachers belonged to the group with low teacher efficacy beliefs, while only 13% of the certified teachers belonged to this group. About 20% of the teachers had high teacher efficacy beliefs, approximately 60% had moderate and approximately 20% had low teacher efficacy beliefs, no matter of years of experience.

Earlier research has reported that teacher characteristics are related to, for example, teaching practices and student achievement (Anthony & Walshaw, 2009; Austin, 2013; Holzberger et al., 2013; Kai, Caiser, Perry & Wong, 2009; OECD, 2009). In this study, teachers with high teacher's efficacy beliefs was found to more frequency use differentiation in content, flexible examination models, and co-teaching. These findings are in line with earlier research which indicated that teachers with high teacher efficacy beliefs invest more effort into implementing new teaching methods, strategies and personalised learning support (Holzberger et al., 2013), while also demonstrating greater flexibility in classroom engagement and lesson design (Temiz & Topeu, 2013), all of which are important for effective differentiation (Tomlinson & Strickland, 2005). Furthermore, it has been reported that teachers with high teacher efficacy beliefs are more capable of organizing and executing teaching tasks for specific contexts (Skaalvik & Skaalvik, 2007).

Teachers with high teacher efficacy beliefs were significantly more frequently using differentiation in content and flexible examination models than teachers with moderate and low teachers' efficacy beliefs, while teachers with low teacher efficacy beliefs reported significant lower use of co-teaching than both teachers with moderate or high teacher efficacy beliefs. Since co-teaching is considered to be an effective model for support in secondary mathematics (Friend, 2008; Mageira et al., 2005) this result is pertinent to the development of teacher efficacy beliefs. Earlier research has also found that teacher efficacy beliefs is a significant predictor of teachers' instructional strategies for mathematics (Bates et al., 2011; Swackhamer et al., 2009; Takahashi, 2011; Temiz & Topeu, 2013), and since teachers with high mathematics teaching efficacy are found to be more effective in their teaching (Enochs et al., 2000; Gresham, 2008; Swars, 2005), it seems clear that teacher efficacy beliefs are important for achieving successful differentiated instruction in mathematics. Since teaching efficacy is reported to be context and subject specific and developed in an early stage (Bandura, 1997) the foundation for high mathematics teacher efficacy beliefs must start already during teacher education.

A highly qualified teacher has full certifications and demonstrates competence in both subject knowledge and teaching skills, use a wide range of learning strategies and understand how students can learn mathematics (U.S. Department of Education, 2002). Teacher certification has earlier been noted to impact both teaching strategies and instruction practices in mathematics (Feng & Sass, 2013; National Research Council, 2000). In this study, certification was not related to any of the differentiation practices. However, it is worth noting that almost half the non-certified teachers belonged to the group of low teacher efficacy beliefs, which was found to be related to differentiated instruction, and that the overall number of non-certified teachers was low.

In this study, a majority of the teachers had worked more than five years. The results from present study indicated that teacher experience was not statistically significantly related to the use of differentiation practices. Foss and Kleinsasser (1997) indicated that due to a lack of teaching experience, inexperienced teachers (e.g., pre-service teachers) tend to overestimate their teacher efficacy beliefs for teaching low-performing students, which can partly be reason for the non-significant results.

For six of the nine differentiation practices (use of calculators, use of manipulative tools, part-time special education, complementary oral examinations, homework support, and remedial education), no significant relation was found between groups of teacher efficacy and the use of differentiation practices. One reason for this lack of a significant relation may be the high number of students provided educational support in Finnish schools (Official Statistics of Finland, 2016). According to Official Statistics of Finland (2016), in 2015, nearly 23% of the students in compulsory education were provided general, intensified or special support, and approximately 80% (in Swedish-speaking schools) of the students receiving special support (full-time special education) were, at some point, included in the general classroom. As a result, it is likely that Finnish teachers, especially in Swedish speaking schools, have relatively high levels of experience with instructional differentiation and are able to effectively use the most traditional differentiation practices common in lower secondary mathematics. It is also worth noting that several of those differentiation practices with no statistically significant relation (e.g., part-time special education, complementary oral examinations, homework support, and remedial education) are related to the differentiation of product (i.e. evaluation and assessment) and learning environment, which may be are easily implemented by all teachers. Most of the differentiation practices analysed in this study with significant differences for level of teacher efficacy beliefs (differentiation in content, flexible examination models and co-teaching) all require both high subject knowledge in mathematics and confidence and interest in teaching low-performing students, both of which have been shown to impact teacher efficacy beliefs (Clotfelter et al., 2007; Holzberger et al., 2013; Kleinsasser, 2014).

4.1 Limitations

This study has some limitations. First, the number of participants is low. With more participants, the statistical results would have been stronger, and some of the differences that were close to significant

(e.g., certification status, homework support, and manipulative tools) may have been significant. The study validation could also have been improved using a standardized scale for teacher efficacy beliefs. Furthermore, it would have been useful to include more items on differentiated instruction practices and *how* teachers differentiate in practice (e.g. content). For self-reported data, there are two issues that must be considered according to the validity. First, the cognitive factor (weather the respondents understand the questions and weather they have the knowledge to answer it) and second, the situational factor (the influence of the setting of the survey) (Brener, Bill & Grady, 2003). In this study both the cognitive (this study was part of a larger project concerning educational support in mathematics, so the meaning of the questions for the respondents was clear) and the situational (the respondents could answer anonymously when they had time). However, it is important to take into account that answering this questionnaire was voluntary, and therefore it is difficult to get a sample of participants representing a whole teacher group (Wright, 2005)

4.2 Conclusions

Instructional differentiation is an important part of educational support in secondary mathematics, especially for low-performing students in general education (Finnish National Board of Education, 2011, 2015; NCTM, 2000). This study examined how teacher efficacy beliefs, teacher experience and teacher certification affect the use of differentiation practices in mathematics instruction. The results indicated that teacher efficacy beliefs are important for several differentiation practices, especially those that focus on content and process, for example co-teaching which was found to be used significantly more frequently by both moderate and high teacher efficacy groups than by the low teacher efficacy group. Since teacher efficacy beliefs are established at an early stage of teacher education (Bandura, 1997), the foundation for teacher efficacy beliefs must also begin during teacher education. Thus, it is important to examine how teacher education can support pre-service teachers in developing high teacher efficacy beliefs for teaching mathematics to low-performing students. This concerns both special and mathematics pre-service teachers. Teacher education should also focus on how to support in-service teachers in both special education and mathematics to strengthen their teacher efficacy beliefs for teaching low-performing students in mathematics. This could be realized by introducing and implementing collaboration between different pre-teacher groups (e.g., mathematics and special education pre-teachers), learning how to use teachers specialized (subject and pedagogical) knowledge in a fruitful way for developing the most efficient educational support models and practices.

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APPENDIX. Questionnaires.

Table 1. Items, mean and standard deviation for the different groups´ use of differentiation practices (1 = not at all to 5 = often); low, moderate and high teacher efficacy beliefs.

		M (SD)	
	Low	**Moderate**	**High**
Differentiation in content	4.23 (0.72)	3.94 (0.74)	4.69 (0.48)
Use of calculators	4.23 (0.73)	4.02 (1.03)	4.46 (0.66)
Manipulative tools	3.84 (0.55)	3.82 (0.83)	4.23(0.93)
Flexible examination models	4.08 (0.76)	4.47 (0.66)	4.61(0.51)
Part-time special education	3.23 (0.83)	3.09 (0.83)	3.46 (1.05)
Homework support	2.92 (1.04)	3.32 (1.04)	3.69 (0.85)
Complementary oral examinations	3.85 (0.80)	3.79 (0.94)	4.15 (0.99)
Co-teaching	2.23 (1.01)	3.21 (1.04)	3.39 (1.33)
Remedial education	3.85 (0.69)	3.71 (0.76)	3.77 (0.83)

Table 2. Items (translated from Swedish), correlation, mean and standard deviation for the teacher efficacy scale.

	1	2	3	4	5	6	7	8
1. I have enough knowledge about difficulties in mathematics and know what to do.	1.000							
2. I have a feeling of hopelessness.	**-.466**	1.000						
3. I often ask for advice.	-.247	.151	1.000					
4. It is challenging, but I manage well.	-.002	.023	.031	1.000				
5. I seldom teach low-achieving students myself; the mathematics/special education teacher takes care of them.	**-.404**	**.448**	.141	.0138	1.000			
6. I feel doubtful, but with help I manage.	**-.601**	**.488**	.197	-.125	**.571**	1.000		
7. I get too little help from colleagues (extra resources).	-.113	.080	.084	.299	.008	.135	1.000	
8. I need more knowledge about difficulties in mathematics.	**-.520**	**.458**	.144	.064	**.324**	**.582**	.206	1.000
M	3.07	1.82	2.60	2.81	1.97	1.95	2.40	2.31
SD	0.58	0.67	0.63	0.58	0.88	0.80	0.79	0.82

The total scores from items 1,2,5,6 and 8 were included in the teacher efficacy beliefs variable.