



Tuula Koljonen

**Finnish mathematics curriculum
materials and teachers'
interaction with them in two
cultural-educational contexts**



Tuula Koljonen

Previous studies and degrees:

Bachelor of Education for compulsory school, year 4-9, Mathematics and natural science subjects, Lärarhögskolan Stockholm, applied for degree in 2005

Master of Science in special needs education, Mälardalens högskola, applied for degree in 2012

Postgraduate diploma in special educational needs, Mälardalens högskola, 2012

Licentiate in didactics of mathematics, Mälardalens högskola, 2014



Finnish mathematics curriculum
materials and teachers'
interaction with them in two
cultural-educational contexts

Tuula Koljonen

Pedagogy

Faculty of Education and Welfare Studies
Åbo Akademi University
Vasa, Finland, 2020

ISBN 978-952-12-4001-0 (printed)

ISBN 978-952-12-4002-7 (digital)

Painosalama Oy, Turku, Finland 2020

Abstract

Previous research has shown that teachers are central actors in teaching, but the great importance of the use of curriculum materials for teachers has also been highlighted. However, much of the research on curriculum materials and their role in teaching and learning has been conducted in the United States, and only a few studies have been conducted in Europe, including the Nordic countries. Further, there are relatively few cross-cultural studies in relation to curriculum materials available. Studies investigating curriculum materials, developed in a cultural context other than where they are used, are especially rare. This thesis is an attempt to fill that gap. The present study aims at contributing to knowledge about Finnish curriculum materials in mathematics, and teachers' interaction with them in two different cultural-educational contexts: the Finnish context, in which the curriculum materials are developed, and in a new context, the Swedish, into which the materials are adopted. I thus examine the most commonly used Finnish teacher guides in mathematics (Grades 1–6), and how four Finnish and four Swedish teachers interact with originally Finnish curriculum materials. This study is positioned within the qualitative interpretative research paradigm with a socio-cultural perspective, where the interaction between a teacher and curriculum materials is central.

The thesis is a continuation of my licentiate essay and consists of five papers, of which the first three are document analyses and the last two are case studies. The first part of the thesis examines the characteristics of Finnish curriculum materials in mathematics through content analyses. The results reveal great similarities between the Finnish teacher guides regarding content, form, and nature of communication. The results further display three norms embedded in the teacher guides' potentially constructed mathematics lessons, which jointly reflect mathematics teaching as a whole-class activity. Previous research has shown that these norms are clearly visible in the Finnish education context. Taken together, the studies about curriculum materials indicate cultural traces in the text of Finnish curriculum materials that seems to follow a cultural script. These scripts reflect the underlying Finnish cultural traditions and educational priorities, regarding both the uniformity of the content and the underlying views about teaching and learning.

The second part of the thesis consists of case studies exploring Finnish and Swedish teachers' interaction with curriculum materials originated from Finland. The results reveal very different approaches when it comes to planning of mathematics lessons, where the Finnish teachers plan for the whole lessons while the Swedish teachers plan for a short introductory lecture, 'genomgång'. The results further display significant differences in what Finnish and Swedish teachers choose to use from the teacher guides, and how they organise and structure mathematics lessons. These case studies indicate very different norms regarding both planning and

enactment of mathematics lessons, and thereby different interactions with the curriculum materials. The Finnish teachers' interaction reflects cultural norms and routines aligned with both the Finnish curriculum materials and common educational practise. The Swedish teachers' interaction, on the other hand, reflects the classroom routines and norms aligned with the Swedish educational practise, and not the norms found in the Finnish curriculum materials.

It is reasonable to consider it possible and even fruitful to implement Finnish curriculum materials in the Swedish context, since the environment and the educational cultures seem to be rather similar. However, this study has shown that it is not that straight forward and that there are obstacles. To import curriculum materials from other cultural-educational contexts, in order to create new routines and norms, require profound and thoughtful adjustments in relation to the new context, and, in addition to adjustments of the curriculum materials, also professional development in how to use and adapt the material. The thesis contributes to the international research discourse on mathematics curriculum materials and teachers' use of them. Furthermore, the results are relevant to publishing houses and authors, school heads and teachers, as well as teacher educators.

Keywords: cross-cultural studies, elementary schoolteachers' interaction with curriculum materials, Finland and Sweden, mathematics education

Abstrakt

Tidigare forskning har visat att lärare är centrala aktörer i undervisning men också läromedlens stora betydelse för undervisningen och lärande har lyfts fram. Dock har mycket av forskningen kring läromedel och dess betydelse för undervisning och lärande gjorts i USA och endast ett fåtal studier har genomförts i Europa och Norden. Det finns dessutom väldigt få tvärkulturella läromedelsstudier, speciellt sådana som undersöker hur ett läromedel används i ett annat kulturellt sammanhang än där det har skapats. Denna avhandling är ett försök att fylla det tomrummet. Föreliggande studie syftar således till att bidra till kunskap om finska läromedel i matematik och lärarnas interaktion med ett ursprungligen finskt läromedel i två skilda kultur-pedagogiska sammanhang: det finska sammanhanget där läromedlet har utvecklats, och i ett nytt sammanhang, det svenska där det finska materialet har tagits i bruk. Jag undersöker därmed de mest använda finska lärarhandledningarna i matematik (klass 1–6) och hur fyra finska och fyra svenska lärare interagerar med dem. I sin helhet återfinns studien inom det kvalitativa tolkande forskningsparadigmet och dess teoretiska hemvist är det sociokulturella perspektivet där interaktionen mellan en lärare och läromedel är central.

Avhandlingen är en fortsättning på min licentiatuppsats och består av fem artiklar, varav de tre första är dokumentanalyser och de två senare är

fallstudier. Den första delen av avhandlingen undersöker, genom olika typer av innehållsanalyser, egenskaper hos finska läromedel i matematik. Resultaten avslöjar stora likheter mellan de finska lärarhandledningarna i matematik vad gäller dess innehåll, form och typ av kommunikation. Resultaten visar vidare att det finns tre normer dolda i lärarhandledningarnas konstruerade matematiklektioner, vilka tillsammans återspeglar matematikundervisning som en helklassaktivitet. Tidigare forskning har dessutom visat att dessa normer även är tydligt synliga i den finska pedagogiska kontexten. Sammantaget indikerar läromedelsstudierna vissa kulturella spår i texten som finns i de finska läromedlen vilka verkar följa ett kulturellt manus. Detta manus återspeglar de underliggande finska kulturella traditionerna och utbildningsprioriteringarna, både vad gäller innehållets enhetlighet och de bakomliggande åsikterna om undervisning och lärande.

Den andra delen av avhandlingen utforskar genom fallstudier finländska och svenska lärares interaktion med läromedel som härstammar från Finland. Resultaten avslöjar mycket olika tillvägagångssätt vad gäller planering av matematiklektioner, där de finska lärarna planerar för hela lektioner medan de svenska lärarna planerar för en kort föreläsning, genomgång. Resultaten visar vidare även betydande skillnader på vad finska och svenska lärare väljer att använda från lärarhandledningarna och hur de organiserar och strukturerar sina matematiklektioner. Dessa fallstudier indikerar väldigt olika normer beträffande planering och genomförande av matematikundervisning och därmed också olika interaktion med läromedlet. De finska lärarnas interaktion återspeglar således kulturella normer och rutiner som är i linje med både det finska läromedlet och dess utbildningspraxis. Medan de svenska lärarnas interaktion återspeglar de klassrumsrutiner och normer som är i linje med den svenska utbildningspraxisen, och inte med de normer som återfinns i de finska läromedlen.

Det är rimligt att överväga att det kan vara möjligt eller till och med givande att använda ett finskt läromedel i det svenska sammanhanget, eftersom både miljöerna och utbildningskulturerna tycks vara ganska lika. Emellertid har denna studie visat att det inte är så uppenbart och att det finns vissa hinder. Att importera läromedel från andra utbildningskulturella sammanhang för att skapa nya rutiner och normer kräver djupgående och eftertänksamma justeringar i förhållande till det nya sammanhanget; förutom justeringar av läromedlet i sig krävs också kompetensutveckling i hur man använder och modifierar materialet. Avhandlingen bidrar till det internationella forskningsfältet om läromedel i matematik och lärarnas användning av dem. Den har också relevans för läromedelsförlag och författare, skolhuvudmän och lärare samt lärarutbildare.

Nyckelord: Finland och Sverige, grundskolelärares interaktion med läromedel, matematikundervisning, tvärkulturella studier

To my children and grandchildren

Kate Callahan, BAU agent in Criminal Minds:

“Life is about choices. Some we regret, some we’re proud of
[some will haunt us forever]. We are what we choose to be”

Graham Brown

Acknowledgement

This thesis has reached the end of a long journey, edged by a number of pauses, detours and dead ends. It has been enriching in many ways, but it has not always been easy or joyful.

I wish to express my sincere appreciation to my supervisor Professor Kirsti Löfwall Hemmi and, my additional supervisors, Hendrik van Steenbrugge, and Docent Ann-Sofi Røj-Lindberg. The three of you, have convincingly guided, and encouraged me through my work with this thesis, however differently through your varying personalities and expertise. Kirsti, one of the most knowledgeable in this field oversaw the work and helped me to keep the focus on the essentials. I am not forgetting both your and Clas' hospitality in opening your home for me in Finland, and the same goes for Ann-Sofi and her husband Anders. Ann-Sofi who accepted, at the end of my doctoral studies to supervise me. You did it with fresh eyes and guided me more firmly in the craft of writing. Hendrik, your eye for accuracy and details helped me to include important facts, that otherwise would have been missing. You have also helped me to believe that I actually have important research to share within the community of mathematics education. Heidi Krzywacki, with fruitful conversations you pushed me forward many times even if you were not my supervisor. I really appreciate your commitment. Thank you all four for all your support and collaborations, I am really grateful!

I also want to thank my former supervisor Professor Andreas Ryve and second supervisor Professor Paul Andrews; you too have had a meaningful impact on this work. Andreas guided me in the writing of research papers and Paul carefully guided me regarding the methodology. This thesis would not have been possible without the financial support I have benefited over the years. I therefore express my honest thanks to the graduate school Developing Mathematics Educations (DME), Mälardalen University, as well as Åbo Akademi.

My research journey started when I entered the graduate school for teachers in mathematics education (DME) in 2012, I also became part of a research group, M-TERM, at Mälardalens högskola and became interested in the role of curriculum materials, which is both an interesting and important area. I have also had the pleasure of being a part of the Nordic Network for research on mathematics textbooks (Project 45321, NORDFORSK), which has allowed me to collaborate with Nordic colleagues.

Linda Ahl and Ola Helenius, thanks for all the encouraging pep talks and guidance throughout the years, especially during the more cumbersome periods. You offered me not just valuable support but also collaborations when writing an article. I would also like to thank my PhD fellow Anna-Lena Andersson, together we struggled with the same kind of matters at the same time.

I thank my readers, Professor emeritus Barbro Grevholm and Docent Anu Laine for your valuable input on my manuscript. I also feel honoured to have had Barbro Grevholm as my opponent. I also thank Ulla-Britt Persson for proofreading the thesis.

Finally, yet most importantly, I want to thank Patrik Nyberg, my partner at home for always supporting and encouraging me in various ways, throughout all the years with this thesis work.

With gratitude and humility,

Tuula Koljonen,

Kungsör, June 2020

Table of contents

Abstract

Abstrakt

Acknowledgement

List of papers

List of figures and tables

1. Introduction	13
1.1 <i>Aim and research questions</i>	15
1.2 <i>Overview of the thesis</i>	16
2. Theoretical background and prior research	19
2.1 <i>Theoretical stances</i>	19
2.1.1 <i>The concept of curriculum materials and curriculum</i>	20
2.1.2 <i>Teacher-curriculum interaction</i>	21
2.2 <i>Characterisation of curriculum materials</i>	24
2.2.1 <i>Curriculum materials with focus on different design features</i>	24
2.2.2 <i>Curriculum materials embedded in culture and values</i>	26
2.2.3 <i>Curriculum materials as potential resource</i>	28
2.3 <i>Teacher-curriculum interaction and classroom practises</i>	29
3. Methodology	33
3.1 <i>Research design</i>	33
3.2 <i>The Finnish and Swedish educational contexts</i>	34
3.3 <i>The selection and analyses of the teacher guides</i>	36
3.4 <i>Case studies - teachers' interaction with Finnish materials</i>	37
3.4.1 <i>The cases</i>	38
3.4.2 <i>Data sources and analysis</i>	39
3.5 <i>Ethical consideration and trustworthiness</i>	41
4. Summary of the Papers	47
4.1 <i>Paper I</i>	47
4.2 <i>Paper II</i>	48
4.3 <i>Paper III</i>	50
4.4 <i>Paper IV</i>	52
4.5 <i>Paper V</i>	53
5. Discussion	55
5.1 <i>Main findings</i>	55
5.2 <i>Contributions</i>	59
5.3 <i>Limitations</i>	60
5.4 <i>Suggestions for future research</i>	61
References	63
Appendices	77
Papers I-V	83

List of papers

The thesis is based on the following papers, referred to in the text by their Roman numerals.

- I. Hemmi, K., Koljonen, T., Hoelgaard, L., Ahl, L., & Ryve, A. (2013a). Analyzing mathematics curriculum materials in Sweden and Finland: Developing an analytical tool. In B. Ubuz, Ç. Haser & M.A. Mariotti. (Eds.), *Proceedings of the Eighth Congress of the European Society for Research in Mathematics Education, CERME 8* (pp. 1875–1884). Middle East Technical University, Ankara.
http://cerme8.metu.edu.tr/wgpapers/WG11/WG11_Koljonen.pdf
- II. Hemmi, K., Krzywacki, H., & Koljonen, T. (2017). Investigating Finnish teacher guides as a resource for mathematics teaching. *Scandinavian Journal of Educational Research*.
<https://doi.org/10.1080/00313831.2017.1307278>
- III. Koljonen, T., Ryve, A., & Hemmi, K. (2018). Analysing the nature of potentially constructed mathematics classroom in Finnish teacher guides – The case of Finland. *Research in Mathematics Education*.
<https://doi.org/10.1080/14794802.2018.1542338>
- IV. Koljonen, T. (2017). Finnish teaching materials in the hands of a Swedish teacher: The telling case of Cecilia. In T. Dooley & G. Gueudet (Eds.), *Proceedings of the Tenth Congress of the European Society for Research in Mathematics Education, CERME 10* (pp. 1626–1633). Dublin, Ireland: DCU Institute of Education & ERME.
<https://hal.archives-ouvertes.fr/hal-01938185>
- V. Koljonen, T. (2019). Finnish and Swedish elementary school teachers' interplay with Finnish curriculum resources: An attempt at unraveling tacit cultural practices. In S. Rezat, L. Fan., M. Hattermann, J. Schumacher, & H. Wuschke (Eds.), *Proceedings of the Third International Conference on Mathematics Textbook Research and Development, ICMT 3* (pp. 61–66). Germany: Paderborn.
[doi:10.17619/UNIPB/1-768](https://doi.org/10.17619/UNIPB/1-768)

Kirsti Hemmi and I are the lead authors of the first paper, Paper I. Paper II is drawn on my licentiate thesis, and I am the third author of this paper. I am the lead author of Paper III and it is based on a profound analysis of teacher guides, conducted by me.

Reprints were made with permission from the respective publishers and co-authors.

List of figures and tables

Figure 1. *The overall structure of addressing the research questions.*

Figure 2. *The model of teacher-curriculum relationship*

Table 1. *An overview of data sources connected to each of the individual studies and research questions.*

Table 2. *Background of Finnish participating teachers by 2015/2016 (year)*

Table 3. *Background of Swedish participating teachers by 2015/2016 (year)*

1. Introduction

Curriculum materials, such as textbooks and teacher guides, are widely used in mathematics classrooms around the world and often viewed to promote educational reform (Pepin & Haggarty, 2001; Stein & Kaufman, 2010). They stand as mediators between the official curriculum and the emerged classroom practises (Pepin, Gueudet & Trouche, 2013a; Valverde, Bianchi, Wolfe, Schmidt & Houang, 2002). There is a growing body of research in mathematics education studying teachers' conceptions and use of curriculum materials in different contexts (e.g., Pehkonen, Piht, Pakkas, Laine & Krzywacki, 2017b; Remillard, 2005; Remillard, Herbel-Eisenmann, & Lloyd, 2009; Pepin, Gueudet & Trouche, 2013b). However, contextual issues are often under-emphasised in research on curriculum materials, even though we know that the context plays an influential role in teachers' use of curriculum materials (Lloyd et al., 2009). It is therefore rather hard to reveal patterns across different contexts (Herbel-Eisenmann, Lubienski, & Id-Deen, 2006).

We know that although teachers are central actors and should not be overlooked, curriculum materials also matter (Lloyd, Remillard & Herbel-Eisenmann, 2009; Stein, Remillard & Smith, 2007; Tarr, R.E, Reys, B.J., Reys, Chávez, Shih & Osterlind, 2008). Several studies show that, depending on the character of the materials and how teachers relate and interact with them, the curriculum materials may facilitate as well as constrain teachers' actions in mathematics classrooms (e.g., Brown, 2009; Nicole & Crespo, 2006; Remillard, Harris & Agodini, 2014). Studies have, further, shown clear links between the design of curriculum materials and their influence on teaching and learning (Charalambous, Delaney, Hsu & Mesa, 2010; Hill & Charalambous, 2012; Jablonka & Johansson, 2010; Stein & Kaufman, 2010; Stein et al., 2007). It is therefore important to study curriculum materials and teachers' interaction with materials, since they are both influencing classroom practises and students' learning opportunities (e.g. Ball & Cohen, 1996; Nicol & Crespo, 2006; Stein et al., 2007).

The present study aims at contributing to knowledge about curriculum materials and teachers' interaction with curriculum materials in two cultural-educational contexts. Here, interaction is used in a wide sense. Besides teachers' views and beliefs about curriculum materials in general, interaction also includes what teachers choose or do not choose to use and how their choices are related to their classroom practises (cf. Remillard & Heck, 2014). In other words, I take into account both the use of curriculum materials (what, how, why), and emerged classroom practises when inferring how teachers interact with curriculum materials. To explore the characteristics of curriculum materials and teachers' interaction with them is neither new nor uncommon (e.g., Fan, Trouche, Qi, Rezat & Vinovska, 2018; Pepin et al., 2013b; Remillard 2005; Trouche, Gitirana, Miyakawa, Pepin & Wang, 2019). Fan, Zhu, and Miao (2013), for instance, exposed that

textbook research in mathematics relate foremost to two major areas of research: textbook analysis and comparisons (63 %). Other research areas are covering a smaller number of studies, such as, textbook use (12 %) and other areas (12 %). However, little is known about how curriculum traditions and norms from one cultural context are imported to another cultural context. My aim with this study is therefore to address this gap in research by studying teachers' use of curriculum materials in two different Nordic settings, more specifically in the Finnish and Swedish contexts.

In this work, I adopt a socio-cultural perspective. The interaction between a teacher and curriculum materials takes place in two specific cultural-educational contexts, which both are shaped by historical, social, and cultural factors (Brown, 2009; Remillard, 2005). I examine the most commonly used Finnish teacher guides in mathematics (Grades 1-6) and how teachers interact with them, in two different cultural contexts: the Finnish context, where they are developed, and the Swedish context, into which they are adopted. The setting in the present study is unique because of the focus on both the character of Finnish curriculum materials in mathematics, and on Finnish and Swedish teachers' interaction with curriculum materials that originate from Finland.

There are several reasons why teachers' interaction with curriculum materials across the Swedish and Finnish contexts provide a fruitful setting. Firstly, Finland and Sweden are neighbouring countries with many similarities in school systems (see section 3.2) but different results in international evaluations (e.g., Eklöf, 2007; OECD, 2013, 2019; Skolverket, 2013, 2015, 2019). There has been considerable interest in finding explanations for the differences in students' results between Finland and the other Nordic countries (e.g., Andrews, Ryve, Hemmi & Sayers, 2014; Pehkonen, Ahtee & Lavonen, 2007). However, little focus has been laid on mathematics classroom practises and even less focus has been placed on the characteristics of the Finnish curriculum materials in mathematics.

Secondly, Finnish and Swedish teachers traditionally use curriculum materials in different ways. Curriculum materials play an important role in planning and classroom practises in both countries. Swedish teachers mainly use students' textbooks to plan teaching (Hemmi, Krzywacki & Liljekvist, 2019b; Johansson, 2011), while Finnish teachers use teacher guides to plan and conduct lessons (Joutsenlahti & Vainionpää, 2010). In Finland, in contrast to Sweden, there has been a tradition of producing curriculum materials, including teacher guides, in collaboration between teachers, teacher educators and other experts such as, researchers, since the 1980s (Halinen, 2005; Niemi, 2012).

We know from international research that textbooks are a major resource for teachers' planning and practise and that research on textbooks is a popular approach in the field of mathematics education research (e.g., Fan et al., 2013). The Swedish Research Council has shown that 66 percent of the research on curriculum materials in mathematics education are

mostly conducted in the US and only 11 percent are exclusively related to another context than the US (Vetenskapsrådet, 2015). There has also been a movement from research on textbooks, towards research on teacher guides. This research is still scarce and, as Grevholm (2011) points out, there is a need for research on the characteristics of Nordic teacher guides since little is known about them, their quality and how they are used.

Thirdly, there is research indicating that classroom practises in Finland, including aspects such as structure, norms, and management, differ a lot from the Swedish (e.g., Hemmi & Krzywacki, 2014; Hemmi et al., 2019b; Hemmi & Ryve, 2015a, 2015b). There is, moreover, a growing interest in applying Finnish curriculum materials in other countries, such as Sweden and Italy. However, only a relatively small number of cross-cultural curriculum studies exist (e.g., Roth McDuffie & Mather, 2006), and even more limited is the number of studies that look at how a specific curriculum material is used in multiple contexts (e.g., Hemmi & Krzywacki, 2014; Hemmi et al., 2019b; Hemmi & Ryve, 2015a, 2015b). The use of curriculum materials produced in another cultural-educational context is therefore relatively unexplored. Thus, very few studies have investigated how teachers in one country interact with curriculum materials created in another country, and how this interaction influences classroom practises.

1.1 Aim and research questions

The overall aim of this thesis is to contribute to research by deepening our knowledge of the characteristics of curriculum materials (Grade 1-6) and teachers' interaction with them in two cultural-educational contexts. The thesis answers the following research questions (RQ)

- RQ1** What kind of support do the Finnish teacher guides offer teachers in mathematics education?
- RQ2** What underlying cultural norms can be distinguished in the Finnish teacher guides in mathematics?
- RQ3** How do Finnish and Swedish teachers interact with the Finnish teacher guides?

The thesis is comprised of five papers that report results drawn from the analyses of two empirical data collections. Each paper has specific aims and research questions, which together address the overall aims of the thesis. Figure 1 illustrates the way these five papers address the three research questions.

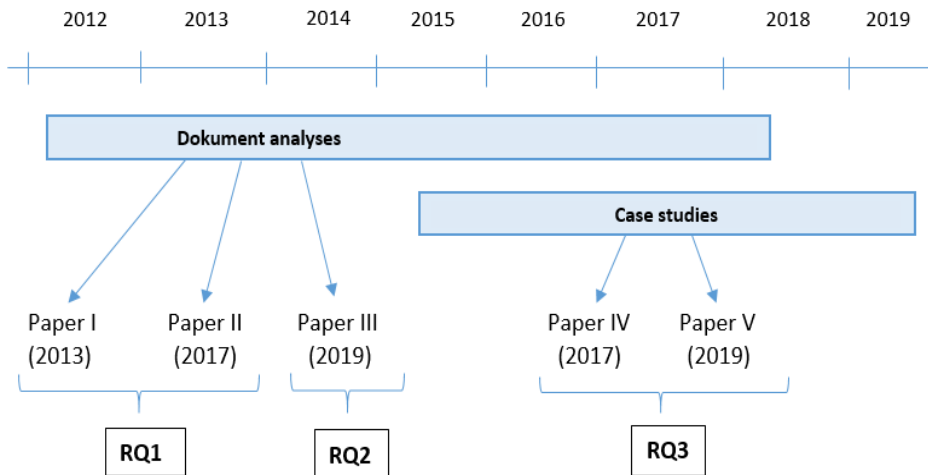


Figure 1. *The overall structure of addressing the research questions.*

1.2 Overview of the thesis

The first three papers are based on document analysis, while the next two papers are based on teacher interviews and video recorded lesson observations. In Paper I the construction and development of an analytical tool for analysing mathematics curriculum materials is in focus and this paper provides a starting point for Paper II and III. The focus of Paper II is on what kind of support the Finnish teacher guides offer teachers, while in Paper III the focus is on uncovering the underlying assumptions of classroom practise and teaching in Finnish teacher guides. The document analyses of Papers I, II and III were necessary to ascertain the features of Finnish teacher guides to be able to understand the relation between the guides and teachers' interaction with them. In this thesis, I regard the teacher guides as a support for teachers in their design of teaching, and teachers as mediators between the teacher guides and the mathematics classroom practises.

The next stage was, therefore, to capture how teachers interact with teacher guides in both planning and teaching. This was operationalized through interviews and video-observations, and then reported in two papers, Paper IV, and Paper V. Paper IV addresses how one Swedish teacher interacts with an originally Finnish teacher guide for planning and enactment of mathematics lessons. In the thesis, enactment refers to what happens when curriculum materials are put into use in classrooms (Remillard & Heck, 2014). It is a dynamic phenomenon occurring in a particular context between teachers, students, and curriculum materials (Ball & Cohen, 1996). Paper V focuses on the emerged mathematics classroom practises of four Finnish and four Swedish teachers when

interacting with curriculum materials that originate from Finland. Papers I and II correspond to the first research question (RQ1), Paper III corresponds to the second research question (RQ2), while Papers IV and V correspond to the third research question (RQ3).

The five chapters in this introductory part of the thesis are organised as follows:

Apart from the introduction, where rationales, overall aims and research questions of the thesis are presented, Chapter 2 introduces the theoretical stances where I frame the concept of curriculum materials and introduce the model of teacher-curriculum interaction. Then, a review is presented comprising relevant prior research regarding characterisation of curriculum materials as well as teacher-curriculum interaction and emerged classroom practises.

Chapter 3 describes the methodological approaches and considerations. The research design is outlined, and the Finnish and the Swedish educational contexts are described. Thereafter, document analysis and case studies are presented separately, including a more detailed account of the methods as well as procedures for data collection and analysis. Finally, trustworthiness as well as ethical issues of the thesis are considered and discussed.

Chapter 4 provides summaries of the contributions of the papers with focus on specific aims, results, and conclusions.

Chapter 5 presents a synthesis of the thesis. It discusses main findings of the five research papers in relation to prior research followed by considerations of how the thesis contributes to research and practise. The limitations of the study are discussed. This part closes with a presentation of continued research and suggestions for further research is pronounced.

2. Theoretical background and prior research

In this chapter, I first present the theoretical stances by briefly introducing the socio-cultural theories in which the work is embedded, before elaboration on curriculum materials and curriculum, which constitute key notions in the thesis. Thereafter, the more specific theoretical positioning of the thesis is described, namely the model of teacher-curriculum interaction. In the second part of the chapter, I review research regarding characterisation of curriculum materials as well as classroom practises and teacher-curriculum interaction.

2.1 Theoretical stances

The overarching perspective of the thesis departs from socio-cultural theories, which hold artefacts, mediation, and contexts in focus (Vygotsky, 1978; Wertsch, 1998). Curriculum materials are regarded as artefacts, socio-cultural tools, and products of the socio-cultural evolution where they both shape and are being shaped by human actions through their affordances and constraints (Vygotsky, 1978; Wertsch, 1998). Hence, artefacts, such as the teacher guides, may influence teachers' capacity to mediate¹ actions, and thereby, potentially what happens in classrooms. Further, teaching is viewed as a cultural activity (Pepin et al., 2013a; Stigler & Hiebert, 2009) dependent on the context. For instance, we know that there are certain patterns in a social activity like teaching, which are characteristic or typical (Stigler & Hiebert, 2009). We also know that curriculum materials are produced within certain educational traditions and are shaped by national perspectives on education as well as on specific school subjects (Andrews, 2007). The curriculum materials moreover present ideas about teaching and learning mathematics that reflect cultural values (e.g., Haggarty & Pepin, 2002; Pepin et al., 2013a). Thus, such materials carry culturally signed interpretations, expectations, and values. When teachers work together with curriculum materials, both teachers and curriculum materials are part of the social practises embedded in certain cultural norms (cf. Hill & Charalambous, 2012), and curriculum materials can thereby influence teachers' actions. Therefore, I found a socio-cultural approach most suitable for this study.

The more specific perspective of the thesis, which will be elaborated on in section 2.1.1, is based on a dynamic model of teacher-curriculum relationship, wherein teaching is viewed as a design activity and teachers as active participants in that process (Brown, 2009; Remillard, 2005). Teachers and the curriculum materials are further located within different

¹ Mediation is defined as the use of certain tools or artefacts within socially organized activity. The tool helps the human to cope with their milieu, situation or thought. The social community and the individual mutually shape each other through the process.

cultural-educational contexts and different classrooms, bringing about a context-embedded interaction between the teacher and the curriculum materials (Brown, 2009). In the end, students' learning is influenced by teachers, materials and teachers' interactions with materials (e.g., Stein et al., 2007) However, that is not the focus of this study.

2.1.1 The concept of curriculum materials and curriculum

The term 'curriculum materials' is largely used by researchers in the US (e.g., Remillard, 2005). It has various definitions and is used interchangeably in the field of mathematics education in different settings and contexts (e.g., Stein et al., 2007; Remillard, 2005). It refers to teaching and learning materials produced for teachers and students to be used during teaching. In some contexts, like the US, such materials are regarded as curricula. Other researchers (e.g., Pepin et al., 2013a) use the term 'curriculum resources'. Curriculum resources indicate an umbrella notion to include, besides curriculum materials, all other available supports for students and teachers in and for teaching. These other supports can, for instance, be printed and hands-on materials, electronic resources, but also resources, which are not necessarily materials, such as interaction and work with colleagues. Remillard, Van Steenbrugge and Bergqvist (2014, 2016), on the other hand, use the term 'curriculum programs', which refers to a package or a set of material, like a specific textbook series including additional materials. Curriculum programs are tightly connected with specific countries or regions, for instance the US, where textbooks define the curriculum because no national core curriculum exists. To use the term 'curriculum programs' within the Finnish and Swedish context is thus not appropriate.

Two other notions used in research are 'teaching material' and 'material resources'. Both concepts are comprehensive, however not linked explicitly to the curriculum. Stein and colleagues (2007), for instance, refer to "resources designed to be used by teachers in the classroom" (p. 321). However, big differences exist, in practise, both between and within countries. On the one hand, there may be obligations to use state-mandated textbooks, like in Cyprus, Croatia, and South Africa, as well as in about half of the states in the US (Charalambous et al., 2010; Johnsson Harrie, 2009; Jukić Matić & Glasnović Gracin, 2016; Leshota, 2015). On the other hand, there may be a possibility to freely choose which material to use and how. Even if many countries do not have state-mandated textbooks, the teachers may still choose to use and follow a material quite strictly, which is quite common in Sweden and Finland (Johnsson Harrie, 2009), or choose not to use, which is quite common in England (Mullis, Martin, Foy & Arora, 2012). In this thesis, I will use the term curriculum materials that is commonly used in the literature. Curriculum materials is used in its narrow sense, comprising commercially produced materials, such as students' textbooks and teacher guides, used by teachers in and for teaching. Curriculum materials is a central concept in this work.

Regarding conceptualizing of curriculum, researchers have used slightly different theoretical frameworks and concepts. Valverde and colleagues (e.g., 2002) for instance use one of the most common frameworks by the concepts of intended, implemented/potentially implemented, and attained curriculum. Implicit in the framework is the assumption that curricula exist in different forms and at different levels of a system (cf. Remillard & Heck, 2014). Stein and colleagues (2007) on the other hand talk about phases and transformations instead of levels, both within and between the phases, as somehow interrelated. They use the concepts of written, implemented, and enacted curriculum, and so do I in this thesis. My premise in this work starts from the printed pages in the Finnish teacher guides in mathematics that form a part of the written curriculum, not in the sense as curriculum in many states in US is understood, but as a support that a teacher can use. Finnish and Swedish teachers' interaction and engagement with these Finnish teacher guides when planning lessons refers to the intended curriculum. The emerged Finnish and Swedish classrooms when teachers interact with Finnish curriculum materials refer to the enacted curriculum. Enactment is dynamic and jointly created in classrooms, by students and teacher when operationalizing the written and intended curriculum, framed by context (see Stein et al., 2007; see also Thompson & Huntley, 2014). This kind of jointly created classroom is in line with the Nordic school tradition (e.g., Kansanen, 2000; Rezat & Strässer, 2012) where teacher's autonomy and agency are central.

Next, I advance into the model of teacher-curriculum interaction, which plays a key role in the thesis.

2.1.2 Teacher-curriculum interaction

Researchers have conceptualised 'curriculum use' differently (e.g., Ben-Peretz, 1990; McClain, Zhan, Visnovska & Bowen, 2009; Stein et al., 2007; Remillard, 2005), and produced several contradictory results. In this thesis, teachers' use of curriculum refers to "how teachers interact, draw on, refer to and are influenced by teaching materials designed to guide instruction" (Remillard, 2005, p. 212). I interpret instruction as teaching and learning situations in education. Remillard (2005) examined through a meta-analysis how curriculum use was conceptualised in research conducted in the US context, and she distinguishes between four partly overlapping meanings of curriculum use, which at large can explain the contrasting findings in research. The four different meanings are; curriculum use as following or subverting the text; curriculum use as drawing on the text; curriculum use as interpretation of text, and curriculum use as participation with the text. This thesis encompasses curriculum use as participation with text (Remillard, 2005), which means that teachers and curriculum materials contribute and influence the relationship between them and in turn the classroom practises. Even if I conceptualise curriculum use as participation with the text, I still acknowledge that this framework also accommodates

two other ways to use curriculum, namely, as 'interpretation of text' and as 'drawing on text'. Teachers need to both read and interpret text to create a participatory relationship when making sense of both the design of lessons and the enacted lessons.

The theoretical starting point of the thesis is the model by Remillard (2005), which conceptualises teacher-curriculum interaction. It is basically the same model as Brown's (2009) framework with factors influencing the teacher-text interaction. Nevertheless, both Remillard (2005) and Brown (2009) recognise that the teacher-curriculum relationship lies in both the teachers' personal resources (i.e., knowledge, skills, beliefs, and commitments) and the curriculum materials' specific resources (e.g., task structure, subject matter representations and visual look/appearance). In other words, both the teachers and the curriculum materials bring their specific characteristics into the joint teacher-curriculum interaction. This conceptualisation of teachers' usage of curriculum materials advocates that the characteristics of the curriculum materials' content as much as the characteristics of the teachers (Brown, 2009; Brown & Edelson 2003; Pepin et al., 2013a; Remillard, 2005). In addition, the teachers and the curriculum materials are located within certain social contexts and classrooms, bringing about a context-dependent teacher-curriculum interaction (Brown, 2009). Curriculum materials are thereby cultural system-specific artefacts (Pepin et al., 2013a), reflecting the specific character of teaching and learning activities that may potentially emerge in classrooms. This interaction between a teacher and the teacher guides in use will mediate and construct the intended and the enacted classroom practises.

Teaching is viewed as a design activity where teachers are active agents and participants in the design process, especially in planning, enacting, and evaluating (Brown, 2009). Understanding teaching as design highlights the interaction between teachers and curriculum materials, which in turn shapes classroom practises. Brown (2009) describes this interaction by offering an analytical construct of three types of artefact use or appropriation: offloading, adapting, and improvising. I use these notions to characterise the teachers' usage of curriculum materials. Offloading emerges when a teacher follows material as a norm and assigns a great degree of authority to the teaching material. That is, the agency for the delivery of content lies in the material. Adapting, on the other hand, occurs when a teacher reflects when elaborating on the material. Here the agency is embedded in both the material and the teacher. Improvising relates to when a teacher does not closely follow the material. That is, the agency lies with the teacher as she relies on her own strategies for teaching, with minimal reliance on the material. To capture the degree of how close teachers' interaction or collaboration is with the materials I further characterise it as participatory or non-participatory. For instance, when the teacher regularly and deliberately uses the material, and looks at it critically, this provides an intimacy between teacher and material, which can be

categorised as a participatory relationship. Whereas, if the teacher’s use of the material is more tacit and sporadic, there will be a lack of intimacy and the relationship is categorised as non-participatory (cf. Leshota, 2015).

Figure 2 visualises the different factors influencing the teacher-curriculum relationship (Remillard, 2005; cf. also Brown, 2009). Even if this model by Remillard is created in the US context, it is still very general, and I use it as a theoretical model to situate teachers’ interaction with curriculum materials and the emerged classroom practise. This model includes four components: (1) the curriculum characteristics; (2) the teacher characteristics; (3) the participatory relationship between the teacher and curriculum, and (4) the planned and enacted curriculum (see Brown, 2009; Brown & Edelson, 2003). In the thesis, the characteristics of curriculum materials (1), or, more precisely, of teacher guides, are examined in three papers, Paper I, II and III. The teachers’ characteristics (2) are not explicitly examined in this study. Yet, some premises of teacher characteristics for participating in the research were set up (see section 3.4.1). The interaction between the teachers and teacher guides (3) is examined and foregrounded in Paper IV, and the emerged classroom practise (4) is foregrounded in Paper V, where also teacher-curriculum interaction is examined but backgrounded.

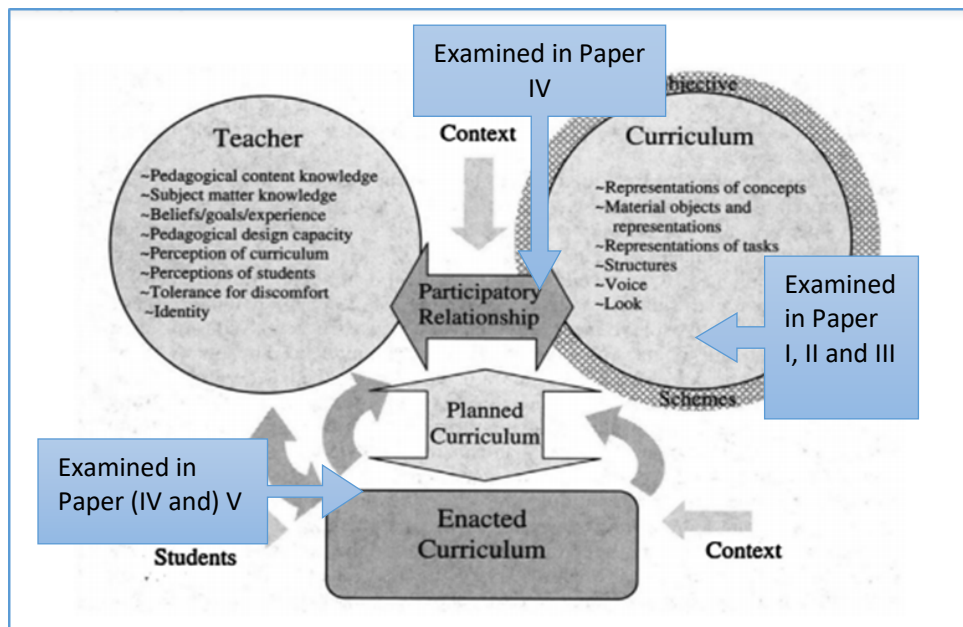


Figure 2. *The model of teacher-curriculum relationship* (from Remillard, 2005, with permission)

Curriculum materials are widely used in mathematics classrooms all over the world (e.g., Mullis, Martin & Foy, 2008; Pepin & Haggarty, 2001), and

regarded as tools for influencing teaching and learning mathematics (e.g., Remillard & Bryans, 2004). However, as Cohen and Ball (2001), McClain et al. (2009), and Remillard and Bryans (2004) have shown, what happens in the classrooms is most often non-identical to the intentions of the curriculum materials. As explained by Cohen, Raudenbush and Lowenberg Ball (2003), a curriculum material is not self-acting and does not carry a “capacity” on its own. This means that curriculum materials are dead objects merely offering a potential support that come to life in the hands of users. Hence, there is no straight line from the written curriculum materials to the enacted classroom. Nevertheless, both the materials itself and its users’ characteristics matter in enacted settings.

2.2 Characterisation of curriculum materials

I have in the research literature, and in relation to this thesis, reviewed research on curriculum materials from various points of view and found two main ways or themes to characterise curriculum materials. In the first theme, design features of curriculum materials are investigated by either comparing content or topic in a broad sense or by positioning the reader. In the second theme, underlying norms of teaching and learning are uncovered when investigating cultures and values embedded in curriculum materials. I finish the chapter with discussing curriculum materials as a potential resource for teaching and learning.

2.2.1 Curriculum materials with focus on different design features

Researchers have investigated different design features or modes of curriculum materials as these might influence the teacher’s interaction with the material. One common way to investigate and compare curriculum materials is to analyse the mathematical content or topic, as well as similarities and differences within and between countries. This is well represented in research, also in the Nordic context, especially in Swedish mathematics education. Many researchers have, for instance, analysed textbook² features, such as, how tasks are structured and presented (e.g., Jablonka & Johansson, 2010; Lithner, 2004; Pepin & Haggarty, 2001), the role of textbooks in mathematics teaching and learning (e.g., Johansson, 2003, 2006; Oates, 2014; Törnroos, 2005), or specific mathematical concepts (e.g., Bergwall & Hemmi, 2017; Bråting, Madej & Hemmi, 2019; Charalambous et al., 2010; Hemmi, Lepik, Madej, Smedlund & Bråting, 2019a; Juter, 2003; Larsson, 2015; Lundberg, 2011; Mesa 2010). An extensive amount of research has focused on students’ textbooks regarding

² The notions of textbook and textbook evaluations were officially in use in Sweden until 1974. After that, the notion of curriculum materials/teaching materials and their evaluations was used. This shift has occurred in a large part of the world and this may be one explanation for the usage of both textbook and curriculum/teaching materials in literature.

both content and support for students' learning and goal-fulfilment (e.g., Brändström, 2005; Rezat, 2009; Valverde et al., 2002). This is reasonable, since in many countries, teachers plan and conduct teaching that is close to the students' textbook (Fan et al., 2013; Grevholm, 2014; Joutsenlahti & Vainionpää, 2010; Mullins et al., 2012; Skolverket, 2015; Stein et al., 2007). Even if research shows that there is a shortage in the link between national core curriculum and the content of curriculum materials (Fan & Zhu, 2007; Johansson, 2003; Lundberg 2011), teachers still rely on and use curriculum materials to fulfil the content and goals of the national core curriculum (Thompson & Fleming, 2005; Vincent & Stacey, 2008). In recent years, research has widened to studies of teacher guides.

Form and content of curriculum materials play a key role in the thesis, and they are included in design features that many researchers have investigated (e.g., Ball & Cohen, 1996; Remillard & Kim, 2020). In Koljonen (2014), I investigated the content of Finnish curriculum materials for Grades 1-6. The analysis shows that the teacher guides display many similarities regarding the content and form but also that they offer rich and varied resources for teachers in their everyday work. Similarly, Hoelgaard (2015) investigated the content of Swedish teacher guides in mathematics for Grades 1-3. Her analysis shows large differences regarding the structure and content of the guides as well as their capacity to offer different and varying degrees of support to teachers. Hoelgaard reports that the included support in traditional Swedish teacher guides was restricted to help students work with their textbooks, and teachers were expected to have a controlling role rather than being active designers (see also, Hoelgaard, Hemmi & Ryve, 2015). Sayer, Petersson, Rosenqvist and Andrews (2019) recently investigated students' opportunities to acquire FoNS (fundamental number sense) by comparing three textbooks in year one used by Swedish teachers but originally authored in three different contexts (Sweden, Finland and Singapore). Sayer and her colleagues claim that differences such as structure of re-visitation of most FoNS-related forms of tasks or the exposure of several FoNS categories challenge teachers didactically when trying to adapt to the imported materials to their practises.

Another common way to investigate design features is to focus on how a text characterises materials and positions the readers, like for instance, through linguistic forms (e.g., Halliday, 1973; Herbel-Eisenmann & Wagner, 2007; Morgan, 2006). Remillard (2012), on the other hand, argues that curriculum materials position teachers through five design considerations or modes; look, structure, voice, medium and genre (see Paper III). Researchers often focus on one of these modes and some have thus specifically focused on how the authors communicate with and position potential readers, i.e., a teacher and students. Herbel-Eisenmann (2007), for instance, studied how a middle school mathematics textbook in the US positioned the students by investigating the language construction (imperatives, personal pronouns, and modality) as an expression of the

textbook's voice. She found that the language positioned the textbook as the mathematical authority and simultaneously positioned the students as doers of the scripted assignments represented by the textbook.

A study of how a text positions the teachers has lately been conducted in research on teacher guides. For instance, Ahl, Koljonen and Helenius (2017) examined the voice of two Swedish lower secondary mathematics teacher guides by following Remillard's (2012) notions 'speaking to' (i.e., curriculum materials communicate the central ideas in the curriculum and provide for flexible customisation) and 'talking through' (i.e., curriculum materials focus on what the teacher should do). They found that the traditional Swedish teacher guides more commonly 'speak through' by dictating teachers' precise actions, rather than 'talk to' by communicating overarching and important ideas and leave the implementation to teachers to design. Ahl and colleagues also noticed and introduced a new notion; teacher guides as 'talking past' the teachers. That is, the teacher guides staged teachers to witness what students are supposed to work with from a distance without involving teachers as mediators.

Brown (2009) investigated the relationship between a teacher and curriculum materials in science education by using the concepts resource-centric and procedure-centric when characterising curriculum materials. Resource-centric materials communicate the main ideas and curricular features but leave details of implementation to the teachers. Procedure-centric resources, on the other hand, focus on the action of performing lessons. Remillard and Reinke (2012) approached materials by characterising how curriculum materials are organised and how they communicate to teachers, using two categories: explicit scripts and descriptive scripts, which largely overlap Browns' two notions procedure-centric and resource-centric. Remillard and Reinke (2012) reported that teacher guides often contained a mix of explicit and descriptive scripts, which is also true for the Finnish curriculum materials (e.g., Koljonen, 2014). They further state that both the explicit and the descriptive scripts can function as support for teacher learning and teaching. Similarly, Van Steenbrugge and Ryve (2018) suggested that materials should contain both types of guidance. The notions by Brown (2009), as well as Remillard and Reinke (2012), have been embraced by the field of mathematics education and play a key role in this thesis.

2.2.2 Curriculum materials embedded in culture and values

A way to characterise materials, and partly overlapping the previous section, is to investigate curriculum materials when text analysis focuses on cultures and values. This has been examined in only a few studies. Haggarty and Pepin (2002), for example, examined how the topic of angles was structured in textbooks at the lower secondary level, and what aspects of the topic were included in the books, in three educational contexts: England, France and Germany. They identified differences between the textbooks and

traced the differences to the educational traditions in each country (see also Pepin & Haggarty, 2001). Pepin et al. (2013a) compared mathematics curriculum documents, commonly used textbooks, and teaching practises with respect to educational traditions in France and Norway. In line with Haggarty and Pepin (2002), Pepin and her colleagues (2013a) found a similar relationship between the documents/textbooks and practises, related to cultural and historical traditions or norms. Pepin and Haggarty (2001) conclude that classroom cultures are shaped by at least two factors: firstly, teachers' pedagogical principles in their immediate school and classroom context; and secondly, a system's educational and cultural traditions as these develop over time. They claim that mathematics classroom cultures need to be understood in terms of a wider cultural and systemic context, for shared understandings, principles, and meanings to be established.

Some cross-cultural studies have been undertaken (Hemmi, Krzywacki & Liljekvist, 2019b; Pehkonen, Hemmi, Krzywacki & Laine, 2017a; Remillard et al., 2014, 2016), but research on curriculum materials and their relationship to cultural aspects are indeed rare. In the US, Remillard et al. (2014, 2016), for instance, examine and compare middle grade teacher guides in three distinct school systems: Sweden, the US, and Flanders in Belgium. They noticed culturally distinctive patterns in the support provided by teacher guides to teachers, such as how much guidance they offer and for what purpose. The Swedish teacher guides differed from the US teacher guides in that the US teacher guides offered more directive guidance for leading teaching, whereas the Swedish teacher guides offered more guidance in facilitating the students' text interaction (cf. Ahl et al., 2017a). Remillard et al. (2014, 2016) claim that the differences between contexts tend to be bigger than differences within a context, which in turn may well reflect the cultural traditions and educational priorities in each system. These findings are in line with prior research, like Charalambous et al. (2010), who examined textbooks from the three countries Cyprus, Ireland, and Taiwan, and found more differences in the textbooks between the countries than within them.

National patterns of mathematics teaching have been conceptualised in numerous ways. For instance, as pedagogical flows (Schmidt et al., 1996), lesson signatures (Givvin, Hiebert, Jacobs, Hollingworth & Gallimore, 2005; Hiebert, Gallimore, Bogard Givvin, Hollingworth, Jacobs et al., 2003), lesson scripts and cultural scripts (Stigler & Hiebert, 2009), as well as lesson events (Clarke, Keitel, Shimizu, 2006; Clarke, Mesiti, O'Keefe, Xu, Mok & Shimizu, 2007). National patterns have moreover been investigated with implicit methods, for instance, Andrews and Larsson (2017) investigated lesson events through students' understanding of the notion 'genomgång' (short introduction) in the Swedish context (cf. Clarke et al., 2007). Cultural scripts have also been implicitly examined through feedback discussions between a mentor and student-teachers during teacher education in Japan (Corey,

Peterson, Lewis & Bukarau, 2010), as well as between Swedish and Finnish student-teachers and their mentors (Hemmi & Ryve, 2015b).

Cultural scripts and cultural norms are understood as the regularities of the practise and the social interaction established by a group regarding what is perceived as acceptable or desirable. These norms are then the shared rules regarding the expectations of behaviour, rather than actual behaviour. Cultural norms both limit and enhance the available range of strategies of action a person can draw from, selectively deploying them according to the situation (cf. Stigler & Hiebert, 2009). In addition, the values of a culture shape norms and involve taken-as-shared ideas of what constitutes an appropriate and desirable mathematics classroom (cf. Hiebert et al., 2003). Haggarty and Pepin (2002) further claim that textbooks have a nation's cultural values embedded in them, and therefore legitimise and reflect the cultural-educational values of countries. Curriculum materials, and especially teacher guides, are pedagogical texts (cf. Wikman, 2004) written to support teachers in their work of teaching. Curriculum materials reflect, therefore, pedagogical preferences and views about classroom practises. Andrews (2007) suggest that teachers' professional identities are aligned with the pedagogical traditions of their country, forming a characteristic set of lessons and lesson scripts as well as pedagogical strategies that are routine. The idea of norms or cultural norms becomes an essential concept when studying the potentially constructed mathematics classroom in the teacher guides.

2.2.3 Curriculum materials as potential resource

We know that curriculum materials have the potential to function as a source of inspiration for planning and teaching (Ahl, Gunnarsdóttir, Koljonen & Pálsdóttir, 2015a; Davis & Krajcik, 2005; Remillard, 2000, 2005). Curriculum materials serve as an important resource for teachers in designing teaching, especially when emphasising clear links between the design of curriculum materials and teaching (e.g., Jablonka & Johansson, 2010; Pepin et al., 2013a; Stein & Kim, 2009; Stylianides, 2007). Another important mode or design consideration when conceptualising curriculum materials is for whom the materials are written and how the materials are understood and perceived by readers. For instance, Love and Pimm (1996) state that mathematics textbooks are primarily written for students, which is also true today and in line with the Swedish and Finnish production of textbooks. For long, it has been a custom in many countries that teachers also use textbooks for planning and enacting teaching. However, in the Finnish context teachers traditionally use teacher guides and the offered activities frequently, which has not been common in Sweden (Grevholm, 2014; Joutsenlahti & Vainionpää, 2010). The Finnish teacher guides offer teachers pedagogical support in their everyday work of teaching and learning (Koljonen, 2014; Krzywacki, Pehkonen & Laine 2016).

Curriculum materials can also function as tools for teacher learning when developing mathematical knowledge and teaching skills (Ball & Cohen, 1996; Collopy, 2003; Remillard & Bryans, 2004). Curriculum materials can be regarded as resources for teachers (e.g., Davis & Krajcik, 2005) that both support and limit teachers' thoughts and actions (Brown, 2009; Stein et al., 2007). A relatively new and growing area in many countries, such as the US, is to develop so called educative curriculum materials that are designed to support not only students learning but also teacher learning, by offering teachers explicit support for learning about teaching (e.g., Beyer & Davis, 2009; Davis & Krajcik, 2005; Schneider & Krajcik, 2002; Wang & Paine, 2003). In other words, these educative curriculum materials are designed to speak 'to' teachers and not 'through' teachers (Remillard, 2000). Davis and Krajcik (2005) have established a set of guidelines that could be utilised when producing teacher guides, which specifically support teacher learning. Ball and Cohen (1996) state that curriculum materials need to be developed with the enacted curriculum in mind and argue that pedagogical guidance and support for teacher learning may have great potential to influence teaching as well as classroom practises (see also Tarr, Chavez, R. Reys and B. Reys, 2006; Tarr, R. Reys, B. Reys, Chavez, Shih & Osterlind, 2008).

2.3 Teacher-curriculum interaction and classroom practises

Classroom research is an established tradition and an extensive field of research (Sahlström, 2008), while classroom practise, where the attention is laid on use of curriculum material and its enactment in classrooms, is relatively new. How teachers interact with curriculum materials and the enactment of classroom practises have been a focus for several studies outside Nordic countries (e.g., Collopy, 2003; Nicole & Crespo, 2006; Remillard & Bryans, 2004; Schneider, Krajcik & Blumenfeld, 2005), whereas only some literature is available in relation to Nordic mathematics classrooms (e.g., Gunnarsdóttir & Pálsdóttir, 2016, Hemmi & Krzywacki, 2014; Hemmi et al., 2019b). The teacher-curriculum interaction is an important aspect in the present thesis, as both the character of a material and how teachers relate to and interact with the material supports and limits teachers' actions in mathematics classrooms (e.g., Remillard 2000; Remillard & Bryans, 2004; Stein & Kim 2009).

Research has shown that how a teacher interacts with material can vary during different lessons (Clarke et al., 2006; Hiebert et al., 2003; Jukić Matić, 2019; Jukić Matić & Glasnović Gracin, 2020), and that teachers enact the same curriculum material in diverse ways (Cohen & Ball, 2001; Eisenmann & Evan, 2009; Lesotha, 2015; McClain et al, 2009; Remillard, 2001; Hemmi et al., 2019b). The variation can depend, for example, on what a teacher regards as most beneficial for the students (e.g., Jukić Matić, 2019), but there are also other factors that influence teachers' interactions with materials.

Teachers bring different features to the teacher-curriculum interaction and teachers' experiences seem to be a crucial aspect of how teachers use curriculum materials (e.g., Drake & Sherin, 2006; 2009; Nicole & Crespo, 2006; Remillard & Bryans, 2004). For example, Remillard and Bryans (2004) found that confident US teachers mostly used materials as a support for teaching principles, while inexperienced teachers mostly utilised and relied on the specific activities included in the materials. In contrast, Ahl et al. (2015b) display that experienced Swedish teachers used teacher guides as a source from which to choose teaching activities to design teaching. The less experienced teachers, on the other hand, used a wider scope of the content in the teacher guides; both for design of teaching and as a source for teacher learning. Grossman and Thompson (2008) argued that when teachers became more experienced (see also, Drake & Sherin, 2006, 2009) and gained more specific resource experiences, they began to adapt more. Thus, their interaction with the resources changed from focusing on details to broad overviews where they become aware of the overarching and important pedagogical ideas in mathematics. This increase was mostly found to be based on teachers increased trust in the resource. Teachers' skill to perceive the affordances of a material will thus develop over both time and teaching experience.

Research further indicates that teachers' beliefs and views might influence how curriculum materials are used (cf. Beyer & Davis, 2009; Grossman & Thompson, 2008; McDuffie, Choppin, Drake & Davis, 2018; Jukić Matic & Glasnović Gracin, 2020; Lloyd et al., 2009; Remillard & Bryans, 2004). For example, teachers' beliefs related to their own experiences with mathematics, such as their early memories of learning mathematics and their current perceptions of themselves as mathematics learners, could influence their use of materials (Drake & Sherin, 2006). How well teachers' views are aligned with curriculum materials also influences teacher-curriculum interaction (e.g., McDuffie et al, 2018; Remillard & Bryans, 2004).

The embedded support of curriculum materials also influences the teacher-curriculum interaction. Neuman, Hemmi, Ryve and Wiberg (2015), for instance, report from a survey on how Swedish teachers perceived support from curriculum materials. They saw major differences connected to the different types of curriculum materials. That is, teachers using a material with educative teacher support (see section 2.2.3) experienced more support than teachers using a non-educative material, who also reported that they had more individual student work than teachers with the educative material. McDuffie et al. (2018) further revealed that teachers' perspectives were very much in line with the overall design of the curriculum materials they chose. In addition, teachers with similar types of curriculum materials in general paid attention to similar features of the materials, but their decisions varied based on their orientation. Similarly, Ahl et al. (2015a) displayed that both Swedish and Icelandic teachers used

the educative teacher guides differently from the traditional, non-educative teacher guides. Teachers with an educative material were more likely to use a wider range of lesson design considerations, and teachers made more reflections about the design of lessons. Teachers using 'traditional' teacher guides used them to facilitate classroom practises; for instance, these teachers often just used the guides for picking out some activities. Contrarily, Hodgen, Brown, Kuchemann and Coe (2010) investigated curriculum materials in England and did not find any evidence that the more educative curriculum materials offered teachers more support in classroom practise. Hemmi, et al. (2019b) followed Swedish primary school teachers using an originally Finnish curriculum material. Their findings are in line with Remillard and Bryans (2004), that is, teachers offloaded a great deal of their agency to the material in order to become familiar with the ideas that the material mediate. The Swedish teachers in Hemmi et al. (2019b) highly stressed the 'usability' of the material, since they felt that it reduced teachers' workload and the changes they made in their classrooms were tightly related to the support offered by the materials.

Researchers (e.g., Davis et al., 2011; Remillard 2000; Lloyd, 2009; Stein & Kim 2009) have revealed that the way in which teachers read and interpret text in curriculum materials seems to be crucial and important for how teachers adapt curriculum materials, which in turn may not only influence the teacher-curriculum interaction but also the enacted classroom activities. There are in research suggestions for what teachers need in order to use and adapt curriculum materials productively. Grant, Kline, Crumbaugh, Kim, and Cengiz (2009) explored, in the US context, two teachers' usage of a new material, and noticed that acquiring pedagogical support enabled teachers to engage in students' thinking during whole-class discussions more effectively. Thereto, researchers stress that it is fruitful to offer clear rationales for activities and working approaches (e.g., Davis & Krajcik, 2005; Guskey, 2002; Remillard, 2000). Guskey (2002) claims that without justification for a certain working approach, teachers continue with their earlier routines to be on the safe side (cf. Hemmi et al., 2019b). Further, Davis, Beyer, Forbes, and Stevens (2011) suggest that curriculum materials should include support for teachers in how to understand the intent of the suggested lessons or activities, so that teachers could customise those recommendations into their classrooms and students (see also Davis, Palinscar, Arias, Bismack, Marulis & Iwashyna, 2014). Swedish teachers in the study by Hemmi et al. (2019b) received some background information about the rationales behind the Finnish materials, which obviously made it easier for the teachers to adapt the material in a productive manner, something that the substitute teachers were not able to do. Stein and Kaufman (2010) found that the quality of teaching was higher if teachers attended to the mathematical topic through the overarching and important mathematical ideas while preparing for lessons. Cobb and Jackson (2012) add that it is important to assure the usability of materials; for this to

happen, the material must be easy to access and, at the same time, harmonise with the planned reorganisation of practise.

I conclude with some words about Finnish and Swedish primary school practises (Grades 1-6) in relation to curriculum use and classroom practise. Swedish classroom practises at primary school level have often been pictured, for the last two decades, as organising individualised learning with only short introductions focusing on the methods within the student's textbook. Most of the students manage to work individually with their textbooks but with different content and at their own pace (cf. Boesen et al., 2014; Engvall, 2013; Ryve & Hemmi, 2019). Teachers in such classrooms are conceptualised as "reactive and passive in terms of setting goals, orchestrating classroom discussions, and introducing new mathematical concepts" (Hemmi & Ryve, 2015a, p. 385). The role of curriculum materials is to provide students with explanations and tasks to work with at their own pace. Finnish classroom practises and teaching at primary school level (Krzywacki, Pehkonen & Laine, 2016; Pehkonen et al., 2007; Pehkonen & Rossi, 2007; Savola, 2010) are, in research, portrayed in less uniform ways than the Swedish. Krzywacki et al. (2016), describe primary school mathematics teaching in Finland as teacher-centred (cf. Andrews, 2013; Patrikainen, 2012; Røj-Lindberg, 2017), including teaching in whole class with high involvement in different student activities, which are often found in the curriculum materials in use. In addition, Finnish primary school teachers traditionally use teacher guides to a greater extent than the Swedish teachers. Finnish teachers are, in contrast to Swedish teachers, conceptualised as acting proactively in the mathematics classrooms (Hemmi & Ryve, 2015a; Ryve & Hemmi, 2019).

3. Methodology

In the following chapter, I present methodological approaches and considerations in relation to the five studies within the thesis. Firstly, an overview of the research design is outlined. Secondly, features of the Finnish and the Swedish educational contexts relevant for this study are described. Thirdly, the two research strategies; document analysis and case studies are separately presented. Finally, the trustworthiness and ethical aspects are considered.

3.1 Research design

The overall aim of this thesis is to contribute to research by deepening our knowledge of the characteristics of curriculum materials in mathematics (Grades 1-6) and teachers’ interaction with Finnish teacher guides in Finnish and Swedish contexts. Hence, the five individual studies in the thesis consists both of analyses of teacher guides, and case studies of Finnish and Swedish teachers’ interaction with these guides. Table 1 provides an overview of how the data sources are connected to each individual study and research question. The purpose and methods of analysis of each individual study are discussed in section 3.3 and 3.4. In an appendix, I also offer a table where both the purpose and methods of analysis are easily available (see Appendix A). The thesis is problem-driven, meaning that questions were formulated before a suitable methodology was chosen, signalling that it is an explanatory study (Silverman, 2010).

Table 1. *An overview of data sources connected to each of the individual studies and research questions.*

DATA SOURCES		PAPERS				
		PI	PII	PIII	PIV	PV
Curriculum materials	Teacher guides in FIN	X	X	X		X
	Teacher guides in SWE	X			X	X
Interviews	FIN teachers					X
	SWE teachers				X	X
Lesson observations	FIN lessons					X
	SWE lessons				X	X
		RQ1		RQ2	RQ3	
RESEARCH QUESTION						

I made a methodological shift when I moved the focus from the analyses of teacher guides to investigations of teachers’ interaction with them in the Swedish and the Finnish cultural-educational practises. I therefore needed to take into account a number of new methodological issues in relation to

the research design. I knew, for instance, that the insider and outsider perspective was crucial and that I had to collect data in two cultural-educational contexts as well as conducting the analyses myself, in original languages. I considered this as possible since I have roots in both contexts. This approach with one person being both an insider and an outsider when investigating different cultural contexts is unusual. A far more common approach applied is to investigate one cultural context, i.e., the researcher's own (e.g., Leshota, 2015). Another common approach, especially within cross-cultural contexts, is to make use of team member's different cultural belongings as being insiders or outsiders (e.g., Remillard et al., 2014, 2016).

3.2 The Finnish and Swedish educational contexts

Many similarities exist between the educational contexts of the two neighbouring countries Finland and Sweden but there are also interesting differences to be considered in this study.

The Finnish and the Swedish educational systems consist of inclusive nine-year compulsory basic education with no special tracking. The Finnish and Swedish comprehensive schools begin in Grade 1 and end in Grade 9 (ages 7–16). The Finnish schools are divided into two stages: primary schools including school Grades 1–6 and lower secondary school including school Grades 7–9. The Swedish schools are divided into three stages: the lower Grades 1–3, and the middle Grades 4–6 comprise the primary school level (Grades 1–6). The third stage encompasses the lower secondary Grades 7–9. Education at comprehensive school levels (Grades 1–9) in both Finland and Sweden is free of charge. This means that there is no payment or fees for teaching, textbooks, or other school material. Finland and Sweden have 100 percent funding of comprehensive school, which is rare and exists only in Finland, Sweden, and Norway (<https://www.ekonomifakta.se>).

Finland and Sweden both have a national core curriculum, renewed regularly, providing an overall outline for school education including the content and goals of teaching. The Finnish national core curriculum for basic education [FNBE] from 2004 (Opetushallitus, 2004) and the newest Swedish national core curriculum –Lgr11, Curriculum for the compulsory school, preschool class, and the recreation centre (Skolverket, 2011), were the national core curriculums in use at the time of the data collection. The steering documents are very general in both countries (cf. Hemmi et al., 2019b, Hemmi, Lepik & Viholainen, 2013b) and leave a lot of space for teachers to plan and enact their teaching in their own ways. All schools in both countries are required to follow the national core curriculum (Hemmi, Krzywacki, Partanen, 2017b; Specialpedagogiska skolmyndigheten, <https://www.spsm.se>). Finnish teachers and schools are not controlled by external evaluation or monitoring. In Sweden there are national assessments [nationella prov, in Swedish] in mathematics for Grades 3, 6,

and 9. However, these tests are not for grading of the students, instead they should be used as a guidance for teachers about the performance level of the class. Further, the School inspectorate monitor the schools in Sweden.

Curriculum materials in both countries are published by commercial enterprises. There is no state control of published materials since 1991 in Sweden and since 1992 in Finland (Hemmi & Ryve, 2015a; Kaasila, Hannula, Laine & Pehkonen, 2008). Curriculum materials in both countries are often written by experienced teachers or teacher educators who write these materials beside their regular teaching job. The traditional Swedish curriculum materials vary greatly, at least at the primary school level (Hoelgaard, 2015; Neuman et al., 2015; Sayer et al., 2019) and the development and publishing of teacher guides in Sweden has not had the same importance as student textbooks. In contrast, the development of mathematics textbooks and teacher guides has had an important role in introducing new ways to teach mathematics in Finland (Asami-Johansson, 2019; Pehkonen, 2004). In general, Finnish teachers rely on and find the curriculum materials as a guarantee of good quality in mathematics education (Pehkonen et al., 2017b). Further, many Finnish teachers use the included suggestions in almost every lesson for various purposes, but especially for exercises in classrooms and for homework tasks (e.g., Lepik, Grevholm & Viholainen, 2015).

Teacher education aimed at primary school teachers (Grades 1-6) in Finland has been research-based since several decades (Pehkonen et al., 2017a). It comprises a master's degree in pedagogy (Niemi, 2012; Niemi, Toom, & Kallioniemi, 2012). The teaching profession has a high status in Finland and primary-school teacher education is popular (Krzywacki et al., 2016; Sahlberg, 2011; Simola, 2005; Välijärvi, 2004). In Sweden, there has been a gradual movement towards research-based teacher education since 1977 (Grevholm, 2006; 2010). However, there is still a no requirement of master's degree at primary school level. Teachers at primary school level achieve a Bachelor of Art degree when graduating. Finland has a long tradition of practise schools, in connection to universities, where student teachers do their main practise. In Sweden, the practise is mostly conducted in ordinary schools, but it is becoming more common to also organize practise in specific practise schools connected to universities.

Teachers (Grades 1-6) in both Finland and Sweden are expected to teach most of the subjects covered in the curriculum. Finnish and Swedish teachers have a great deal of autonomy. Besides having the responsibility to choose which curriculum materials and assessment materials to use, they can also choose in what order and how to teach a subject as well as which teaching methods to use. Teachers are moreover responsible for supporting learning of students in heterogeneous classrooms and thus to help all students to progress in line with the principles of the national core curriculum. Finnish and Swedish teachers also usually follow a group of pupils for several years.

3.3 The selection and analyses of the teacher guides

Three of the studies (Paper I, II and III) in the thesis make explicit use of qualitative content analysis (Bryman, 2012; Hsieh & Shannon, 2005) of teacher guides. The text and the figures in the selected guides were analysed through different approaches relevant for the research questions. In the following section, I present the selection of the teacher guides, sampling of the content and how the content analyses were conducted.

In the study presented in Paper I, on similarities and differences within and between Swedish and Finnish curriculum materials in mathematics, we analysed and compared teacher guides for Grade 1 from two different textbook series in Finland and Sweden, as to what kind of support they offer to teachers. The choice of teacher guides was based on two criteria, namely, representing commonly used curricular materials in Finland and Sweden, respectively, and representing an older and a newer curricular material. A direct, or deductive approach (Bryman, 2012; Hsieh & Shannon, 2005) was used when analysing the content of the entire teacher guides and their educative potential with an analytical tool developed from Davis and Krajcik's (2005) educative guidelines in science. The analysis comprised pedagogical support, support for mathematics, progression and connections, as well as connecting theory and practise. To develop an analytical tool was important, since we were not aware of any existing frameworks in the Finnish and Swedish contexts that could be used for investigating curriculum materials in mathematics. Hence, the study in Paper I was important for the entire research process and served as a starting point for later studies.

In the study presented in Paper II, on what kind of resource the Finnish teacher guides for Grades 1-6 constitute for teachers, we chose teacher guides for Grades 1, 3 and 5/6 from four textbook series that together covered almost 90 percent of the Finnish market and hence were commonly used by teachers. The textbook series comprise both older and newly produced materials. We noticed that the tool based on Davis and Krajcik's (2005) framework, presented in Paper I, had limitations, since it did not cover the entire content profile of the Finnish curriculum materials. In Paper II, we therefore continued with the construction of an analytical tool where we focused on the contextual issues when mapping the content of the Finnish guides. We noticed a need to develop two separate analytical tools to match the content of Finnish teacher guides better. The focus of the new analytical tool covers both the content and how the content was communicated to teachers. For the analysis, we selected three different sample lessons from the guides. The introductory texts and the introduction to the chapter supporting the chosen sample lessons were also analysed. We used a conventional or inductive approach (Bryman, 2012; Hsieh & Shannon, 2005) to the text as codes were derived from data iteratively, and

we gained a deeper knowledge about the character of Finnish curriculum materials and knowledge about Finnish educational features.

In the study presented in Paper III, on identifying the cultural norms of the potentially constructed classrooms, we analysed the recurrent activities of teacher guides (teacher-led instruction; mental calculation; problem-solving; games and play activities; and homework). Again, four commonly used teacher guides were chosen based on the same criteria as in Paper II. The rather coherent structure and form, as well as recurrence of activities included in the Finnish guides (Paper II), made me curious about possible underlying norms or pedagogical features. I therefore decided to continue to dig deeper into one category 'Design of teaching' of the five categories developed in Paper I. The recurrent activities of the teacher guides at three grade levels (Grades 1, 3 and 6) were first identified to perceive the picture of the most common lesson features at primary-school level. To access the underlying structures and norms of potentially constructed classrooms, I modified the concepts form and function from Clarke and colleagues (2007) to use them for analysing data supplied by texts instead of classroom observations. In doing so, we were able to capture the didactic aspects (what, how and why) of the recurrent activities. A summative approach (Hsieh & Shannon, 2005) was applied to the recurrent activities. The analysis was conducted in three steps to understand the contextual use and the underlying meaning of the content used. First, each randomly chosen recurrent activity was separately analysed. All the analysed activities were then grouped and investigated within their respective activity type (e.g., mental calculation is one such group). From all the five merged summaries, commonalities were finally drawn from the patterns emerged and perceived as conceivable norms (see Paper III).

3.4 Case studies - teachers' interaction with Finnish materials

The studies presented in the two final papers make use of case study as research strategy (e.g., Bassey, 1999; Creswell, 2013). By a case study, I mean an in-depth investigation of a social and contemporary phenomenon, in its natural setting (cf. Bassey, 1999; Creswell, 2013; Wellington, 2000) where "the boundaries between phenomenon and context are not clearly evident" (Yin, 1984, p. 23). The cases in this study are investigated with different methods and with qualitative analysis. The case study approach provided the depth that was needed when investigating Finnish and Swedish teachers' interaction with a Finnish curriculum material, especially when focusing on emerged patterns or norms (e.g., Stigler & Hiebert, 2009; Andrews, 2007).

3.4.1 The cases

The selection of the teachers was based on specific qualifications: holding a formal education in teaching and certified to teach mathematics in Grades 1-6; regarded as a locally competent³ teacher; using a teaching material with the same Finnish origin and representing different Grade levels. Each case consists of a primary school teacher (Grade 1-5), eight teachers (cases) in total. I have given the participating teachers pseudonyms to protect their privacy. The four teachers from Finland are Anja, Crista, Jukka, and Erkki whereas the four teachers from Sweden are Anna, Cecilia, Diana, and Eva. The participating teachers had from five to 29 years of teaching experience (see Table 2 and Table 3) and they had mostly been working with students in lower grades.

All four Finnish teachers worked at the same university practise school in one of the biggest cities of Finland and were considered as well qualified. Two of the teachers have two exams, besides in teacher education also a PhD for Anja and a subject teacher education for Erkki. The four Swedish teachers were appointed as either head of mathematics (*ämnesföreträdare i matematik*, in Swedish) or a lead teacher⁴ (*Förstelärare*, in Swedish). All teachers in this study are, therefore, regarded as locally competent (cf. Clarke, Keitel & Shimizu, 2006). They are all linked to a university by offering supervision for student teachers. However, the Swedish teachers were working at three different practise schools within a major city/municipality with diverse characteristics as to students' socio-economic backgrounds and the number of immigrants. One of the schools was located in a rural area. The Finnish teachers used different textbook series, but all teachers, except Erkki, were familiar with the series they used. Erkki was trying out a brand-new textbook series.

All Finnish teachers stated that they had chosen the curriculum materials themselves and that they all used the teacher guides a lot. The Swedish teachers used the textbook series *Favorit Matematik (FM)* which was new only to Diana. Analyses of this originally Finnish teaching material is presented in Papers I, and II. The Swedish version includes some additional elements, for instance, references to the Swedish national core curriculum. Among the Swedish teachers, only Cecilia did not choose the teaching material herself, since it was already chosen for her before she began to work at the school. Cecilia tells that she continued using the material since she fancies and enjoys it. Two Swedish teachers Anna and Diana stated that they used the teacher guides extensively; Eva somewhat regularly, whereas

³ "Locally competent" is a term coined by Clarke (2006). It means that teachers are recognised and esteemed for their 'teaching competence' and have been nominated by the school's principal and the municipality and thus regarded as a local subject specialist.

⁴ *Förstelärare* in Sweden has been a career opportunity since 2013 for particularly skilled teachers in comprehensive school and upper secondary school. The school's principal and the municipality nominate these teachers and they are recognised and esteemed for their 'teaching competence' and regarded as a local subject specialist. The teachers are also often responsible for educational development work.

Cecilia stated that she did not use the teacher guides more than to have a glance at them.

Table 2. *Background of Finnish participating teachers by 2015/2016 (year)*

	Anja, Grade 1	Christa, Grade 3	Jukka, Grade 4	Erkki, Grade 5
Education & Certification	Teacher education, 1-6, Master of Education; PhD in pedagogy wherein she focused on mathematics	Teacher education, 1-6, Master of Education.	Teacher education, 1-6, Master of Education.	Teacher education, 1-6, Master of Education; Subject teacher in Finnish language & literature
Gender	Female	Female	Male	Male
Teaching experience	13 years	22 years	28 years	29 years
Students in class	19 students	25 students	25 students	24 students
Material experience	3 years	2 years	Many years	0 years

Table 3. *Background of Swedish participating teachers by 2015/2016 (year)*

	Anna, Grade 1 School A	Cecilia, Grade 3 School B	Diana, Grade 4 School C	Eva, Grade 5 School B
Education & Certification	Teacher education, 1-5. B.A in science, mathematics & civics. Head of mathematics	Teacher education, K-6. B.A in language, play & learning in mathematics. Lead teacher	Teacher education, 1-7. B.A in science & mathematics. Head of mathematics	Teacher education, K-6, B.A in science, mathematics & music. Head of mathematics
Gender	Female	Female	Female	Female
Teaching experience	10 years	5 years	18 years	20 years
Students in class	20 students	24 students	26 students	18 students
Material experience	5 years	2 years	0 years	5 years

3.4.2 Data sources and analysis

Eight teachers participated voluntarily in the study. A written description of the study was delivered to the teachers. The data sources consist of one semi-structured interview per teacher and video-recordings of three consecutive lessons with each teacher. In addition, the parts of the teaching material relevant for the lessons were explored. The different data sources

made it possible to triangulate the data (cf. Creswell, 2013) offering a nuanced picture of the teachers' interaction with the materials.

The interviews lasted between 50 and 110 minutes each and resulted in almost 9 hours of audio recordings (see Appendix B). The interview guide for these interviews was designed based on themes relevant for the purpose of the study: teacher's education; teacher's experience; school settings; classroom culture; beliefs about mathematics and its teaching; teacher guides; and planning of lessons (see Appendix C). The relatively few but open questions provided a structure and information through probing and follow-up questions, while the interviewees were given opportunities to speak freely as well as to clarify and develop their answers. In doing so, I could understand more in depth what was said (cf. Kvale & Brinkman, 2014). The interview guide was tested with eight teachers (six Swedish teachers and two Finnish teachers), who did not meet the criteria for the study and therefore could not be included in the research. During these test interviews, I evaluated the interview questions and identified different interpretations of words. One example is the term 'typical', which worked well in the Swedish context but not in the Finnish, where I needed to make clarifications. This issue I was not able to foresee with my limited pre-knowledge of the Finnish context. My most important insights from this stage of the research process related to how teachers understood the questions, how long an interview would take and if questions should be added or deleted. I also noticed what kind of data I might obtain from the questions asked.

Before the videotaping, I visited all the participating classes during one mathematics lesson. I introduced myself and explained why I would be there and what I would do. The students were also given the opportunity to ask questions. When videotaping one camera was situated at the front of the class, facing the classroom, and capturing students' actions and talk, while the other camera was movable and placed more in the middle of the classroom. This camera followed the teacher and captured the teacher's actions and talk. The static camera had an external microphone that caught talk in the classroom. The teachers were equipped with a small microphone which captured the conversation between the teacher and individual students. In total 24 mathematics lessons lasting for 40-60 minutes each were recorded resulting in about 19 hours of video data (see Appendix B).

The transcriptions, as well as the analyses of the interviews and the lessons, were conducted in original languages. Only those excerpts that are presented in Papers IV and V were translated into English. I did all the transcriptions myself, which enabled me to start the analysis by making notes but also to take out illustrative photos from the video recordings to include into the video transcriptions. The processes of analysis of the studies presented in both Papers IV and V were inspired by thematic analysis (Braun & Clarke, 2006), by focusing on emerged patterns, and

involved several stages. This process was not linear, more of a back-and-forth process where I commuted between the whole and the parts.

The single case study presented in Paper IV, explores how one Swedish teacher interacts with a Finnish guide and how that interaction influenced her classroom practise. I applied a deductive approach when using Brown's (2009) three analytical constructs (see section 2.1.2) to characterise the teachers' interaction with the curriculum material. These results were then compared to the video-recorded lessons in determining how the teacher's interaction with the Finnish teacher guides influenced the classroom practise and how that complied with the lesson suggestions of the teacher guide. The multiple case study presented in Paper V, focuses on tacit cultural practises of mathematics teachers' classrooms when teachers use a Finnish teacher guide. The thematic analysis started with organizing the data sources. First each teacher's individual lessons were organised by structure and content. In the next stage, each teacher's three lessons were grouped and a search for similarities and differences of patterns started. The lessons were analysed in three stages with different approaches and frameworks; the organisation of the lessons using the constructs of classwork and seatwork (O'Keefe et al., 2006); the lesson structure focusing on what teachers do, and use from the materials; and the features of classroom talk during the periods of classwork (Boaler & Brodie, 2004). Finally, the teachers were grouped according to their nationalities into two groups. The emerged commonalities within each group were merged to visualise patterns of norms. These results were then compared with the interview data.

The starting points of these two case studies differ. The take off in Paper IV was to focus on teacher and curriculum interaction whereas the take off in Paper V was on emerged classroom practises when using the Finnish material in two cultural-educational contexts. This change to a primary focus on videotaped data instead of interviews was necessary in order to access the cultural norms directly and to obtain new insights.

3.5 Ethical considerations and trustworthiness

In the research process the ethical requirements and recommendations made by the European code of conduct for research integrity (ALLEA, 2011) were considered and followed. I have strived to open up the research process, from describing the different choices made, the processes of framework modifications and adopted frameworks used as lenses, in order to show, in a clear and transparent way, how the data collections and analyses were carried out. The studies presented in Papers I, II and III are based on text analyses and did not include informants in the usual sense. However, the responsibilities towards publishers of the textbook series have been considered by conducting a stringent and transparent analysis with relevant analytical approaches. Several ethical considerations are

however made in the case studies (Papers IV and V) and presented below. The four ethical principles: information, informed consent, confidentiality, and utilisation (Bryman, 2012) have been dealt with in the following manner.

Regarding information, both teachers and students received oral and written information about the purpose of the thesis research project. I participated in one lesson in all the eight classes before the actual videotaping. In doing that, the students could ask me questions and then recognise me when the videotaping started. I emphasised that the focus in the thesis research project was on the teachers' thoughts and actions in planning and classroom practise, whereas the students were in the background. I stressed that participation in the research was voluntary, and that both teachers and students could withdraw at any time. A special consideration was made to the information of students in a language that was accessible to them. Information about the thesis research project was given both in a letter before the study commenced and orally just before the interviews and the classroom observations to underline the voluntariness. Regarding consent in Sweden, I obtained a written consent from the parents of the students participating in the videotaped classrooms, since the Swedish practise schools did not have an overall consent that embrace all activities that schools accept. In Finland, on the contrary, the university practise school administer a letter of consent at the beginning of every school year in order to manage all visits they receive. Hence, no written individual consent was needed from the Finnish parents. In both Finland and Sweden, consent was orally obtained from the teachers. Regarding confidentiality, all informants were informed that their anonymity would be insured, so no names, schools or municipalities could be identified. All names adopted are thus fictive and pseudonyms were chosen from a list of common names given to teachers within respective country and in accordance with their gender. In all conversations and presentations, I have used the pseudonyms. The collected material is stored safely, in a locked safe when not in use. Regarding utilisation of the material, it was clarified at the beginning, both orally and in written form, that the video-recorded lessons, the audio-recorded teacher interviews, as well as the transcribed material from them would only be used for research purposes by me, and my co-workers.

Trustworthiness is used for judging the quality of qualitative research and can be divided into credibility, transferability, dependability, and confirmability (Bryman, 2012; Hsieh & Shannon, 2005). Below I discuss foremost the decisions, which I regard as most crucial in relation to the studies.

Credibility deals with how well the data and the processes of analysis address the focus of the study. The main concern in Paper I was related to the development of the categories, since it is impossible to design coding that does not incorporate some interpretation. I estimated that the simple

coding, with a three-step rating, as follows: (+) when the category occurred sporadically, for example on some lesson/information/chapter pages; (++) when the category occurred regularly in every chapter but also in several lessons as well; (-) when the category was absent, minimised the probability of differing ratings, since the three codes were clearly separated. Hence, the subjectivity was minimised by analysing the content systematically with this simple rating. In Paper II, the initial analysis was conducted separately to test and unify the interpretations of the developed categories. All the categories were exemplified with authentic extracts from the teacher guides making the analysis transparent. I was involved in all the analyses in all the papers, sometimes alone and sometimes in cooperation with the other authors. In Papers I and II, all authors, had a continuous co-operation throughout the process, while in Papers III, IV and V, I discussed and reasoned together with the co-writers and supervisors in agreeing on the findings and the interpretations (cf. internal reliability in Bryman, 2012), in order to strengthen the credibility. To strengthen the credibility in Papers IV and V, I used several data sources for triangulation (interviews, video-recorded observations and relevant parts of the teacher guides), since these offer different kinds of information (Denscombe, 2009). For example, Cecilia one of the participating Swedish teachers, told at the interview that she does not use the curriculum materials for planning or enactment of lessons. She does not believe in following other people's plans, instead she creates her own introduction ('genomgång') based on the students she has in her class. However, students follow the student's textbook. The video recorded observations show that Cecilia used the exact same exemplary tasks that are found in the curriculum material. I was able to notice this because I have analysed the curriculum materials. This was true for all three observed lessons. The interviews and the lesson observations were recorded by both audio and video as another way to strengthen the credibility. The large amount of data sources related to Paper V exposed an unexpected issue, which was the risk of including irrelevant data and/or excluding relevant data. To avoid these pitfalls, I attempted to maintain a transparent process of the analyses and I regularly consulted colleagues and supervisors. For this, I received feedback from the reviewers, in several cycles. They helped me forward so that I was able to present the analysis clearly, accurately and in a straightforward way, as this is one of the most important indicators for judging a study's credibility. The analyses in all the studies have further been conducted in original language, which minimises loss of data and thus functions to strengthen the credibility of the thesis.

Transferability relates to replicability and generalisations (cf. external validity in Bryman, 2012). I have conducted analyses on Finnish teacher guides that cover approximately 90 percent of the Finnish market, using three different methods of analysis with different units of analysis. The different analyses provided both breadth and depth. I claim having provided enough detailed descriptions and rationales in relation to each study

description without going into too much detail on the two cultural-educational contexts, which aims to strengthen the transferability and thus the validity of my studies (cf. Cohen, Manion & Morrison, 2011). The teacher guides analysed for Papers I, II and III do not change, but the interpretations by different researchers may vary. Even though I used different theoretical frameworks to offer more transferability, it is still important to stress that it is my and my co-authors' interpretations, which may have been affected by who we are as persons.

In Papers IV and V, it became more complex since the informants' (eight cases consisting of teachers from two different cultural-educational contexts), as well as the researchers' interpretations, may vary. It can be argued that the results from the case studies are not transferable in any sense other than to this specific group of teachers within their specific context, and that no claim regarding generalization of the results could be made. However, I claim, and I do it with caution, that this group of teachers with specific qualifications is a subset of a larger group of teachers in Finland and Sweden. Thus, the findings most likely represent some norms of the two contexts. Specific circumstances, like activities and events in the cases reported in Papers IV and V, have been transformed into general circumstances in relation to existing scientific literature. This is called analytical generalisation (Fejes & Thornberg, 2015; Kvale & Brinkman, 2014; Yin, 2009).

Dependability relates to how I evaluate the findings and interpretations (cf. reliability in Bryman, 2012). I have in the introduction as well as in this chapter, explained and justified the design of the thesis, the rationale behind the choices, and how each study is related to the aims and the research questions. I have also presented necessary information in relation to the case studies (Papers IV and V) but only in so much detail as needed without revealing the schools or the participants' identities. Considerations have further been taken in relation to the insider-outsider perspective. In Papers I, II and III (cf. investigator triangulation, Wellington, 2012), the insider and outsider perspectives establish our position as researchers, where the position can be understood in the context of power and knowledge (Rabe, 2003; cf. also Clarke, 2013). An outsider's and an insider's descriptions are views from slightly different angles and, since both insiders and outsiders were included in the research group, we could observe and explain aspects of the guides which enriched the total outcome. In Paper IV and V, I regarded the many challenges within cross-cultural studies, insider- and outsider perspectives being one of them, which includes both languages and cultural-contextual issues. I consider this to be something that I have carefully been taking into account. For instance, I can understand the fine-grained nuances of both languages, and I have enough knowledge and understanding of both cultural contexts, which correspond with the native's perspectives.

When improving two of the papers [articles], I needed to re-analyse the teacher guides several times. It could therefore be argued that too much

familiarity constrains the ability to approach data (Papers II and III). The same applies when I approached the transcripts of interviews and lesson observations in a familiar context, i.e., the Swedish (Papers IV and V). There is always a risk that one might affect or miss aspects in relation to interpretations. However, I claim that this was not a problem, quite the reverse, the constant systematic analyses during the re-analyses has increased dependability as well as credibility. I have, moreover, considered several methods and data sources as a way to triangulate (cf. Wellington, 2012), in order to understand both the general and the specific regarding the interaction between a teacher and a teacher guide and the emerged lessons. Therefore, both the usage of different ways of triangulation and that I have discussed results with my fellow researchers during the research process have strengthened the dependability.

Confirmability relates to objectivity (cf. reliability in Bryman, 2012). I have obtained distance to my assumptions and preconceptions by relating the data to collectively developed frameworks (Papers I and II) and by using triangulation for the data analyses (Papers IV and V). My co-authors have been critical reviewers throughout the whole thesis research project and the results have been confirmed jointly. Confirmability is, thus, partly obtained by my frequent reflecting on, and discussing results with fellow researchers and supervisors. It is, however, important to stress that even if others will use the same frameworks as I have, they might interpret the categories differently and the results will thereby be different. There is always a matter of subjectivity in interpretative situations, as all interpretations are influenced not only by explanations and definitions, but also by the interpreter's personal perceptions and beliefs. In addition, all the papers have gone through peer-review processes where the different reviewers of the journals have acted as critical friends. Three of the papers (Papers I, IV and V) have been presented at international conferences and were thereby open for critique.

4. Summary of the Papers

In the following chapter, each paper is briefly summarised. The summaries mainly focus on the aims, results and the conclusions as both theory and methodology have been elaborated in previous chapters. The results of the papers are used in the next chapter to discuss the overall aim of the thesis. The papers are attached in full as appendices for further reading.

4.1 Paper I

Title: Analyzing mathematics curriculum materials in Sweden and Finland: Developing an analytical tool.

Paper I describes the results of an analysis of mathematics teaching materials. The study presented in the paper helps to answer the first research question (see Figure 1); what kind of support do the Finnish teacher guides offer teachers in mathematics education? The study aims to contribute to two interrelated areas. Firstly, it adds to the knowledge about teacher guides and their potential for various kinds of teacher learning in two neighbouring countries – Sweden and Finland, with quite similar school systems but different teaching styles (e.g., Hemmi & Ryve, 2015b). The rationale for using a comparative approach was that through a process of investigating similarities and differences in curricular materials from two countries, we could reveal some taken-for-granted and hidden aspects (cf. e.g., Andrews, 2010) of teachers' work in classrooms. In turn, such findings could contribute to the international research discourse on aspects of curriculum materials and their influence on teaching and teacher learning. Secondly, it aims to develop an analytical tool for analysing curriculum materials. To accomplish this aim, a framework to fit mathematics was constructed based on Davis and Krajcik's (2005) guidelines of five educative features. The five predetermined categories were modified and converted into an analytical tool; 1) general knowledge of students ideas and strategies and suggestions for how to encounter students' ideas and strategies; 2) concepts and facts; 3) progression and mathematical connections; 4) connecting theory and practise by understanding designers' rationale for pedagogical choices; and 5) design of teaching. These ideas originate from Ball and Cohen's (1996) well-established ideas about Mathematics Knowledge for Teachers (cf., also Ball, Thames & Phelps, 2008). The theoretical stances in this study are in line with Brown's (2009) theories, according to which teachers and curriculum materials (artefacts) participate together in a collaborative relationship in teachers' professional practise (see section 2.1.2). We conducted content analysis consisting of both quantitative and qualitative features in two Swedish and two Finnish teacher guides for Grade 1.

In relation to the first aim of this paper, the data analysis revealed significant differences between the guides both within and between the countries. Two of the guides (FIN 1, SWE 2) deal with topics connected to all five analytical categories. FIN 1 deals extensively with these topics and might thus be regarded as a resource for potential teacher learning in practise. The other Swedish guide (SWE 1) totally lacks these qualities and can therefore not be regarded as resource for potential teacher learning in terms of the qualities connected to the different analytical categories. Both Finnish guides focus on lesson plans with additional ideas for teaching, such as mental calculation, problem-solving, games and homework in connection to every lesson. This is not the case with the Swedish materials, which leave more space for the teacher to decide which units to use in their teaching. This indicates that the difference in the 'found' categories could connect to differences in teachers' work in practise.

In relation to the second aim of this paper, the data analysis reveals that the first four categories of the tool worked well in their current design, whereas the fifth category was very general and hence, of minor help for describing the qualities of the resources offered by the teacher guides. The evaluation of the functionality of the analytical tool was done in collaboration with research colleagues. It was an advantage that we discussed and analysed the guides together, in consolidating the tool. The five predetermined categories that were examined showed that Category 1 should be kept but divided into 1a (General knowledge of students' ideas and strategies) and 1b (Suggestions for how to encounter students' ideas and strategies), since interesting differences emerged in the empirical data; for instance, one textbook series consistently excluded 1b, while another guide frequently presented support related to it.

To conclude, the findings from this paper show significant differences between the investigated guides both within and between the countries. However, the most significant results are related to the development of the analytical tool, which was further conducted in the next investigation of Finnish teacher guides (Paper II).

4.2 Paper II

Title: Investigating Finnish teacher guides as a resource for mathematics teaching.

Paper II deepens our knowledge about the characteristics of Finnish teaching materials. The results of this paper also help to answer the first research question (see Figure 1); what kind of support do the Finnish teacher guides offer teachers in mathematics education? This study adds to the knowledge of Finnish teacher guides and their potential from two main perspectives: the characterisation of content (cf. Davis & Krajcik, 2005) and the nature of communication (cf. Remillard & Reinke, 2012; Brown, 2009).

The study addresses the following question: What kind of resources do Finnish mathematics teacher guides (Grades 1-6) constitute for teachers? The most used Finnish mathematics teacher guides, covering almost 90 percent of the market of Finnish schools in 2008 (Joutsenlahti & Vainionpää, 2010) were investigated. A content analysis was conducted on sample lessons of topics that represent different mathematical areas and central themes at different grade levels. In addition, we analysed the general introduction to the material and the introduction to the chapters supporting the chosen lessons from each teacher guide. This study is embedded in a socio-cultural frame where guides are considered as mediating artefacts and cultural products (Vygotsky, 1978; Wertsch, 1998). They are thus, seen as resources for the design of mathematics classrooms and constitute an important component in the participatory relationship between the teacher and teacher guides (see section 2.1.2).

Three main content categories were established, which constitute the basis for profiling the nature of the content of the teacher guides: 1) information about the use of material; 2) mathematical concepts and facts; and 3) pedagogical support. The analysis revealed that all the guides provide rather detailed descriptions of the different parts, mostly located at the beginning of the guide, in the introductory part and at the beginning of each chapter. They also offer information about the structure and content of students' textbooks, and all guides point out the place of homework in student's lesson pages, as well as pages for individualising teaching in connection with every lesson. In addition, suggested teaching sessions at lesson level is a theme that all the guides approach quite profoundly, and they describe some general ideas concerning teacher-led teaching within the different mathematical topics. Mathematical concepts and facts are hardly discussed in any part of the materials, whereas pedagogical support, on the other hand, dominates the contents of the guides. However, the pedagogical support is elaborated differently, since all the analysed teacher guides offer goals, teaching, assessment, and differentiation in teaching methods for diverse learners as central themes.

The nature of communication was approached through three aspects: 1) mode of the text; 2) rationale behind the suggested activities and procedures; and 3) flexibility of use. The data analysis revealed that all the teacher guides tend to provide rather general information for teachers instead of explicit scripts when proceeding with a lesson. Thereto, most of the teacher-led teaching sessions at the lesson level are mixed in mode. It is common to use lists, tables, and figures when communicating about ideas at all levels. In addition, there are few accounts of the rationales behind the recurrent activities. None of the guides provides a thorough description that would help users understand the ideas underlying the different parts and the connections between them. Concerning the rationale behind the pedagogical support, all the guides include some motives for the main topics of teaching and learning mathematics, such as, proceeding from the concrete

through mental strategies to automation. Overall, the Finnish teacher guides seem to be relatively normative as they often state, “it is good to proceed” in a certain way, “pupils need,” or “teacher needs”. Most of the teacher guides inform that the recurrent activities, like mental arithmetic, problem solving, and games, are only suggestions that a teacher can utilise in flexible ways for their own purposes. All the guides offer separate activities for diverse learners, and all the guides offer differentiating tasks at the lesson level.

To conclude, the findings in this paper show that the structure and the main content of the analysed guides are quite homogeneous, in that the pedagogical support dominates the content, while mathematical concepts and facts are rarely discussed. The nature of communication is mostly descriptive, and separate activities suggested for each lesson are explicitly described. The suggested recurrent activities, such as mental calculation tasks and homework assignment, are typically motivated by non-specific rationale, and many activities seem to be taken for granted in the Finnish mathematics classroom culture. For instance, teachers are offered a lot of information, but they must decide autonomously precisely how to act and carry out activities in the classroom. Thus, this investigation indicates that teacher guides may say something implicit about the classroom practises, which is the focus in Paper III.

4.3 Paper III

Title: Analysing the nature of potentially constructed mathematics classrooms in Finnish teacher guides – the case of Finland.

Paper III presents the results of a text analysis by means of a novel analytical approach in the context of text analysis. The results from this paper help to answer the second research question (see Figure 1); what underlying cultural norms can be distinguished in the Finnish teacher guides in mathematics? We understand cultural norms as the regularities of the practise and the social interaction established by a group regarding what is perceived as acceptable or desirable. Moreover, the values of a culture shape norms, and involve taken-as-shared ideas of what constitutes an appropriate and desirable mathematics classroom (cf. Hiebert et al., 2003). Our approach rests, thus, on the assumption that cultural-educational values and norms are embedded in the text of teacher guides, as they are regarded as cultural system-specific artefacts (e.g., Hemmi et al., 2019b; Pepin et al., 2013a) (see section 2.2.2). Besides the methodological contribution, this study also contributes to international research on teacher guides as well as knowledge about the features of the Finnish mathematics education tradition. The following question has guided our study: What kind of potentially constructed mathematics classrooms do the recurrent activities of Finnish teacher guides mediate? By potentially constructed mathematics classrooms, we refer to implicit and explicit ways

in which the guides construct mathematics classrooms. We analysed the guides' five recurrent activities (see Paper III): teacher-led classroom teaching session; mental calculation; problem-solving; games and play activities; and homework, through the notions of form and function (Clarke et al., 2007; cf. also Clarke & Mesiti, 2003). This investigation aimed to identify what kind of potentially constructed mathematics classrooms that are mediated by the recurrent activities in Finnish teacher guides at primary-school level.

We found three intertwined and overlapping features within all activities: (1) creating opportunities for learning through a variety of activities and communication; (2) keeping the class gathered around a specific mathematical topic; and (3) concurrent active involvement of teachers and students. These key features represent the joint pattern of the embedded underlying cultural norms, mediating the image of a constructed mathematics classroom. These features further mediate the picture of advocating whole-class teaching around a specific goal or topic. We claim that these norms capture important elements of what seems to be significant factors of Finnish mathematics teaching, and they jointly reflect teaching as a whole-class activity. All the activities in the guides are to be presented and led by the teachers with the purpose of offering the students an opportunity to learn specific mathematical content, through both variation (task differentiation) and communication as means, whereby students should share their thinking and contribute to the joint whole-class discussion. Keeping students gathered around a topic, and within the same mathematical content area, is a fundament for allowing them to be involved in whole-class collaboration during the mathematical tasks for teaching. Homework serves as a mechanism to ensure that all students are properly prepared for following the next lessons. The active involvement of teachers and students is visible throughout all the analysed five recurrent activities. Students are engaged in various ways, for instance, through individual practising of the core mathematics by mental calculation and/or through game and play activities, whereby the mathematical topic of the lesson is often practised in groups or pairs. Teachers always present these activities and are involved in their performance.

We conclude that the methodology of a systematic examination of a set of dominating teacher guides and their form and function might be a productive approach for mapping the underlying cultural norms; with the presumption that teachers use guides, and that they are uniform. Under these conditions, teacher guide analysis is an alternative methodological approach to investigate cultural norms. The empirical results from this paper further show that three cultural norms are present in the potentially constructed Finnish mathematics classrooms, and they jointly reflect teaching as a whole-class activity. However, more research is required to complement the text analysis with interviews and classroom observations

in order to validate whether this portrayal is the actual Finnish model or not. That is my focus in the next Paper (Paper IV).

4.4 Paper IV

Title: Finnish teaching materials in the hands of a Swedish teacher: The telling case of Cecilia.

The results from Paper IV help to answer the third research question (see Figure 1); how do Finnish and Swedish teachers interact with the Finnish teacher guides? This paper presents a case study of Cecilia, a Swedish primary mathematics teacher, locally regarded as competent by the school principal and the municipality (cf. Clarke et al., 2006). Thus, Cecilia was regarded as a local subject specialist. The aim is to expose Cecilia's interaction with an imported teaching material from Finland, called *Favorit Matematik* (FM). Due to the different character of classroom practises in Sweden and Finland, it is of interest to investigate a Swedish teacher's interaction with a Finnish teaching material, more precisely with the teacher guide, to compare the written and the enacted curricula grounded in two different cultural platforms.

The position taken in this paper builds on socio-cultural theories, assuming that teaching materials have a potential to support teachers in their work with designing and enacting teaching. Teaching is viewed as a cultural activity manifesting a cultural script (cf. Stigler & Hiebert, 2009, see section 2.1). Analyses were made of one transcribed interview and three consecutive video-recorded mathematics lessons. In the analysis, I compare the potentially constructed lessons in the teacher's guide with Cecilia's actual classroom practise through different degrees of artefact appropriation: offloading, adapting, and improvising (Brown, 2009; see section 2.1.2). The analysis aims to answer the following questions: 1) how does a Swedish primary school teacher, locally regarded as competent, interact with a Finnish teacher guide while planning and implementing teaching? 2) How does this interaction influence the classroom practise?

In relation to the first question, my analysis revealed that Cecilia used the student textbook and hardly ever the teacher guide for and in teaching, and that she offloaded agency to the textbook. This interaction is categorised as non-participatory since it lacks intimacy. Cecilia's interaction with the teacher's guide was even weaker, and more sporadic and tacit than with the textbook. Cecilia stated that she creates her lesson plans. However, her focus was not on the entire lesson, since she prepared only for the short introduction (in Swedish, *genomgång*), which is the teaching phase.

In relation to the second question, my analysis revealed that Cecilia's classroom practise mirrors the "typical Swedish" practise, with short introductions and then individual seatwork, which is working in the student's textbook, most of the time. Cecilia does not keep the students

together around a specific mathematical topic by using the curriculum materials embedded differentiation; neither does she use concrete materials during these three lessons. No lesson objectives are stated. These are all important parts of the cultural norms found in Finnish teacher guides (Koljonen et al., 2018). Thus, Cecilia's classroom practise contrasts with those promoted by the Finnish teacher guide. I consider that Cecilia's practise is marginally affected by her relationship with the material.

My conclusion from this paper is that the use of the originally Finnish teaching material has not had the intended impact on practise as promoted by the guides. Instead, Cecilia's actions originate from and confirm her pre-existing culture (cf. Davis, Janssen & Van Driel, 2016; Stein et al., 2007; Stigler & Hiebert, 2009). To understand this phenomenon better, I continued to investigate and compare several Finnish and Swedish teachers' interactions with the same materials, as well as their enacted classroom practises, in the next study (Paper V).

4.5 Paper V

Title: Finnish and Swedish elementary school teachers' interplay with Finnish curriculum resources: An attempt at unraveling tacit cultural practices.

Paper V is a multiple case study (Yin, 2009) of four Finnish and four Swedish teachers, where each teacher forms a case. The data consist of 24 videotaped mathematics lessons: three consecutive lessons per teacher and one audio-recorded semi-structured complementary interview with each teacher. The results from this paper also help to answer the third research question (see Figure 1); how do Finnish and Swedish teachers interact with the Finnish teacher guides? The mathematics curriculum materials are regarded as artefacts used by teachers when designing and enacting teaching, and these artefacts reflect the embedded native cultural values (cf. Haggarty & Pepin, 2002). The aim is to investigate, through different kinds of analysis, tacit cultural classroom practises of Finnish and Swedish teachers when using the same kind of curriculum material while planning and enacting teaching.

The first analysis of the videotaped mathematics lessons identified a substantial difference between how the Finnish and Swedish lessons were organized. The dominating style in the Finnish lessons were classwork, CW (10/12), while in the Swedish lessons the dominating style was seatwork, SW (9/12).

The second analysis revealed differences in the structure of lessons. The Swedish lessons were all divided into two sessions: a teaching session and an individual student practising session, but somewhat differently between the teachers. The lessons always ended with students practising. The Swedish teachers included very few activities into classroom practises. Two of the teacher guides' suggested activities were used for teaching sessions

by two of the teachers; the digital frame-story, and the ready-made classroom instruction (*genomgång*). The student's textbook was used for students' practising and digitally shown on the board. The Finnish teachers' lessons showed both more, and a larger variation of, activities within each lesson and the lessons tended to end with a game or play activity. The guides' recurrent activities were all visible in the Finnish teachers' lessons and the teachers used several activities from the guides for each lesson, both for the teaching and practising sessions. The textbook was used as a complement for students' practising. Thus, Finnish classrooms contain a substantial variation of activities from the guides, which enable students to participate as contributing actors in many ways (cf. Klette et al., 2018).

The third analysis revealed how teachers enable students' participation and interaction during whole class teaching episodes (Boaler & Brodie, 2004). This analysis showed substantial similarities as well as differences among the Finnish and Swedish teachers' usage of questions. Both the Finnish and the Swedish teachers largely used questions type 1 (Gathering information, leading students through a method) and 4 (Probing, getting students to explain their thinking). However, Finnish teachers also used questions of type 2 (Inserting terminology), 3 (Exploring mathematical meanings and/or relationships), 5 (Generating discussion), and 6 (Linking and applying), which were almost absent among the Swedish teachers. Two of the four Finnish teachers used all nine question types, including 7 (Extending thinking), 8 (Orienting and focusing), and 9 (Establishing context) during the lessons. None of the Swedish teachers used all the nine question types.

Based on the findings, I conclude that the Swedish teachers' practises display versions of an individualised learning pedagogy, since they accommodate learning needs to individual students by giving a short introduction (*genomgång*), after which students work at their own pace in their workbooks (cf. Savola, 2010). The Finnish teachers' lessons, on the contrary, display a form of differentiated teaching pedagogy, in which teachers adjust the learning needs for a group of students by having students concurrently participate during the teacher-led activities and other group activities or constellations. Even though teachers in this study use the same textbook series, it is difficult to see the same recurrent elements both in the Finnish and in the Swedish mathematics classrooms. Consequently, the Finnish curriculum materials have not had the intended impact on the new Swedish cultural practise, as promoted by the embedded cultural values of Finnish teacher guides. Instead, this study tends to confirm the pre-existing culture in the Swedish mathematic classroom, rather than the one intended by the Finnish teacher guides (cf. Koljonen, 2017; Stein et al., 2007). I conclude that there are cultural similarities as well as differences between teachers within teachers' classroom practises in the two countries (cf. Haggarty & Pepin, 2002; O'Keefe et al., 2006).

5. Discussion

This chapter is divided into four sections. First, I answer the research questions, presented in section 1.1, and discuss them in relation to prior research. Thereafter, I accentuate the contributions before raising some of the limitations of the thesis. Finally, I give suggestions for further research.

5.1 Main findings

The studies of curriculum materials expose considerable similarities between the Finnish teacher guides regarding content, form, and nature of communication. The common characteristic of the Finnish teacher guides is that they are built as uniform packages offering potential support for a particular lesson design related to teachers' everyday teaching work (cf. Krzywacki et al., 2012). This lesson design includes a recurrent pattern of suggested classroom activities such as, ideas of instruction of new contents, mental calculation tasks, play and game activities, problem solving tasks, and homework. All the investigated guides also offer differentiating tasks at the lesson level. The suggested activities are mostly communicated by a descriptive voice (cf. Remillard & Reinke, 2012). The results indicate that the Finnish teacher guides are relatively normative. The guides do not provide descriptions that would help users understand the underlying ideas of the activities and the connections between them. Anyway, the Finnish teacher guides offer a homogeneous package with a rather detailed and direct support for a lesson design in a mostly descriptive voice. This summary answers the first research question about what kind of support the Finnish teacher guides offer teachers in mathematics education.

While Finnish teacher guides focus on the lessons, which coincides with findings from the US (Remillard, 2005), the findings contrast with studies of Swedish teacher guides, which tend to be structured around chapters and based on how to manage students' individual work (cf. Hemmi et al., 2013a; Sayer et al., 2019). One possible explanation for the differences between Finnish and Swedish teacher guides may be that it is often experienced teachers or teacher educators in respective country who write curriculum materials. The materials are assumed to be constructed in proximity to current traditions and norms of their educational contexts (cf. Pepin et al., 2013a). Previous research has also suggested that there exist more differences in curriculum materials between countries than within them (Charalambous et al., 2010; Remillard et al., 2014, 2016). However, in contrast to my findings that the Finnish teacher guides were relatively homogeneous, studies of Swedish teacher guides have revealed large differences between different teacher guides series (cf. Hemmi et al., 2013; Hoelgaard, 2015; Neuman et al., 2015). This raises questions, such as, why teacher guides look the way they do, and how they are used; if it is a matter

of culturally bound patterns, for instance, norms of teaching, influencing the design of teacher guides or if the form and content of the teacher guides influence the practises. Cultural norms are, however, not static nor similar within countries. There is also a variability in interpretations and usage of teacher guides which make this relation complex.

Since the Finnish teacher guides were so homogeneous, it makes sense to examine the cultural scripts in the guides and through these scripts draw conclusions about cultural norms in Finnish mathematics teaching. Analysis of the teacher guides revealed that the potentially constructed mathematics lessons of the guides incorporated three particularly distinct norms: (1) creating opportunities for learning through a variety of activities and communication; (2) keeping the class gathered around a specific mathematical topic; and (3) concurrent active involvement of teachers and students, jointly reflecting teaching as a whole-class activity (Koljonen et al., 2018). This answers the second research question about what underlying cultural norms are distinguishable in the Finnish curriculum materials.

These results are in line with previous results obtained by interviewing Finnish teacher educators, who mentioned the same recurrent activities found in the investigated teacher guides as important for good mathematics teaching, and they emphasized whole-class teaching (Hemmi & Ryve, 2015b). The Finnish teacher educators further commented on the importance of a balance between routines and variation. Assuming that these opinions, brought forward by the teacher educators, are aligned with the cultural norms and shared with the authors of the teacher guides; this may explain the richness of activities included in the guides, but also why there is little guidance in when and how to use each activity, and few explicit rationales that explain the ideas behind the pedagogical suggestions. If there is a system of shared norms, with the same recurrent activities included in both curriculum materials and among teacher educators in Finland, it is reasonable for authors of teacher guides to assume that teachers are well acquainted with such activities and therefore need no further motivation for their insert. A conclusion is then that the lack of rationales and explanations of the recurrent activities in the teacher guides are strong cultural norms in themselves. There is simply no need to explain what all teachers are already assumed to be familiar with. The practise of motivating the recurrent activities by non-specific rationales (Hemmi et al., 2017a) means that explicit rationales for how to use the activities remain invisible. I will discuss this below, in connection to the third research question concerning Finnish and Swedish teachers' interaction with originally Finnish materials.

The case studies I conducted with Swedish and Finnish teachers reveal strikingly different approaches when it comes to planning of mathematics lessons. The Finnish teachers plan for complete mathematics lessons involving teacher-led sessions as well as students' individual and group work, in line with the support in the teacher guides. Swedish teachers plan for a short teacher-led lecture, called *genomgång*. The Finnish videotaped

lessons also display a large amount of whole-class work (cf. Clarke et al., 2007), exposing the same three norms as found in the Finnish teacher guides, wherein teachers and students are concurrently active around the same topic and where different teaching and learning approaches are used (Koljonen et al., 2018). Analysis of the Swedish lessons did not reveal actions related to these norms.

The findings further display substantial differences in the sense of how the Finnish and Swedish teachers interact with the curriculum materials (Koljonen, 2019). In the terminology of Brown (2009), the majority of the Finnish teachers in this study mostly adapt the teacher guides (see Appendix D). They choose and modify the content by using the recurrent activities and sometimes also material from other publishers' teacher guides to fit the classroom situation. In contrast, the majority of the Swedish teachers offload their agency to the students' textbooks (see Appendix D). Overall, the findings on the Swedish teachers' work, largely conform with previous research. For example, the Swedish teachers' role is to motivate students and facilitate their work with textbook tasks (Hemmi & Ryve 2015a; Remillard et al., 2016) and for that, they often use students' textbooks, which do not include any pedagogical support. It is also known that it has not been common in Sweden to use teacher guides for planning and enactment of lessons (e.g., Skolverket, 2006). Moreover, the practise of starting lessons with a short teaching session and follow up with a large amount of individual student work, which was identified in my studies, also conform with existing research on Swedish classroom practise (Boesen et al., 2014; Johansson, 2006). I have, hereby, answered the third research question on how Finnish and Swedish teachers interact with the Finnish teacher guides.

In summary, while the norms distinguishable in the work of the Finnish teachers were aligned with the scripts noticeable in the curriculum materials, the Swedish teachers' work seemed to be guided by a completely different set of cultural norms that are further distinguishable as Swedish. The adoption of the Finnish curriculum materials by the Swedish teachers did not lead to the Swedish teachers adjusting their teaching towards the Finnish norms. Therefore, if the import of the Finnish curriculum materials to Sweden builds on an assumption that the Swedish teachers, armed with the Finnish materials, would teach in a way more consistent with the Finnish way of teaching, the analysis I have presented indicate that this has failed. Textbooks and accompanying teacher guides are, thus, not powerful enough to change teachers' practises, at least not in the cases presented here.

A prominent question is whether the design of curriculum materials examined in this thesis can explain the Swedish teachers' lack of adaptation. Finnish curriculum materials are not created as manuscripts with directive instructions for how teachers should proceed with lessons, like several of the US curriculum materials (Brown, 2009; Hemmi et al., 2017a). They are instead created as maps from which teachers choose, appropriate at time,

activities for each lesson. As I have explained, this is not a problem in the Finnish situation, where the general teaching norms are so close to the norms distinguishable in the curriculum materials. However, when importing the materials to another country, the lack of specific rationales and explanations of the activities may make it less likely that teachers use them in the same way as they are used in the culture where they were produced. So, if a curriculum material is imported from one culture to another culture, with the aim of changing norms and routines, it requires profound and thoughtful adjustments in relation to the existing new culture (cf. Tarr et al., 2006; 2008). Besides adjustments of the curriculum materials itself, also professional development is needed in how to use and adapt the components of the material (Ball & Cohen, 1996; Desimone, 2011; Kennedy, 2016; Shulman, 1986).

Research has shown that curriculum materials alone seem to have limited influence on teacher's classroom practises (Stein & Kaufman, 2010; Stein & Kim, 2009). Teachers need various support for their work with curriculum materials (cf., e.g., Beyer & Davis, 2009; Davis & Krajcik, 2005; Davis et al., 2014; Grossman & Thompson, 2008; Remillard 2000), through additional training/tutoring in how to use the material (cf. Cobb & Jackson, 2012). Teachers may, for example, need help to understand the ideas underlying the various parts and the connections between them (Davis et al., 2011; Stein & Kaufman, 2010), otherwise teachers may abandon the materials' ideas, and the embedding of the curriculum materials into the classroom practises fails (Ahl et al., 2015a). In fact, research by Hemmi et al. (2019b) displays a case where the Swedish teachers use a variety of the recurrent activities from the Finnish curriculum materials with the aim of changing classroom practises. However, those teachers had guidance from researchers about how to think and use the Finnish material. This was not the case with the teachers in my study. A more explicit teacher guide may make the Finnish material workable as an agent for change, as would an accompanying expert guidance (cf. Hemmi et al., 2019b).

To conclude, it is reasonable to consider that it could be possible and even fruitful to implement Finnish curriculum materials into the Swedish context, since Finland and Sweden are countries close to each other with many educational similarities (see section 3.3). However, this study has shown that it is not that straight forward, and there are obstacles when importing curriculum materials from another cultural-educational context, even if the environment and the educational cultures seem to be rather similar. Thereby, a curriculum material seems not to generate and establish culture by itself, but conversely; culture generates and establishes curriculum materials.

5.2 Contributions

The contributions of the thesis are empirical, methodological, and theoretical.

Insights gained from the five included studies contribute threefold to the field of mathematics education empirically (see section 5.1). First, the findings contribute to the international research field on written mathematics curriculum by characterization of Finnish teacher guides. Second, the findings contribute to the research area on enacted mathematics curriculum by investigating Finnish and Swedish teachers' interaction with originally Finnish teacher guides. Third, the findings also contribute to the field of cross-cultural research by deepening our understanding of the transition from the written to the enacted curriculum (Remillard & Heck, 2014; Valverde et al., 2002) in two different cultural-educational contexts.

Methodological contribution is offered by the development and use of the novel analytical tool in Paper III. For the first time in the field of text analysis, form and function (Clark et al., 2007) are applied to Finnish teacher guides to trace the underlying cultural norms of the potentially constructed mathematics lessons. Previously, research has reported on cultural norms through video data of classrooms (e.g. Stigler & Hiebert, 2009) or by interviewing teacher educators (e.g. Hemmi & Ryve, 2015b), as well as studying feedback discussions between student teachers and mentors (e.g. Corey et al., 2010).

The thesis contributes theoretically to the field of curriculum materials. The theoretical foundation used for analysing the teacher guides are developed based on ideas from Ball and Cohen (1996), and Davis and Krajcik's (2005) clarifying framework on what curriculum materials need to contain to support teacher's learning. Still, these thoughts were merely theoretical ideas. In fact, we did not know much about what curriculum materials, such as teacher guides, were offering teachers. Content analysis of textbooks were rather common (Fan et al., 2013), but the teacher guides were still a blind spot. The thesis shows that the iteratively developed tools (Papers I and II), anchored in research, are useful for investigating Finnish curriculum materials with regard to content and underlying norms. The framework initially sprung from ideas born in the US context, hence it is reasonable to believe that the framework also will work well in those contexts, as well as in all other contexts with similar organization of schooling.

The practical implications of the theoretical approaches of this thesis address several educational levels. Most important is that the findings indicate that it is, most likely, not possible to organize professional development of teachers only by using a curriculum material, even though it offers potential support for improvement of classroom practise. It is a tempting idea, but also an elusive wish, that the introduction of new curriculum materials in the end will have a positive effect on students' results. The cultural norms for teaching in Finland are reflected in the

Finnish teacher guides. It is easy for Finnish teachers to use the materials since the teaching practise informs the content and form in the teacher guides, not the other way around. In other words, the cultural norms forego the design of the Finnish curriculum materials' cultural scripts. Consequently, a material developed as a reflection of Finnish cultural norms will create a conflict for teachers working within a different cultural norm. Despite the teacher's wish to change her practise (Koljonen, 2017), the Swedish cultural norms prevent her from using the Finnish material as intended. Therefore, it is reasonable to believe that the launch of new materials aiming to change practise needs to come with a program for professional development in how to use them. This insight has implications, for instance, for publishing houses, authors of curriculum materials, and teachers.

Publishing houses that introduce imported materials may consider how to offer support for teachers' use of the material. If they want the material to both gain market share and maintain them over time, the teachers need opportunities to learn how to use the offered support. It is reasonable to believe that a successful use of Finnish teacher guides assumes that Swedish teachers may need to adapt some of the cultural norms from the Finnish classroom practises. The same goes for authors of curriculum materials who import ideas from research or other contexts. The present study shows that the knowledge of how difficult it is to gain trust in ideas inconsistent with existing norms, is worth considering when designing curriculum materials.

5.3 Limitations

I have chosen to discuss the trustworthiness of the thesis under section 3.5. Nevertheless, there are some limitations or circumstances of the thesis that need to be noticed. Taking another theoretical stance and a different research design, would have led to other choices and results.

One possible limitation is, that very few teachers per cultural-educational context were involved in this research. Yet, it was hard to find teachers for the thesis research project who answered to the specific qualifications set up. The target group of teachers was, however, of interest, as this study try to pinpoint teachers' interactions with Finnish curriculum materials. Furthermore, the participating teachers in this study worked in practise schools and they may, most likely, work under different circumstances than teachers in municipality schools, especially in Finland. The four Finnish teachers together had also much longer teaching experience than the four Swedish teachers; 92 years for the Finnish and 53 years for the Swedish. It is, thus, most likely that the results would have been different if mathematics teachers in municipality schools had been investigated or if the teaching experiences between the two groups had been more equal. Hence, the small number of teachers with specific qualifications make it difficult to draw conclusions relating to Finnish and Swedish teachers' interaction with

curriculum materials on a more general level. I have done it anyway, but note, the conclusions are related to a certain subgroup of teachers with specific qualifications, in Finland and Sweden, and that the conclusions made are quite general. No conclusions were drawn based on a single method. Instead, two or three methods were always present.

Another possible limitation is, that although this thesis uses a targeted group of teachers, it does not take into account the teachers' characteristics in full, as in the model of teacher-curriculum relationship by Remillard (2005). This means that there are several possible factors related to the participating teachers' beliefs and views that may have influenced how the teachers interacted with the curriculum materials. For instance, teachers' educational background may be one of them. The Finnish teachers in the study have at least a master's degree in education, and two of them have two educations, while the Swedish teachers have a bachelor's degree in education. In turn, the Swedish teachers chose the Finnish materials with the purpose of improving their teaching, which was not the case for the Finnish teachers. These two aspects may have a bearing on how they interacted with the material, but I have not taken it into account in the analyses. In addition, the Finnish teachers have for years trusted and valued the familiar content of the curriculum materials and thereby used the guides for planning and enacting lessons (Hemmi et al., 2017a). The Swedish teachers did also trust the originated Finnish curriculum materials in this study. Swedish teachers have for many years asked for more directive guidance for teaching, since both the national core curriculum and traditional curriculum materials have been very general (e.g., Hemmi et al., 2019b). Could it be so, that Swedish teachers even appreciate the directive guidance offered by the curriculum materials because the traditional Swedish materials often lack that kind of guidance?

5.4 Suggestions for future research

I would suggest an expansion of text analysis of the Finnish curriculum materials. More precisely, to investigate and compare, in depth, the mathematical content in the Finnish materials. Even though the focus on content have been huge in curriculum studies in mathematics education (cf. Fan et al., 2013), the Finnish context has not been examined in depth. This was something I considered before I decided to conduct case studies. Such studies would have given access to the nature of mathematics, as embedded in the culture of Finnish school mathematics. In addition, the thesis could have had more focus on the didactics of mathematics.

Further, I would suggest a study where students' perspectives are included. More precisely, to investigate what kind of progress the curriculum materials express in relation to the students' learning and progression. The Swedish teachers were stressed over the high mathematical level and the high speed of progression within the Finnish

curriculum materials. Knowledge of similarities and differences in progression would have given access to a more holistic view of the enacted classroom, since students too are a part of the classroom context. However, students were not the focus in this thesis.

Another idea for further research emerged during the period of analysing the cases and adheres to the culturally specific norms of the teaching context. The initial analyses of the videotaped lessons revealed very diverse interactional practises between the Finnish and the Swedish teachers and, thus, different educational norms. To investigate how teachers, enable students' participation and interaction through various question types would be interesting, since questioning strategies serve as an important tool for teachers (Stein et al., 2007). This would help us to deepen our understanding of how cultural norms govern the classroom practises.

Finally, I suggest that the support from online and other digital resources, in addition to printed curriculum resources, is investigated (e.g., Pepin, Choppin, Ruthven & Sinclair, 2017; Pepin, Gueudet & Trouche, 2017; Pepin, Gueudet, Yerushalmy, Trouche & Chazan, 2015). The Finnish curriculum materials include digital components. For example, there are digital tools for designing mathematics tests and materials for whole-class presentations. A continuation would be to investigate the support from the digital components of Finnish curriculum materials. The idea for this emerged during the interviews with the four Swedish teachers, who all used and appreciated the digital components of the curriculum materials. I have not analysed the digital components of Finnish curriculum materials as part of the thesis project. However, I have been given the opportunity to participate in a project, founded by the Swedish research council (2016-04616) where we investigate how teachers in four regions (Finland, Sweden, Flanders, and the USA) make sense of, and use, curriculum resources, especially the digital ones. I have continued, as a part of that project, to investigate the digital components of two Swedish curriculum materials, one being the imported Finnish material included in this thesis.

References

- Ahl, L., Gunnarsdóttir, G. H., Koljonen, T., & Pálsdóttir, G. (2015a). How teachers interact and use teacher guides in mathematics – cases from Sweden and Iceland. *Nordic Studies in Mathematics Education*, 20(3–4), 179–197.
- Ahl, L., Koljonen, T., & Helenius, O. (2017). The voice of curriculum developers in teacher guides. *For the Learning of Mathematics*, 37(2), 35–39.
- Ahl, L., Koljonen, T., & Hoelgaard, L. (2015b). How are mathematics teacher guides used for support and inspiration in teaching? In H. Sifverberg, T. Kärki, & M. S. Hannula (Eds.), *Nordic research in mathematics education – Proceedings of NORMA 14* (pp. 153–162). University of Turku. https://helda.helsinki.fi/bitstream/handle/10138/159388/AD-14_Norma.pdf
- ALLEA (2011). *The European code of conduct for research integrity*. ALLEA & ESF. <https://allea.org/code-of-conduct/>
- Andrews, P. (2007). Negotiating meaning in cross-national studies of mathematics teaching: kissing frogs to find princes. *Comparative Education*, 43(4), 489–509. <https://doi.org/10.1080/03050060701611888>
- Andrews, P. (2010). Comparing Hungarian and English mathematics teachers' professional motivations. In V. Durand-Guerrier, S. Soury-Lavergne, & F. Arzarello (Eds.), *Proceedings of the Sixth European Conference on Research in Mathematics Education*, CERME 6 (pp. 2452–2462). Institut National de Recherche Pédagogique.
- Andrews, P. (2013). What does PISA performance tell us about mathematics teaching quality? Case studies from Finland and Flanders. In H.-D. Meyer & A. Benavot (Eds.), *Who succeeds at PISA and why? The role of international benchmarking in the emerging global education governance system. Institutional and policy perspectives* (pp. 99–114). Symposium Books.
- Andrews, P., & Larson, N. (2017). Analysing genomgång: A Swedish mathematics teaching lesson event. *Nordic Studies in Mathematics Education*, 22(3), 85–105.
- Andrews, P., Ryve, A., Hemmi, K., & Sayers, J. (2014). PISA, TIMSS and Finnish mathematics teaching: An enigma in search of an explanation. *Educational Studies in Mathematics*, 87(1), 7–26. <https://doi.org/10.1007/s10649-014-9545-3>
- Andrews, P., & Sayers, J. (2013). Comparative studies of mathematics teaching: Does the means of analysis determine the outcome? *ZDM – The International Journal on Mathematics Education*, 45(1), 133–144. <https://doi.org/10.1007/s11858-012-0481-3>
- Asami-Johansson, Y., Attorps, I., & Winsløw, C. (2019). Comparing mathematics education lessons for primary school teachers: case studies from Japan, Finland and Sweden, *International Journal of Mathematical Education in Science and Technology*. <https://doi.org/10.1080/0020739X.2019.1614688>
- Ball, D. L., & Cohen, D. K. (1996). Reform by the book: What is-or might be-the role of curriculum materials in teacher learning and instructional reform? *Educational Researcher*, 25(9), 6–8, 14.
- Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: what makes it special? *Journal of Teacher Education*, 59(5), 389–407. <https://doi.org/10.1177/0022487108324554>
- Bassey, M. (1999). *Case study research in educational settings*. Open University Press.
- Ben-Peretz, M. (1990). *The teacher-curriculum encounter: Freeing teachers from the tyranny of texts*. SUNY Press.

- Bergwall, A., & Hemmi, K. (2017). The state of proof in Finnish and Swedish mathematics textbooks-Capturing differences in approaches to upper-secondary integral calculus. *Mathematical Thinking and Learning*, 19(1), 1–18.
<https://doi.org/10.1080/10986065.2017.1258615>
- Beyer, C., & Davis, E. (2009). Using educative curriculum materials to support preservice elementary teachers' curricular planning: A comparison between two different forms of support. *Curriculum Inquiry*, 39(5), 679–703.
<https://doi.org/10.1111/j.1467-873X.2009.00464.x>
- Boaler, J., & Brodie, K. (2004). The importance of depth and breadth in the analyses of teaching: A framework for analyzing teacher questions. In D. E. McDougall & J. A. Ross (Eds.), *Proceedings of the 26th Conference of the Psychology of Mathematics Education*, PME 26 (pp. 773–782). University of Toronto.
- Boesen, J., Helenius, O., Bergqvist, E., Bergqvist, T., Lithner, J., Palm, T., & Palmberg, B. (2014). Developing mathematical competence: From the intended to the enacted curriculum. *The Journal of Mathematical Behaviour*, 33(1), 72–87.
<https://doi.org/10.1016/j.jmathb.2013.10.001>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
<https://dx.doi.org/10.1191/1478088706qp063oa>
- Brändström, A. (2005). *Differentiated tasks in mathematics textbooks an analysis of the levels of difficulty*. (Lic. Luleå University, 2005: 18). Luleå University.
- Brown, M. W. (2009). The teacher – tool relationship. Theorizing the design and use of curriculum materials. In J. T. Remillard, B. A. Herbel-Eisenmann, & G. M. Lloyd (Eds.), *Mathematics teachers at work. Connecting curriculum materials and classroom instruction* (pp. 17–36). Routledge.
- Brown, M., & Edelson, D. (2003). *Teaching as design: Can we better understand the ways in which teachers use materials so we can better design materials to support their changes in practice?* (Design Brief). Centre for Learning Technologies in Urban Schools.
- Bryman, A. (2012). *Social research methods*. Oxford University Press Inc.
- Bråting, K., Madej, L., & Hemmi, K. (2019). Development of algebraic thinking: opportunities offered by the Swedish curriculum and elementary mathematics textbooks. *Nordic Studies in Mathematics Education*, 24(1), 27–49.
- Charalambous, C. Y., Delaney, S., Hsu, H.-Y., & Mesa, V. (2010). A comparative analysis of the addition and subtraction of fractions in textbooks from three countries. *Mathematical Thinking and Learning*, 12(2), 117–151.
<https://doi.org/10.1080/10986060903460070>
- Clarke, D. (2013). The validity-comparability compromise in cross-cultural studies in mathematics education. In B. Ubuz, Ç. Haser & M. A. Mariotti (Eds.), *Proceedings of the eight congress of the European society for research in mathematics education, CERME 8* (pp. 1855–1864). Middle East Technical University of Ankara.
- Clarke, D., Keitel, C., & Shimizu, Y. (2006). (Eds.). *Mathematics classrooms in twelve countries: The insider's perspective*. Sense Publishers.
- Clarke, D., & Mesiti, C. (2003). Addressing the challenge of legitimate international comparisons: Lesson structure in Australia and the USA. In L. Bragg, C. Campbell, G. Herbert, & J. Mousley (Eds.), *Mathematics Education Research: Innovation, Networking, Opportunity: Proceedings of the 26th Annual Conference of the Mathematics Education Research Group of Australasia* (pp. 230–237). Deakin University Press.

- Clarke, D., Mesiti, C., O'Keefe, C., Xu, L. H., Jablonka, E., Mok, I. A. C., & Shimizu, Y. (2007). Addressing the challenge of legitimate international comparisons of classroom practice. *International Journal of Educational Research*, 46(5), 280–293.
<https://doi.org/10.1016/j.ijer.2007.10.009>
- Cobb, P., & Jackson, K. (2012). Analyzing educational policies: A learning design perspective. *Journal of the Learning Sciences*, 21(4), 487–521.
<https://doi.org/10.1080/10508406.2011.630849>
- Cohen, D.K., & Ball, D.B. (2001). Making Change: Instruction and its Improvement. *PDK International*, 83(1), 73–77.
<https://doi.org/10.1177/003172170108300115>
- Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education* (6th Ed.). Routledge.
- Cohen, D. K., Raudenbush, S. W., & Loewenberg Ball, D. (2003). Resources, Instruction, and Research. *Educational Evaluation and Policy Analysis Summer*, 25(2), 119–142.
<https://larrycuban.files.wordpress.com/2011/03/resourceceepa2003.pdf>
- Collopy, R. (2003). Curriculum materials as a professional development tool: How a mathematics textbook affected two teachers' learning. *Elementary School Journal*, 103(3), 287–311.
- Corey, D. L., Peterson, B. E., Lewis, B. M., & Bukarau, J. (2010). Are there any places that students use their heads? Principles of high-quality Japanese mathematics instruction. *Journal for Research in Mathematics Education*, 41(5), 438–478.
- Creswell, J. W. (2013). *Qualitative Inquiry & Research Design: Choosing among Five Approaches* (3rd ed.). SAGE Publications Inc.
- Davis, E. A., Beyer, C., Forbes, C. T., & Stevens, S. (2011). Understanding pedagogical design capacity through teachers' narratives. *Teaching and Teacher Education*, 27(4), 797–810.
<https://doi.org/10.1016/j.tate.2011.01.005>
- Davis, E. A., Janssen, F. J. J. M., & Van Driel, J. H. (2016). Teachers and science curriculum materials: Where we are and where we need to go. *Studies in science education*, 52(2), 127–160.
<https://doi.org/10.1080/03057267.2016.1161701>
- Davis, E. A., & Krajcik, J. S. (2005). Designing educative curriculum materials to promote teacher learning. *Educational Researcher*, 34(3), 3–14.
- Davis, E. A., Palincar, A-M., Arias, A. M., Bismarck, A., Marulis, L. M., & Iwashyna, S. K. (2014). Designing educative curriculum materials: A theoretically and empirically driven process. *Harvard Educational Review*, 84(1), 24–52.
<https://doi.org/10.3102/0013189X17727502>
- Denscombe, M. (2009). *Forskningshandboken: För småskaliga forskningsprojekt inom samhällsvetenskaperna* (2nd ed.). Studentlitteratur.
- Desimone, L. M. (2011). Outcomes: Content-focused learning improves teacher practice and student results. *Journal of Staff Development*, 32(4), 63–69.
- Drake, C., & Sherin, M. G. (2006). Practicing change: Curriculum adaptation and teacher narrative in the context of mathematics education reform. *Curriculum Inquiry*, 36(2), 153–187.
<https://doi.org/10.1111/j.1467-873X.2006.00351.x>
- Drake, C., & Sherin, M. G. (2009). Developing curriculum vision and trust: Changes in teachers' curriculum strategies. In J. T. Remillard, B. A. Herbel-Eisenmann & G. M. Lloyd (Eds.), *Mathematics teachers at work. Connecting curriculum materials and classroom instruction* (pp. 321–337). Routledge.
- Eisenmann, T., & Evan, R. (2009). Similarities and differences in the types of algebraic activities in two classes taught by the same teacher. In

- J.T. Remillard, B.A. Herbel-Eisenmann & G.M. Lloyd (Eds.), *Mathematics teachers at work. Connecting curriculum materials and classroom instruction* (pp. 152–170). Routledge.
- Eklof, H. (2007). Test-taking motivation and mathematics performance in TIMSS 2003. *International Journal of Testing*, 7(3), 311–326.
<https://doi.org/10.1080/15305050701438074>
- Engvall, M. (2013). *Handlingar i matematikklassrummet. En studie av undervisningsverksamheter på lågstadiet då räknemetoder för addition och subtraktion är i fokus* [Actions in the mathematics classroom – A study of teaching activities in primary school when calculation methods for addition and subtraction are in focus]. (Diss. Linköpings universitet, 2013:178). Linköpings Universitet.
- Fan, L., Trouche, L., Qi, C., Rezat, S., & Vinovska, J. (Eds.). (2018). *Research on mathematics textbooks and teachers' resources: Advances and issues*. Springer International Publishing.
- Fan, L., & Zhu, Y. (2007). Representation of problem-solving procedures: A comparative look at China, Singapore, and US mathematics textbooks. *Educational Studies in Mathematics*, 66(1), 61–75.
<https://doi.org/10.1007/s10649-006-9069-6>
- Fan, L., Zhu, Y., & Miao, Z. (2013). Textbook research in mathematics education: development status and directions. *ZDM–The international Journal on mathematics education*, 45(5), 1–14.
<https://doi.org/10.1007/s11858-013-0539-x>
- Fejes, A., & Thornberg, R. (2009). *Handbok i kvalitativ analys*. Liber.
- Givvin, K. B., Hiebert, J., Jacobs, J., Hollingsworth, H., & Gallimore, R. (2005). Are there national patterns of teaching? Evidence from the TIMSS 1999 Video Study. *Comparative Education Review*, 49(3), 311–343.
- Grant, T.J., Kline, K., Crumbaugh, C., Kim, O-K., & Cengiz, N. (2009). How can curriculum materials support teachers in pursuing student thinking during whole-group discussions? In J. T. Remillard, B. A. Herbel-Eisenmann & G. M. Lloyd (Eds.), *Mathematics teachers at work. Connecting curriculum materials and classroom instruction* (pp. 103–117). Routledge.
- Grevholm, B. (2006). Matematikdidaktikens möjligheter i en forskningsbaserad lärarutbildning. In S. Ongstad (red.), *Fag og didaktikk i lærerutdanning. Kunnskap i grenseland*. (s 183–206). Universitetsforlaget.
- Grevholm, B. (2010). Research on mathematics teacher education in Sweden. In B. Sriraman, C. Bergsten, S. Goodchild, G. Palsdóttir, B. D. Søndergaard, L. Haapasalo (Eds.), *The First Sourcebook on Nordic Research in Mathematics Education: Norway, Sweden, Iceland, Denmark and contributions from Finland*. The Montana Mathematics Enthusiast: Monograph Series in Mathematics Education (pp. 347–362). Information Age Publishing.
- Grevholm, B. (2011). Network for research on mathematics textbooks in the Nordic countries. *Nordic Studies in Mathematics Education*, 16(4), 91–102.
- Grevholm, B. (2014). Frågor om läroboken i matematik – vilka är de och finns det några svar? [Questions about mathematics textbook – what are they and are there any answers?] In K. Wallby, U. Dahlberg, O. Helenius, J. Häggström & A. Wallby (Eds.), *Nämnamn 10 Matematikundervisning i praktiken* (pp. 147–160). Nationellt center för matematik, NCM.
- Gunnarsdóttir, G. H., & Pálsdóttir, G. (2016). Instructional practices in mathematics classrooms. *Proceeding of the ninth Congress of the European Society for Research in Mathematics Education*, CERME 9 (pp. 3036–3042).
<https://hal.archives-ouvertes.fr/CERME9-TWG19>

- Guskey, T. R. (2002). Professional Development and Teacher Change, *Teachers and Teaching*, 8(3), 381–391. <https://doi.org/10.1080/135406002100000512>
- Grossman, P., & Thompson, C. (2008). Learning from curriculum materials: Scaffolds for new teachers? *Teaching and Teacher Education*, 24(4), 2014–2026. <https://doi.org/10.1016/j.tate.2008.05.002>
- Haggarty, L., & Pepin, B. (2002). An investigation of mathematics textbooks in England, France and Germany: Some challenges for England. *Research in Mathematics Education*, (4)1, 127–144. <https://doi.org/10.1080/14794800008520106>
- Halinen, I. (2005). *The Finnish curriculum development processes*. Utbildningsstyrelsen.
- Halliday, M. A. K. (1973). *Explorations in the functions of language*. Edward Arnold Ltd.
- Hemmi, K., Lepik, M., Madej, L., Bråting, K., & Smedlund, J. (2019a). Introduction to early algebra in Estonia, Finland and Sweden – some distinctive features identified in textbooks for Grades 1-3. In Jankvist, U. T., Van den Heuvel-Panhuizen, M., & Veldhuis, M. (Eds.), *Proceedings of the Eleventh Congress of the European Society for Research in Mathematics Education*, CERME 11 (pp. 2039 – 2016). Freudenthal Group & Freudenthal Institute, Utrecht University and ERME.
- Hemmi, K., Koljonen, T., Hoelgaard, L., Ahl, L., & Ryve, A. (2013a). Analyzing mathematics curriculum materials in Sweden and Finland: developing an analytical tool. In B. Ubuz, Ç. Haser & M.A. Mariotti (Eds.), *Proceedings of the eight congress of the European society for research in mathematics education*, CERME 8 (pp. 1875–1884). Middle East Technical University of Ankara.
- Hemmi, K., & Krzywacki, H. (2014). Crossing the boundaries: Swedish teachers' interplay with Finnish curriculum materials. *Proceedings of the first International Conference on Mathematics Textbook Research and Development, ICMT 1*, University of Southampton. <http://blog.soton.ac.uk/icmtrd2014/>
- Hemmi, K., Krzywacki, H., & Koljonen, T. (2017a). Investigating Finnish teacher guides as a resource for mathematics teaching. *Scandinavian Journal of Educational Research*. <https://doi.org/10.1080/00313831.2017.1307278>
- Hemmi, K., Krzywacki, H., & Liljekvist, T. (2019b). Challenging traditional classroom practices: Swedish teachers' interplay with Finnish curriculum materials. *Journal of Curriculum Studies*, 51(3), 342–361. <https://doi.org/10.1080/00220272.2018.1479449>
- Hemmi, K., Krzywacki, H., & Partanen, A.-M. (2017b). Mathematics curriculum: The case of Finland. In D. R. Thompson, M. A. Huntley, & C. Suurtamm (Eds.), *International Perspectives on Mathematics Curriculum* (pp. 71–102). Information age publishing, Inc.
- Hemmi, K., Lepik, M., & Viholainen, A. (2013b). Analysing proof-related competences in Estonian, Finnish and Swedish mathematics curricula—towards a framework of developmental proof. *Curriculum Studies*, 45(3), 35–4378. <https://doi.org/10.1080/00220272.2012.754055>
- Hemmi, K., & Ryve, A. (2015a). The culture of the mathematics classroom during the first school years in Finland and Sweden. In B. Perry, A. Gervasoni, & A. MacDonald (Eds.), *Mathematics and transition to school – International perspectives* (pp. 185–198). Springer. https://doi.org/10.1007/978-981-287-215-9_12
- Hemmi, K., & Ryve, A. (2015b). Effective mathematics teaching in Finnish and Swedish teacher education discourses. *Journal of Mathematics Teacher Education*, 18(6), 501–521. <https://doi.org/10.1007/s10857-014-9293-4>

- Herbel-Eisenmann, B. (2007). From intended curriculum to written curriculum: Examining the 'voice' of a mathematics textbook. *Journal of Research in Mathematics Education*, 38(4), 344–369.
<https://doi.org/10.2307/30034878>
- Herbel-Eisenmann, B. A., Lubienski, S. T., & Id-Deen, L. (2006). Reconsidering the study of mathematics instructional practices: the importance of curricular context in understanding local and global teacher change. *Journal of Mathematics Teacher Education*, 9(4), 313–345.
<https://doi.org/10.1007/s10857-006-9012-x>
- Herbel-Eisenmann, B. A. & Wagner, D. (2007). A framework for uncovering the way a textbook may position the mathematics learner. *For the Learning of Mathematics*, 27(2), 8–14.
- Hiebert, J., Gallimore, R., Gamier, H., Bogard Givvin, K., Hollingsworth, H., Jacobs, J. et al. (2003). *Teaching mathematics in seven countries: Results from the TIMSS 1999 video study*. NCEs, National Center for Educational Statistics.
- Hill, H. C., & Charalambous, C. Y. (2012). Teacher knowledge, curriculum materials, and quality for instruction: Lessons learned and open issues. *Journal of Curriculum Studies*, 44(4), 559–576.
- Hodgen, J., Brown, M., Kuchemann, D., & Coe, R. (2010). Increasing attitudes and attainment in secondary school mathematics: Evidence from a large-scale study in England. In M. Joubert (Ed.), *Proceedings of the British Society for Research into Learning Mathematics* 29(3), 49–54.
<https://bsrlm.org.uk/wp-content/uploads/2016/02/BSRLM-IP-29-3-09.pdf>
- Hoelgaard, L. (2015). *Lärarhandledningen som resurs: En studie om svenska lärarhandledningar för matematikundervisning i grundskolans årskurs 1-3* [The teacher guide as a resource: A study of Swedish teachers guides for teaching of mathematics in primary grade 1-3]. [Lic. Malardalen University, 2015:231]. Malardalen University.
- Hoelgaard, L., Hemmi, K., & Ryve, A. (2015). Teaching by the book: What kind of classroom practice do three different teacher's guides for year 1 promote? In H. Silfverberg, T. Kärki & M. Hannula (Eds.), *Proceedings of Nordic research in mathematics education* (pp. 163–172). University of Turku.
- Hsieh, H. F., & Shannon, S. E. (2005). "Three approaches to qualitative content analysis". *Qualitative Health Research*, 15(9), pp. 1277–1288.
<https://doi.org/10.1177/1049732305276687>
- Jablonka, E., & Johansson, M. (2010). Using texts and tasks: Swedish studies on mathematics textbooks. In B. Sriraman, C. Bergsten, S. Goodchild, G. Palsdottir, B. Dahl, B.D. Söndergaard & L. Haapasalo (Eds.), *The first sourcebook on Nordic research in mathematics education* (pp. 363–372). Information Age Publishing.
- Johansson, M. (2003). *Textbooks in mathematics education. A study of textbooks as the potentially implemented curriculum*. (Lic. Luleå tekniska universitet, 2003:65). Luleå tekniska universitet.
- Johansson, M. (2006). *Teaching mathematics education: a classroom and curricular perspective*. (Diss. Luleå tekniska universitet, 2006:35). Luleå tekniska universitet.
- Johansson, M. (2011). "Tänk så här": Didaktiska perspektiv på läroböcker i matematik ["Think like this": Didactic perspectives on textbooks in mathematics]. In G. Brandell & A. Pettersson. (Eds.), *Matematikundervisning Vetenskapligt perspektiv* [Mathematics teaching Scientific perspective] (p. 149–186). Stockholms University Press.
- Johansson Harrie, A. (2009). Staten och läromedel. En studie av den svenska statliga förhandsgranskningen av läromedel 1938 – 1991 [The State and the textbooks. The state approval scheme for textbooks and teaching

- aids in Sweden 1938-1991]. (Diss. Linköping University, 2009:142) Linköping University.
- Joutsenlahti, J., & Vainionpää, J. (2010). Oppimateriaali matematiikan opetuksessa ja osaamisessa. [Learning materials in the teaching and learning of mathematics]. (Koulutuksen seurantaraportit, 2010:2). In E.K. Niemi & J. Metsämuuronen (Eds.), *Miten matematiikan taidot kehittyvät? Matematiikan oppimistulokset peruskoulun viidennen vuosiluokan jälkeen vuonna 2008. [How do pupils' mathematical skills develop? The learning outcomes in the end of the fifth grade in compulsory school.]* Opetushallitus.
- Jukić Matić, L. (2019). The pedagogical design capacity of a lower secondary mathematics teacher and her interaction with curriculum resources. *REDIMAT – Journal of research in mathematics education*, 8(1), 53–75. <https://doi.org/10.4471/redimat.2019.2396>
- Jukić Matić, L., & Glasnović Gracin, D. (2016). The use of the textbook as an artefact in the classroom. A case study in the light of a socio-didactical tetrahedron. *J Math didactic*, 37(2), 349–374. <https://doi.org/10.1007/s13138-016-0091-7>
- Jukić Matić, L., & Glasnović Gracin, D. (2020). How do teacher guides give support to mathematics teachers? Analysis of a teacher guide and exploration of its use in teachers' practices. *Research in mathematics education*. <https://doi.org/10.1080/14794802.2019.1710554>
- Juter, K. (2003). *Learning limits of function*. (Lic. Luleå University, 2003:70). Luleå Universitet.
- Kaasila, R., Hammula, M. S., Laine, A., & Pehkonen, E. (2008). Evaluating admission procedures for teacher education in Finland. *Teaching Mathematics and Computer Science*, 6(1), 231–243.
- Kansanen, P. (2000). Kampen mellan vetenskap och lära [The struggle between science and learning]. In E. Alerby, P. Kansanen & T. Kroksmark. (Eds.), *Lära om lärande [Learning about learning]* (pp. 29–44). Studentlitteratur.
- Kennedy, M. M. (2016). How does professional development improve teaching? *Review of Educational Research*, 86(4), 945–980. <https://doi.org/10.3102/0034654315626800>
- Klette, K., Sahlström, F., Blikstad-Balas, M., Luoto, J. M., Tanner, M., Tengeberg, M., & Roe, A. (2018) Justice through participation: Student engagement and in Nordic Classrooms. *Education Inquiry*, 9(1), 57–77. <https://doi.org/10.1080/20004508.2018.1428036>
- Koljonen, T. (2014). *Finnish teacher guides in mathematics – Resources for primary school teachers in designing teaching*. (Lic. Mälardalen University, 2014:178). Mälardalen Studies in Educational Sciences.
- Koljonen, T. (2017). Finnish teaching materials in the hands of a Swedish teacher: The telling case of Cecilia. In T. Dooley & G. Gueudet (Eds.), *Proceedings of the Tenth Congress of the European Society for Research in Mathematics Education, CERME 10* (pp. 1626–1633). <http://hal.archives-ouvertes.fr/hal-01938185>
- Koljonen, T. (2019). Finnish and Swedish elementary school teachers' interplay with Finnish curriculum resources: An attempt at unraveling tacit cultural practices. In S. Rezat, L. Fan, M. Hattermann, J. Schumacher, & H. Wuschke (Eds.), *Proceedings of the Third International Conference on Mathematics Textbook Research and Development, ICMT 3* (pp. 61–66). <https://doi.org/10.17619/UNIPB/1-768>
- Koljonen, T., Ryve, A., & Hemmi, K. (2018). Analysing the nature of potentially constructed mathematics classrooms through teacher guides – the case of Finland. *Research in Mathematics Education*, 20(3), 295–311.

<https://doi.org/10.1080/14794802.2018.1542338>

- Krzywacki, H., Pehkonen, L., & Laine, A. (2016). Promoting mathematical thinking in Finnish mathematics education. In H. Niemi, A. Toom & A. Kallioniemi (Eds.), *Miracle of Education. The principles and practices of teaching and learning in Finnish schools* (pp. 109–123). Sense Publishers.
https://link.springer.com/chapter/10.1007/978-94-6300-776-4_8
- Kvale, S., & Brinkman, S. (2014). *Den kvalitativa forskningsintervjun*. (2nd ed.). Studentlitteratur.
- Larsson, M. (2015). *Orchestrating mathematical whole-class discussions in problem-solving classroom. Theorizing challenges and support for teachers*. (Diss. Mälardalens högskola, 2016:193). Mälardalens högskola.
- Lepik, M., Grevholm, B., & Viholainen, A. (2015). Using textbooks in the mathematics classroom – the teachers' view. *Nordic Studies in Mathematics Education*, 20(3–4), 129–156.
- Leshota, M. (2015). *The relationship between textbook affordances and mathematics' pedagogical design capacity (PDC)*. (Diss. University of Witwatersrand, School of education: Faculty of humanities.
<http://hdl.handle.net/10539/18211>
- Lithner, J. (2004). Mathematical reasoning in calculus textbook exercises. *Journal of Mathematical Behaviour*, 23(4), 405–427.
<https://doi.org/10.1016/j.jmathb.2004.09.003>
- Lloyd, G. M. (2009). School mathematics curriculum materials for teachers' learning: Future elementary teachers' interactions with curriculum materials in a mathematics course in the United States. *ZDM - The International Journal on Mathematics Education*, 41, 763–775.
<https://doi.org/10.1007/s11858-009-0206-4>
- Lloyd, G. M., Remillard, J. T., & Herbel-Eisenmann, B. A. (2009). Teacher's use of curriculum materials: An emerging field. In J. T. Remillard, B. A. Herbel-Eisenmann, & G. M. Lloyd (Eds.), *Mathematics teachers at work: Connecting curriculum materials and classroom instruction* (pp. 3–14). Routledge.
- Love, E., & Pimm, D. (1996). 'This is so': a text on texts. In A.J. Bishop, K. Clements, C. Keitel, J. Kilpatric, & C. Laborde (Eds.), *International handbook on mathematical education* (pp. 371–409). Kluwer Academic Publishers.
- Lundberg, A. (2011). *Proportionalitetsbegreppet i den svenska gymnasie matematiken: en studie om läromedel och nationella prov*. (Diss. Linköping University, 2011:1498). Linköpings University.
- McDuffie, A., Choppin, J., Drake, C., & Davis, J. (2018). Middle school mathematics teachers' orientations and noticing of features of mathematics curriculum materials. *International Journal of Educational Research*, 92, 173–187.
<https://doi.org/10.1016/j.ijer.2018.09.019>
- McClain, K., Zhao, Q., Visnovska, J., & Bowen, E. (2009). Understanding the role of the institutional context in the relationship between teachers and text. In J. T. Remillard, B. A. Herbel-Eisenmann & G. M. Lloyd (Eds.), *Mathematics teachers at work: Connecting curriculum materials and classroom instruction* (pp. 56–69). Routledge.
- Mesa, V. (2010). Characterizing practices associated with functions in middle school textbooks: An empirical approach. *Educational Studies in Mathematics*, 56(2/3), 255–286.
<https://www.jstor.org/stable/4150284>
- Morgan, C. (2006). What does social semiotics have to offer mathematics education research? *Educational studies in mathematics*, 61(1–2), 219–245.
<https://doi.org/10.1007/s10649-006-5477-x>

- Mullis, I., Martin, M., & Foy, P. (2008). *TIMSS 2007 International Mathematics Report*. TIMSS & PIRLS International Study Center, Boston College.
- Mullis, I., Martin, M., Foy, P., & Arora, A. (2012). *TIMSS 2011 international results in mathematics*. TIMSS & PIRLS International Study Center, Boston College.
- Neuman, J., Hemmi, K., Ryve, A., & Wiberg, M. (2015). Mathematics textbooks' impact on classroom instruction: Examining the views of 278 Swedish teachers. In H. Sifverberg, T. Kärki, & M.S. Hannula (Eds.), *Nordic research in mathematics education – Proceedings of NORMA 14* (pp. 215–225). University of Turku. https://helda.helsinki.fi/bitstream/handle/10138/159388/AD-14_Norma.pdf
- Nicol, C. C., & Crespo, S. M. (2006). Learning to teach with mathematics textbooks: How preservice teachers interact and use curriculum materials. *Educational studies in mathematics*, 62(3), 331–355. <https://doi.org/10.1007/s10649-006-5423-y>
- Niemi, H. (2012). The societal factors contributing to education and schooling in Finland. In H. Niemi, A. Toom & A. Kallioniemi. (Eds.), *Miracle of education: The principles and practices of teaching and learning in Finnish schools* (pp. 19–38). Sense Publishers.
- Niemi, H., Toom, A., & Kallioniemi, A. (2012). (Eds.). *Miracle of Education. The principles and practices if teaching and learning in Finnish schools*. Sense Publishers.
- Oates, T. (2014). Why textbook count. A policy paper. University of Cambridge. <https://www.cambridgeassessment.org.uk/Images/181744-why-textbooks-count-tim-oates.pdf>
- OECD. (2013). *PISA 2012 results in focus. What 15-year-olds know and what they can do with what they know*. www.oecd.org/pisa
- OECD. (2019). *PISA 2018. Insights and interpretations*. www.oecd.org/pisa
- O'Keefe, C., Xu, L. H., & Clarke, D. (2006). Kikan-shido: Between desks instruction. *Making connections: Comparing mathematics classrooms around the world* (pp. 73–106). Sense Publishers.
- Opetushallitus. (2004). Finnish National Core Curriculum for Basic Education 2004. Finnish National Board of Education [FNBE]. http://www.oph.fi/english/curricula_and_qualifications/basic_education <http://blog.soton.ac.uk/icmtrd2014/>
- Patrikainen, S. (2012). *Luokanopettajan pedagoginen ajattelu ja toiminta matematiikan opetuksessa*. (Diss. University of Helsinki, 2012: 342). University of Helsinki.
- Pehkonen, L. (2004). The magic circle of the textbook – An option or an obstacle for teacher change. In M. Johsen Høines & A. B. Fuglestad (Eds.), *Proceedings of the 28th Conference of the International Group for the Psychology of Mathematics Education* (pp. 513–520). Bergen University College. https://www.emis.de/proceedings/PME28/RR/RR191_Pehkonen.pdf
- Pehkonen, E., Ahtee, M., & Lavonen, J. (Eds.). (2007). *How Finns learn mathematics and science*. Sense Publishers.
- Pehkonen, L., Hemmi, K., Krzywacki, H., & Laine A. (2017a). A cross-cultural study of teachers' relation to curriculum materials. In E. Norén, H. Palmér & A. Cooke (Eds.), *Proceedings of the eight Nordic Conference on Mathematics Education, NORMA 17* (pp. 309–318). US-AB Digital tryckeri. <http://matematikdidaktik.org/wp-content/uploads/2018/09/NORMA-17-2018-papers-SMDF-skriftserie.pdf>
- Pehkonen, L., Piht, S., Pakkas, K., Laine, A., & Krzywacki, H. (2017b). Estonian and Finnish teachers' view about the textbooks in mathematics teaching. In E. Norén, H. Palmér & A. Cooke (Eds.), *Proceedings of the eight Nordic Conference on Mathematics Education, NORMA 17* (pp. 319–327). US-AB Digital tryckeri. <http://hdl.handle.net/10138/247826>

- Pehkonen, E., & Rossi, M. (2007). Some alternative teaching methods in mathematics. In E. Pehkonen, M. Ahtee, & J. Lavonen (Eds.), *How Finns learn mathematics and science* (pp. 143–154). Sense Publishers.
- Pepin, B., Choppin, J., Ruthven, K., & Sinclair, N. (2017). Digital curriculum resources in mathematics education: Foundations for change. *ZDM - The International Journal on Mathematics Education*, 9(5), 645–661. <https://doi.org/10.1007/s11858-017-0879-z>
- Pepin, B., Gueudet, G., & Trouche, L. (2013a). Re-sourcing teachers' work and instructions: a collective perspective on resources, their use and transformation. *ZDM - The International Journal on Mathematics Education*, 45(7), 929–943. <https://doi.org/10.1007/s11858-013-0534-2>
- Pepin, B., Gueudet, G., & Trouche, L. (2013b). Investigating textbooks as crucial interfaces between culture, policy and teacher curricular practice: two contrasted case studies in France and Norway. *ZDM - The International Journal on Mathematics Education*, 45(5), 685–698. <https://doi.org/10.1007/s11858-013-0526-2>
- Pepin, B., Gueudet, G., & Trouche, L. (2017). Refining teacher design capacity: Mathematics teachers' interactions with digital curriculum resources. *ZDM - The International Journal on Mathematics Education*, 49, 799–812. <https://doi.org/10.1007/s11858-017-0870-8>
- Pepin, B., Gueudet, G., Yerushalmy, M., Trouche, L., & Chazan, D. (2015). e-textbooks in/for teaching and learning mathematics: A disruptive and potentially transformative educational technology. In L. English & D. Kirshner (Eds.), *Handbook of international research in mathematics education* (pp. 636–661). Springer Nature.
- Pepin, B., & Haggarty, L. (2001). Mathematics textbooks and their use in English, French and German classrooms: a way to understand teaching and learning cultures. *Zentralblatt für Didaktik der Mathematik*, 33(5), 158–175. <https://doi.org/10.1007/BF02656616>
- Rabe, M. (2003). Revisiting “insider” and “outsider” as social researchers. *African Sociological Review*, 7(2), 149–161. <https://www.jstor.org/stable/43657708>
- Remillard, J. T. (2000). Can curriculum materials support teachers learning? Two fourth-grade teachers' use of new mathematics text. *Elementary School Journal*, 100(4), 331–350. <https://doi.org/10.1086/499645>
- Remillard, J. T. (2005). Examining key concepts in research on teachers' use of mathematics curricula. *Review of Educational Research*, 75(2), 211–246. <https://doi.org/10.3102/00346543075002211>
- Remillard, J. T. (2012). Modes of engagement: Understanding teachers' transactions with mathematics curriculum resources. In G. Gueudet, B. Pepin, & L. Trouche (Eds.), *From text to 'lived' resources: Mathematics curriculum materials and teacher development* (pp. 105–122). Springer Nature.
- Remillard, J. T., & Bryans, M. B. (2004). Teachers' orientations toward mathematics curriculum materials: Implications for teacher learning. *Journal of Research in Mathematics Education*, 35(5), 352–388.
- Remillard, J. T., Harris, B., & Agodini, R. (2014). The influence of curriculum material design on opportunities for student learning. *ZDM - The International Journal on Mathematics Education*, 46(5), 736–749. <https://doi.org/10.1007/s11858-014-0585-z>
- Remillard, J. T., & Heck, D. (2014). Conceptualizing the curriculum enactment process in mathematics education. *ZDM - The International Journal on Mathematics Education*, 46(5), 705–718.

- <https://doi.org/10.1007/s11858-014-0600-4>
- Remillard, J. T., Herbel-Eisenmann, B.A., & Lloyd G.M. (2009). (Eds.). *Mathematics teachers at work. Connecting curriculum materials and classroom instruction*. Routledge.
- Remillard, J. T., & Kim, O-K. (2020). *Elementary mathematics curriculum materials*. Research in Mathematics Education. Springer
- Remillard, J. T., & Reinke, L. (2012). *Complicating scripted curriculum: Can scripts be educative for teachers*. Paper presented at AERA's annual meeting, 2012.
<https://icubit.gse.upenn.edu/sites/default/files/RemillardReinkeAERA2012.pdf>
- Remillard, J. T., Van Steenbrugge, H., & Bergqvist, T. (2014). A cross-cultural analysis of the voice of curriculum materials. In K. Jones, C. Bokhove, G. Howson, & L. Fan (Eds.), *Proceedings of the first International Conference on Mathematics Textbook research and development*, ICMT 1 (pp. 395–400). University of Southampton.
https://eprints.soton.ac.uk/374809/1/ICMT-2014_proceedings150331.pdf
- Remillard, J. T., Van Steenbrugge, H., & Bergqvist, T. (2016). A cross-cultural analysis of the voice of six teacher's guides from three cultural contexts. *Paper presented at the AERA annual meeting, 2016*.
- Rezat, S (2006). A model of textbook use. In Novotná, J., Moraová, H., Krátká, M. & Stehlíková, N. (Eds.), *Proceedings 30th Conference of the International Group for the Psychology of Mathematics Education, PME 30* (pp. 409–416).
<https://www.emis.de/proceedings/PME30/4/409.pdf>
- Rezat, S. (2009). The utilization of mathematics textbooks as instruments for learning. *Proceedings of the Sixth Congress of the European Society for Research in Mathematics Education, CERME 6* (pp. 1260–1269). Institut national de recherche pédagogique. <http://ife.ens-lyon.fr/publications/edition-electronique/cerme6/wg7-22-rezat.pdf>
- Rezat, S., & Sträßer, R. (2012). From the didactical triangle to the socio-didactical tetrahedron: artifacts as fundamental constituents of the didactical situation. *ZDM - The International Journal on Mathematics Education, 44*(5), 641–651.
<https://doi.org/10.1007/s11858-012-0448-4>
- Roth McDuffie, A., & Mather, M. (2006). Reification of instructional materials as part of the process of developing problem-based practices in mathematics education. *Teachers and Teaching: theory and practice, 12*(4), 435–459.
- Ryve, A., & Hemmi, K. (2019). Educational policy to improve mathematics instruction at scale: Conceptualizing contextual factors. *Educational Studies in Mathematics, 102*(3), 379–394.
- Røj-Lindberg, A. (2017). *Skolmatematisk praktik i förändring – en fallstudie [school mathematical practice in change - a case study]*. (Diss. University of Åbo). Åbo akademi.
- Sahlberg, P. (2011). *Finnish lessons. What can the world learn from educational change in Finland?* Teachers College Press.
- Sahlström, F. (2008). *Från lärare till elever, från undervisning till lärande: utvecklingslinjer i svensk, nordisk och internationell klassrumsforskning*. (Vetenskapsrådets rapportserie 2008:9).
- Savola, L. (2010). Structures of Finnish and Icelandic mathematics lessons. I B. Sriraman, C. Bergsten, S. Goodchild, G. Pálsdóttir, B. Dahl, & L. Haapasalo (Eds.), *The first sourcebook on Nordic research in mathematics education. Norway, Sweden, Iceland, Denmark, and contributions from Finland* (s. 519–538). Information Age Publishing.
- Sayers, J., Petersson, J., Rosenqvist, E., & Andrews, P. (2019). Opportunities to learn foundational number sense in three Swedish year one textbooks: Implications for the importation of

- overseas-authored materials.
International Journal of Mathematics Education in Science and Technology.
<https://doi.org/10.1080/0020739X.2019.1688406>
- Schmidt, W. H., Jorde, D., Cogan, L. S., Barrier, E., Gonzalo, I., Moser, U., Shimizu, K., Sawada, T., Valverde, G. A., McKnight, C., Prawat, R. S., Wiley, D. E., Raizen, S. A., Britton, E. D., & Wolfe, R. (1996). *Characterizing pedagogical flow. An investigation of mathematics and science teaching in six countries*. Kluwer Academic Publishers.
- Schneider, R. M., & Krajcik, J. (2002). Supporting science teacher learning: The role of educative curriculum materials. *Journal of Science Teacher Education*, 13(2), 167–217.
- Schneider, R. M., Krajcik, J., & Blumenfeld, P. (2005). Enacting reform-based science materials: The range of teacher enactments in reform classrooms. *Journal of Research in Science Teaching*, 42(3), 283–312.
- Shulman, L. S. (1986). Knowledge and teaching: Knowledge growth in teaching. *Educational Researcher*, 15(2), 1–23.
- Silverman, D. (2010). *Interpreting qualitative data – A guide to the principles of qualitative research* (4th ed.). SAGE Publications Inc.
- Simola, H. (2005). The Finnish miracle of PISA: historical and sociological remarks on teaching and teacher education [From teacher to students, from teaching to learning]. *Comparative Education*, 41(4), 455–470.
<https://doi.org/10.1080/03050060500317810>
- Skolverket (2006). Läromedlens roll i undervisningen Grundskollärares val, användning och bedömning av läromedel i bild, engelska och samhällskunskap [The role of teaching materials in teaching primary school teachers' choice, use and assessment of curriculum materials in Art, English and social studies]. (Rapport, 284).
- Skolverket. (2011). *Läroplan för grundskolan, förskoleklassen och fritidshemmet 2011. – Lgr 11* [Curriculum for the compulsory school, preschool class, and the recreation]. Skolverket.
- Skolverket (2013). *PISA 2012: 15-åringars kunskaper i matematik, läsförståelse och naturvetenskap* [PISA 2012 15-year-olds knowledge in reading comprehension, mathematics and science]. (Rapport internationella studier, 398). Skolverket.
- Skolverket. (2015). *To respond or not to respond: The motivation of Swedish students in taking the PISA test*. Skolverket.
- Skolverket (2019). *PISA 2018 15-åringars kunskaper i läsförståelse, matematik och naturvetenskap* [PISA 2018 15-year-olds knowledge in reading comprehension, mathematics and science]. (Rapport, internationella studier, 487). Skolverket.
- Stein, M. K., & Kaufman, J. H. (2010). Selecting and supporting the use of mathematics curricula at scale. *American Research Journal*, 47(3), 663–693.
<https://doi.org/10.3102/0002831209361210>
- Stein, M. K., & Kim, G. (2009). The role of mathematics curriculum materials in large-scale urban reform. In J. T. Remillard, B. A. Herbel-Eisenmann, & G. M. Lloyd (Eds.), *Mathematics teachers at work: Connecting curriculum materials and classroom instruction* (pp. 37–55). Routledge.
- Stein, M. K., Remillard, J. T., & Smith, M. S. (2007). How curriculum influence student learning. In F.K. Lester Jr. (Eds.), *Second handbook of research on mathematics teaching and learning* (pp. 319–369). Information Ace Publishing.
- Stigler, J. W., & Hiebert, J. (2009). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. The Free Press. (Original work published 1999).
- Stylianides, G. J. (2007). Investigating the guidance offered to teachers in

- curriculum materials: The case of proof in mathematics. *International Journals of Science and Mathematics Education*, 6(1), 191–215.
<https://doi.org/10.1007/s10763-007-9074-y>
- Tarr, J. E., Chávez, O., Reys, R. E., & Reys, B. J. (2006). From the written to the enacted curricula: The intermediary role of middle school mathematics teachers in shaping students' opportunity to learn. *School Science and Mathematics*, 106(4), 191–201.
<https://doi.org/10.1111/j.1949-8594.2006.tb18075.x>
- Tarr, J. E., Reys, R. E., Reys, B. J., Chávez, O., Shih, J., & Osterlind, S. J. (2008). The impact of middle-grades mathematics curricula and the classroom learning environment on student achievement. *Journal for Research in Mathematics Education*, 39(3), 247–280.
<https://eric.ed.gov/?id=EJ790456>
- Thomson, S., & Fleming, N. (2005). *Summing up: mathematics achievement in Australian schools in TIMSS 2002*. TIMSS Australia Monograph series, 3.
https://research.acer.edu.au/timss_monographs/3
- Thompson, D. R., & Huntley, M. A. (2014). Researching the enacted mathematics curriculum: learning from various perspectives on enactment. *ZDM - The International Journal on Mathematics Education*, 46(5), 701–704.
<https://doi.org/10.1007/s11858-014-0626-7>
- Trouche, L., Gitirana, V., Miyakawa, T, Pepin, B & Wang, C. (2019). Studying mathematics teachers interactions with curriculum materials through different lenses: Towards a deeper understanding of processes at stake. *International Journal of Educational Research*, 93, 53–67.
<https://doi.org/10.1016/j.ijer.2018.09.002>
- Törnroos, J. (2005). Mathematics textbooks, opportunity to learn and student achievement. *Studies in Educational Evaluation*, 31(4), 315–327.
<https://doi.org/10.1016/j.stueduc.2005.11.005>
- Valverde, G., Bianchi, L., Wolfe, R., Schmidt, W., & Houang, R. (2002). *According to the book. Using TIMSS to investigate the translation of policy into practice through the world of textbooks*. Kluwer Academic Publishers.
- Van Steenbrugge, H., & Ryve, A. (2018). Developing a reform mathematics curriculum program in Sweden: relating international research and the local context. *ZDM - The International Journal on Mathematics Education*, 50(5), 801–812.
<https://doi.org/10.1007/s11858-018-0972-y>
- Vetenskapsrådet (2015). *Kartläggning av forskning om formativ bedömning, klassrumsundervisning och läromedel i matematik* [Mapping of research on formative assessment, classroom teaching, and curriculum materials in mathematics]. (delrapport från SKOLFORSK-projektet). Vetenskapsrådet.
- Vincent, J., & Stacey, K. (2008). Do mathematics textbooks cultivate shallow teaching? Applying the TIMSS Video Study criteria to Australian eighth-grade mathematics textbooks. *Mathematics Education Research Journal*, 20(1), 82–107.
<https://doi.org/10.1007/BF03217470>
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Väljjarvi, J. (2004). The system and how does it work – Some curricular and pedagogical characteristics of the Finnish comprehensive school. *Educational Journal of Hong Kong*, 32(1), 31–55.
- Wang, J., & Paine, L. (2003). Learning to teach with mandated curriculum and public examination of teaching as contexts. *Teaching and Teacher Education*, 19(1), 75–94.
[https://doi.org/10.1016/S0742-051X\(02\)00087-2](https://doi.org/10.1016/S0742-051X(02)00087-2)

- Wellington, J. (2012). *Educational research*. Contemporary issues and practical approaches. Continuum International Publishing Group.
- Wertsch, J. V. (1998). *Mind as action*. Oxford University Press.
- Wikman, T. (2004). *På spaning efter den goda läroboken. Om pedagogiska texters lärande potential* [Looking for the good textbook. About the learning potential for educational texts]. (Diss. University of Åbo). Åbo Akademi University press.
<https://www.doria.fi/bitstream/handle/10024/4136/TMP.objres.44.pdf>
- Yin, R.K., (1984). *Case Study Research: Design and Methods*. Beverly Hills, Calif: Sage Publications.
- Yin, R. K. (2009). *Kvalitativ forskning, från start till mål*. Studentlitteratur.

Appendices

Appendix A: A brief summary of the purpose, data sources and methods of analyses connected to each individual study and the publications

Appendix B: A list of video and interview recordings for the project

Appendix C: Interview protocol

Appendix D: Characterisation of Finnish and Swedish teachers' mathematics

Appendix A: A summary of the purpose, data sources and methods of analysis in the study.

Publication	The purpose	Data sources	Method of analysis
Document analyses			
Paper I	To develop an analytical tool, based on the work of Davis and Krajcik (2005), for analysing mathematics curriculum materials to identify cultural similarities and differences.	The entire text of four teacher guides in mathematics for Grade 1, two from Sweden and two from Finland	Content analysis focusing on the content based on the developed analytical framework.
Paper II	To investigate what kind of resource the most commonly used Finnish teacher guides constitute for teachers in planning and enacting mathematics teaching.	Sample lessons that represent different mathematical areas and central themes at different grade levels within four different textbooks series, at primary school level	Content analysis focusing on the content and the nature of communication by modifying and extending the tool used in the first study.
Paper III	To investigate what kind of potentially constructed mathematics classroom is mediated by the recurrent activities of teacher guides.	The recurrent activities found within each lesson of nine teacher guides, from three different textbooks series.	Content analysis focusing on the embedded cultural norms with the modified notions of form and function.
Case studies			
Paper IV	To investigate the interaction with and influence of a slightly modified 'Finnish' teacher guide to classroom practise in one Swedish context.	Semi-structured interviews with four primary mathematics teachers from each country and video recordings of three consecutive mathematics lessons per teacher at primary school level. The originally Finnish teacher guides in use are also a part of the data. A triangulated approach that combine several data sources was applied.	Thematic analysis focusing on the pattern of teacher-teacher guide interaction through three analytical constructs: offloading, adapting, and improvising.
Paper V	To investigate the tacit cultural mathematics practises of four Finnish and four Swedish teachers as they interact with and use an originally 'Finnish' teacher guide.		Thematic analysis focusing on the pattern of emerged classroom practises in terms of lesson organisation, structure and teachers questioning strategies.

Appendix B: A list of video and interview recordings for the study

		School_Teacher	Lesson	Date	Duration actually time/scheduled time	Interview date	Duration
S W E D E N	1	A_T1	L1	151002	43:32/50:00		
	2		L2	151005	41:29/50:00		
	3		L3	151006	39:10/40:00		
						150928	55:42
	4	B_T3	L1	151009	44:13/45:00		
	5		L2	151010	47:24/50:00		
	6		L3	151011	44:13/40:00		
						151109	1:13:49
	7	C_T4	L1	151013	37:25/50:00		
	8		L2	151014	46:31/50:00		
	9		L3	151015	35:52/50:00		
						150929	1:03:04
10	B_T5	L1	151006	58:30/60:00			
11		L2	151007	62:30/60:00			
12		L3	151008	43:47/40:00			
					150929	1:10:03	
F I N L A N D	13	D_T1	L1	160316	44:20/45:00		
	14		L2	160317	42:08/45:00		
	15		L3	160318	44:00/45:00		
						160315	1:20:45
	16	D_T3	L1	160314	45:00/45:00		
	17		L2	160315	42:37/45:00		
	18		L3	160317	46:15/45:00		
						160318	0:50:03
	19	D_T4	L1	160316	44:17/45:00		
	20		L2	160316	41:09/45:00		
	21		L3	160317	42:15/45:00		
						160317	1:49:28
22	D_T5	L1	151028	41:19/45:00			
23		L2	151029	43:23/45:00			
24		L3	151030	37:12/45:00			
					151029	0:48 + 17 min missing	
			TOTAL		17:39:31/ 18: 45:00		8:53:55

Appendix C: Interview protocol

Question schedule

Education:

Tell me about your education... how you became a teacher?

- Professional preparation and becoming a teacher
- Reflect on TE

Experiences:

How long have you been a teacher?

- Present and additional professional experience
- Personal changes and career development

The setting:

Tell me about the school setting...

- Life at school... the internal and external environment

And tell me about your class setting...

- Life in class... the internal and external environment

Classroom culture:

How do you see a typical lesson?

- Reflect on typical lesson: Describe the best and worst scenarios... Barriers?
- Quality of classrooms

Beliefs about mathematics and its teaching

What is your overall purpose as a teacher of mathematics?

- Role of the teacher – Students competences – Content areas
- Teaching and artefacts: national core curriculum and reflection on practise; teaching – students – mathematical content

About teacher guides:

What do you think about/of teacher guides?

- Views on and usage of this and other TGs/resources in planning
- Affect your actions; liberate or constrain – missing parts

Planning of lessons:

What do you usually do when you plan your lessons?

- The start – Attention on what and how as well as other resources
- The usage of textbook/TG/other resources in your teaching

Appendix D: Characterisation of Finnish and Swedish teachers' mathematics lessons

	FIN, T1	FIN, T3	FIN, T4	FIN, T5	SWE, T1	SWE, T3	SWE, T4	SWE, T5
Offload					P	Non-P		Non-P
Adapt	P	P	P				Non-P	
Improvise				Non-P				

Table 9: Characterization the teacher and curriculum program interaction as non-participatory (Non-P) or participatory (P) relationship.

Tuula Koljonen

Finnish mathematics curriculum materials and teachers' interaction with them in two cultural-educational contexts

The doctoral thesis examines Finnish teacher guides in mathematics for grades 1-6 and teacher's interaction with them in two cultural-educational contexts, the Finnish and the Swedish.

The first part of the thesis consists of three studies in which the characteristics of Finnish curriculum materials are examined. The results show great similarities between the teacher guides in terms of content, form, and type of communication, but also the teacher guides' inherent norms. These norms reflect the underlying Finnish cultural traditions and educational priorities, both in terms of content uniformity and views on teaching and learning.

The second part of the thesis consists of two studies examining teacher's interaction with curriculum materials originated from Finland. The results show large differences regarding Finnish and Swedish teachers' planning of mathematics lessons and what they use from the teacher guides, but also how they organize and structure their mathematics lessons. The use by Finnish teachers reflects cultural norms and routines in line with the Finnish curriculum materials and educational traditions. The use by Swedish teachers reflects routines and norms in line with the Swedish educational traditions, and not with the norms found in the original Finnish curriculum materials.

This thesis shows that it is not easy to implement and use Finnish curriculum materials in the Swedish context. Thus, to create new routines and norms requires profound and thoughtful adjustments of the curriculum materials, but also professional development in how to use and adapt the material.

The thesis contributes to the international research discourse on mathematics curriculum materials and teachers' use of them. Furthermore, the results are relevant for publishing houses and authors, school heads and teachers, as well as teacher educators.