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# FINNISH TEACHER GUIDES IN MATHEMATICS

## RESOURCES FOR PRIMARY SCHOOL TEACHERS IN DESIGNING TEACHING

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The Swedish name of the graduate school Developing Mathematics Education is “Att utveckla undervisning och didaktik i matematik”.

DME Developing Mathematics Education

# Abstract

Previous research worldwide has shown that curriculum materials maintain a strong presence and constitute an important tool in mathematics classrooms. Yet, there is a vast lack of research into the design and the characteristics of teacher guides. This thesis aims to: 1) investigate the features of Finnish teacher guides for mathematics in primary schools and 2) map the cultural specificities and norms for classroom practices as construed in Finnish teacher guides. The data consist of nine Finnish teacher guides in mathematics (belonging to three textbook series) for Grades 1-6 and comprise almost 90 percent of the teacher guides utilized in Finnish schools in 2008. These teacher guides are examined in three studies. In the *first study*, we developed and used an analytical tool, based on Davis and Krajcik's ideas about educative curriculum materials, to analyse the teacher guides' content. In the *second study,* we analysed a larger sample of the Finnish teacher guides using the same analytical tool, and extended the study to also analyse their form, i.e. their look, structure and voice. This study shows that there is a wide consensus regarding both the content and the form of the guides. Several educative aspects are presented in the guides, and the analysis shows that they offer rich and varied resources for teachers in their everyday work in designing and enacting mathematics teaching and hence, learning in practice. The *third study* delves more deeply into the characteristics of the support the guides offer to design mathematics classrooms. We characterize the cultural script of the reflected classroom practice by analysing the form and the function of the activities promoted in most of the guides. We found a relatively homogeneous script that promotes differentiation while keeping students in the same mathematical area, opportunities for participation in whole-class interaction comprising a variety of activities like mental calculation, games and problem-solving, individual and group work, and small piece of homework after every single lesson. This thesis contributes to the international research discourse on curriculum materials and, in particular, on teacher guides as resources for design of mathematics classrooms in a specific educational context. The study is also of interest for teachers, and for textbook authors when developing teacher guides in line with current research.

*Keywords: cultural script, curriculum materials in mathematics, Finnish primary school, teacher guide characteristics, resources for teaching*

*To the ones I truly love...*

# 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. (2013). 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* (pp. 1875-1884). Middle East Technical University, Ankara.

II. Koljonen, T., Hemmi, K., & Krzywacki, H. (2014a). Investigating Finnish teacher guides for Grades 1-6 as a resource for teaching mathematics. *Manuscript in progress*.

III. Koljonen, T., Hemmi, K., & Ryve, A. (2014b). Finnish mathematics classrooms as constructed by nine teacher guides. *Manuscript in progress*.

# Contents

# CHAPTER 1

# Introduction

In the thesis I will focus on curriculum materials[1] as they maintain a strong presence in mathematics education in a large part of the world (Fan, Zhu & Miao, 2013; Stein & Kim, 2009; Stein, Remillard & Smith, 2007), and are regarded by researchers as potentially implemented curriculum (e.g. Valverde, Bianchi, Wolfe, Schmidt & Houang, 2002; Johansson, 2003; 2006). Consequently, curriculum materials constitute an important source for mathematics education. A recently rediscovered focus has been attended on the impact of the quality of curriculum materials on mathematics teaching (Charalambous & Hill, 2012; Hill & Charalambous, 2012), as they are typically a major resource for teachers' planning and practice (e.g., Jablonka & Johansson, 2010; Stein & Kim, 2009; Stein et al., 2007). Researchers and school developers, especially in the US, have in recent years become aware of the importance of curriculum materials for the successful reform and development of classroom practice and teaching (cf. Cobb & Jackson, 2011; Remillard, 2005). This has shifted the focus from textbook research towards the research and development of curriculum materials providing support for both teachers' learning and teaching (e.g., Davis & Krajcik, 2005). This research field is relatively new and unexplored.

In several countries, there have been many studies about the work of teaching, but relatively few efforts have been devoted to examining and conceptualising curriculum materials (cf. Pepin, Gueudet & Trouche, 2013; Remillard, 2005; 2013). In general, there is very little research on the design and character of curriculum materials, or on the interaction between teacher and curriculum materials in a specific educational context. Very few studies have focused on teacher guides, which are regarded as providing support for the teacher in mathematics education. The thesis intends to contribute to the area of mathematics teacher guides in a specific educational context by examining Finnish teacher guides for Grades 1-6. Finland is highly interesting for several reasons. For example, firstly, its international result is still at the

[1] In this thesis, I only investigate Finnish teacher guides (abbreviated TG) in mathematics.The term *curriculum materials* (abbreviated CM) are regarded as an umbrella concept including all kinds of commercially produced materials, for instance students' textbooks and teacher guides used by teachers in their teaching.

"top end" in comparison of PISA[2] results with the neighbouring Scandinavian countries (OECD, 2013), and while there has been considerable interest in finding explanations for these results, almost no focus has been placed on the characteristics of either Finnish mathematics classroom practices or the mathematics curriculum materials (e.g., Andrews, Ryve, Hemmi & Sayers, 2014; Niemi, 2003). Secondly, studies indicate that teaching in Finnish classrooms differs a great deal from Swedish teaching (e.g., Jablonka & Johansson, 2010; Pehkonen, Ahtee & Lavonen, 2007). Thirdly, there has been a tradition of producing teacher guides in collaboration with teachers, teacher educators and other experts since 1980s in Finland (Niemi, 2012).

The thesis will contribute to the international research discourse on curriculum materials, since the teacher guides are analysed with respect to both what kind of resource they constitute for the teachers in mathematics, and what kind of mathematics classroom they construct. The purpose of this thesis is to gain deeper knowledge of curriculum materials that are important component in the complex teacher-curriculum relationship (Charalambous & Hill, 2012; Remillard, 2005).

## 1.1 Aims of the thesis

The thesis intends to contribute to the knowledge about curriculum materials as a resource for mathematics teachers as well as for conceptualizing the classrooms that the materials seem to promote. This research focus is realized through three studies:

*The first study* aims at developing and testing an analytical tool for analysing curriculum materials in mathematics, as well as offering insight into the variation within and between Swedish and Finnish curriculum materials. The focus is especially on educative features of curriculum materials (Ball & Cohen, 1996; Davis & Krajcik, 2005; Remillard, 2000; 2005) when investigating the content in two Finnish and two Swedish teacher guides for Grade 1. This study is also the first step into this thesis and is regarded as the pilot study for the two following ones included here. The results of this study are presented in Hemmi, Koljonen, Ahl, Hoelgaard and Ryve (2013).

*The second study* investigates the characteristics[3] of the Finnish teacher guides and their potential for supporting teachers in mathematics teaching and enhancing teacher learning (e.g., Davis & Krajcik, 2005; Pehkonen et al., 2007; Remillard, 2012; Remillard & Reinke, 2012). The analytical tool from the first study is employed and developed. This study quantitatively and qualitatively investigates both the content and the form of nine Finnish

[2] PISA is the abbreviation *of Programme for International Student Assessment*.
[3] In the thesis, *characteristics* are synonymous with *features* and incorporate both the content and form of the teacher guides (abbreviated TG). For more detail see section 3.2.2.

teacher guides for Grades 1-6. The results of this study are presented in Koljonen, Hemmi and Krzywacki (Manuscript in progress).

*The third study* explores the cultural scripts of the mathematics classroom as they are construed in the Finnish teacher guides. The study is a deepening into the support to design classroom practice within the analytical tool from the first and the second study. The study is embedded in the field of cross-cultural studies concerning cultural scripts and qualitatively investigates the form and function of the recurrent activities suggested for the designing of the mathematics lessons by the teacher guides (cf. Clarke, Mesiti, O'Keefe, Xu, Jablonka, Mok & Shimizu, 2007). The results of this study are presented in Koljonen, Hemmi and Ryve (Manuscript in progress).

The diagram below illustrates the relationship and progression between the three studies included in the thesis (Figure 1):

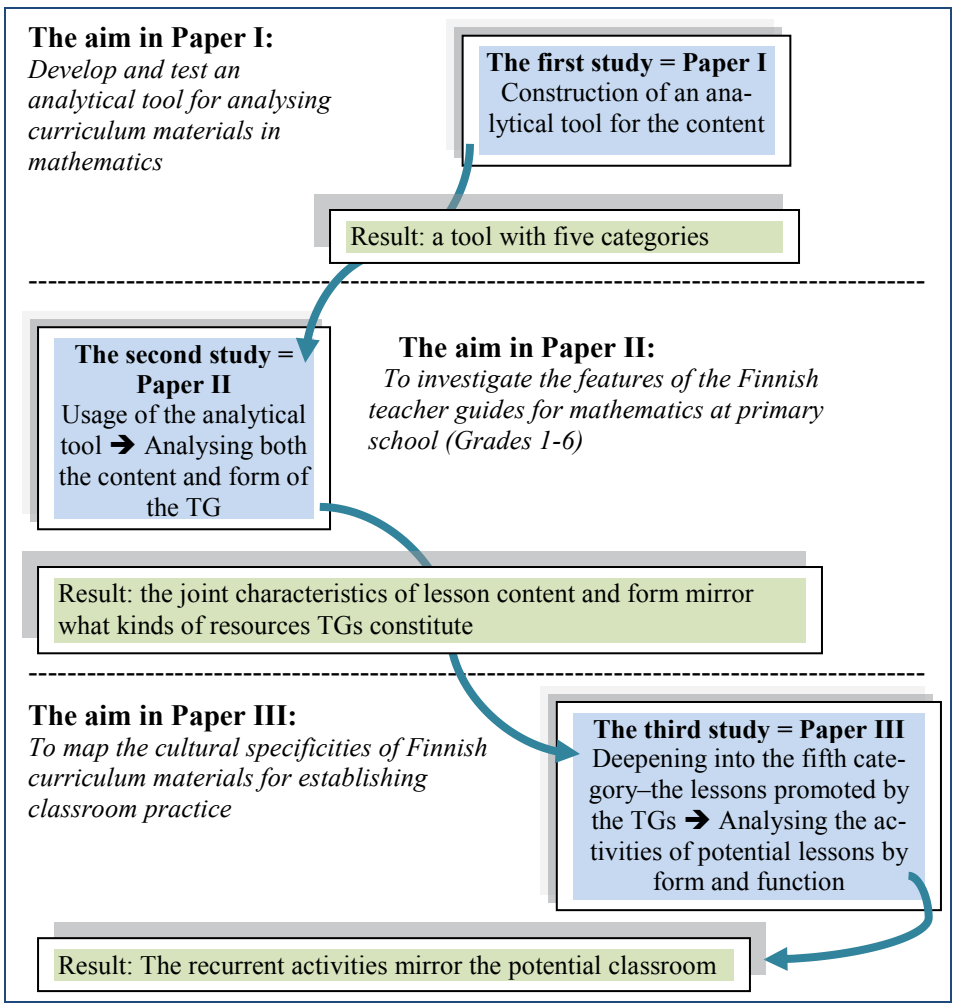


Figure 1. Relationship and progression between the three studies of the thesis.

## 1.2 The structure of the thesis

In *Chapter 2*, the theoretical background is presented and divided into two parts. Firstly, a description of the overall theoretical stances for the studies is provided. Secondly, a review of relevant literature and previous research is presented in order to portray key components of the thesis, such as curriculum materials, educative curriculum materials, teacher guides as resources and cultural scripts.

*Chapter 3* contains the methodology and it is divided into three main sections. In the first section I briefly describe the Finnish context and justify the selection of the documents. In the second section I introduce the three analytical approaches: the analysis of the content, the analysis of the characteristics and the analysis of the recurrent activities. In the last section, I discuss the trustworthiness and the ethical aspects of the study.

*Chapter 4* offers a summary of the three papers included with focus on the main results of the analyses in the separate papers and the progression of how they are related to each other.

In *Chapter 5,* the conclusions are presented and discussed in relation to the aims and research questions of the thesis as well as to previous research. Secondly the practical contributions of the study are outlined. The chapter ends with suggestions for further research.

# CHAPTER 2

# Theoretical background

In this chapter, I first present the theoretical stances this thesis is based on. Then, I review the relevant research on curriculum materials, including ideas about educative curriculum materials and teacher guides as resources for the design of teaching. Finally, I elaborate on the concept of a cultural script in the field of mathematics education research.

## 2.1 Theoretical stances

### 2.1.1 The starting point of this thesis

My entrance into this thesis is through the concept of curriculum materials and teachers' use of them. These notions have different meanings in different contexts, where the various definitions of curriculum materials are used interchangeably in the field of mathematics education as there is no unambiguous existing definition (Stein et al. 2007; Remillard, 2005). Researchers have also conceptualized the use of curriculum materials differently; thus, it is also framed differently across studies. Remillard (2005) distinguishes four different meanings of, or ways to use, curriculum materials:

1. Curriculum use as following or subverting the text
2. Curriculum use as drawing on the text
3. Curriculum use as interpretation of text
4. **Curriculum use as participation with the text**

In the thesis, I align with the fourth way, participation with the text. This teacher-curriculum relationship is considered to be a collaborative relationship in line with Brown (2009). In recent years, the fourth approach has emerged in research that considers curriculum materials as tools or artefacts[4] and the teacher as a collaborator, working with the materials to design the enacted curriculum. The use of these teacher guides[5] is connected to a specific socio-cultural context in which the relationship between teacher and teacher guide is seen as both complex and dynamic.

[4] Tools and artefacts are synonymous and used interchangeably.
[5] Teacher guides are one component of curriculum materials.

The teacher-curriculum relationship has four components (Remillard, 2005):

1. The teacher
2. **The curriculum**
3. The participatory relationship between teacher and curriculum
4. The resulting planned and enacted curriculum

In this thesis, I investigate and examine the second component, the curriculum. The curriculum materials are regarded as cultural tools, artefacts that both shape and are shaped by human actions through their affordances and constraints (Wertsch, 1998). The different social settings, such as a classroom where these tools are used, bring about context-dependent teacher-curriculum interplay. This interplay is grounded in socio-cultural theory (Brown, 2009; Vygotsky, 1986).

In line with Brown (2009), I consider teaching as design. Teacher and teacher guide interact in a collaborative relationship, whereby teachers are viewed as active agents in developing and constructing the planned and enacted curriculum. Both teachers and curriculum materials are situated in a specific socio-cultural context in which they both play a role in mediating the teacher-curriculum relationship, which is shaped by historical, social and cultural factors. This entails the outcome of the enacted instruction being a result of the interplay between the characteristics of the curriculum materials and the teacher with his/her specific skills, goals and beliefs. Brown and Edelson (2003) conceptualize a teacher's use of curriculum materials as a dynamic interaction between his/her personal resources (i.e. knowledge, skills and commitments) and the curricular resources (i.e. task structures, subject matter representations and physical tools). The teacher guides are the artefacts that refer to the cultural tools created by humans that affect their capacity to mediate actions and thus have the potential to affect human activity (Vygotsky, 1978). Resources like artefacts are socio-cultural tools and products of the socio-cultural evolution (Wertsch, 1998). I do not examine the actual outcome of the enacted curriculum since the result is dependent on the collaborative interplay between the teacher's personal resources and the features of the teacher guides. The guides are one of the components in the teacher-curriculum relationship and I only examine that component – the Finnish teacher guides in mathematics for Grades 1-6 through different analytical approaches (see further in 3.2).

To summarize, the teacher guides are considered as tools, artefacts used by teachers in and for teaching to support, guide and enhance teachers' instructional design. In this theoretical view, teachers and the tool (the teacher guides) are active participants in the design process (in planning, enacting and evaluating). Teacher guides are considered as resources with specific affordances and constraints that constituting one of the components of the complex teacher-curriculum relationship.

## 2.2 Literature review

### 2.2.1 Curriculum materials

Several researchers point out that curriculum materials like textbooks and teacher guides serve as an important resource for teachers in designing teaching (e.g. Jablonka & Johansson, 2010; Stein & Kim, 2009; Stylianides, 2007). Recently, researchers have begun to show that curriculum materials can and should be a resource for supporting the teaching and learning of mathematics for teachers (e.g. Doerr & Chandler-Olcott, 2009). Consequently, curriculum materials serve as an important tool for teachers in both enabling and constraining their thoughts and actions (Stein et al. 2007) and shaping their classroom practices (Beyer & Davis, 2009; Grossman & Thompson, 2008). That is, curriculum materials have the potential to function as a source of inspiration for teaching, as a tool for both teachers' and students' learning (Remillard, 2000; 2005). Curriculum materials as a source harmonize with the findings of Grossman and Thompson (2008) which show that that teachers begin to adapt the material as they become more experienced (see also, Drake & Sherin, 2006; 2009) and, in line with this, also begin to create their own way of teaching. This variation on how teachers read, interpret and use materials is explained in several studies (e.g. Collopy, 2003; Remillard & Bryans, 2004; Schneider & Krajcik, 2002). Ball and Cohen (1996) state that teacher guides, with pedagogical guidance used in the practice and support of teacher learning, may have great potential to affect teaching, as the materials "talk" directly to teachers. In fact, recent research (Cobb & Jackson, 2012) suggests that the role of curriculum materials for teachers' learning is crucial within both institutionalized and in-practice professional development. However, the design of materials, especially educative curriculum materials[6] as an explicit type of support for teachers to learn about teaching (Davis & Krajcik, 2005; Schneider & Krajcik, 2002), is a relatively new and growing area in many countries such as the US.

*Educative curriculum materials*

Ball and Cohen (1996) suggest that curriculum materials need to be developed with the enacted curriculum in mind, to better assist teachers in learning about teaching and help them manage their praxis, but also to promote students' learning. Taking such a perspective on curriculum materials includes seeing them as educative (Davis and Krajcik, 2005), and recent research has shown that mathematical knowledge for teachers (MKT) is promoted by the materials' educative features. Recent research has also shown

[6] Educative curriculum materials (abbreviated ECM) comprise one kind of curriculum material that includes support for students' learning as well as for teachers' learning and teaching.

that teachers' pedagogical design capacity[7] - PDC (cf. Brown, 2009) could be enhanced by helping teachers recognize both the rationales for recommendations and the way in which they can productively adopt the recommendations in their classrooms (Davis, Palincsar, Arias, Bismack, Marulis & Iwashyna, 2014). However, although research sees great potential in curriculum materials for teachers' teaching and learning, studies also show that curriculum materials alone are not sufficient for assisting teachers and that professional development is essential for helping teachers to plan and reflect on classroom enactment (cf. Schneider, Krajcik & Blumenfeld, 2005). Thus, introducing curriculum materials into classrooms cannot by itself develop the quality of instructions (Tarr, Chavez, R. Reys and B. Reys, 2006; Tarr, R. Reys, B. Reys, Chavez, Shih & Osterlind, 2008).

Davis and Krajcik (2005) established five guidelines for educative curriculum materials that show what the material should contain in order to support teacher learning. In the first and the second study of this thesis we have modified Davis and Krajcik's (2005) guidelines and constructed an analytical tool with five categories (Further elaborated in section 3.2.1).

*The form of curriculum materials*

Curriculum materials as resources for teaching can be characterized in several ways. The form of the teacher guide could be discussed in terms of different aspects that help to characterize the learning material, for instance, the overall look (refers to the purely visual appearance of the material), the structure (refers to how the material is organized and what it contains) or communication/talk (refers to how the designers/authors communicate with teachers) that is by some researchers called the voice (e.g., Remillard, 2012). In the second study, we characterize curriculum materials where the designers of the materials are communicating differently with the teachers. Brown (2009) uses the concepts resource-centric and procedure-centric when characterizing 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) characterize teacher guides as explicit or descriptive scripts which, to a large extent, overlap Brown's two notions of procedure- and resource-centric and, thus, are tangential to each other. Explicit scripts are guides that speak through the teacher and guide or direct what he/she should do by indicating precise words or actions. They can, e.g. contain specific sentences for teachers to read to students, illustrate what to draw on the board or show how to imple-

[7] PDC constructs a way to understand how teachers *perceive* and *mobilize* existing resources to design instruction. To perceive indicates the ability to recognize, or notice, potential resources, and to mobilize highlights the importance of teachers' abilities to act on or with those resources (Remillard (2005).

ment an activity. Descriptive scripts are teacher guides in which the given information, such as the central ideas of the material, instead plays a coaching role and therefore "talks" to the teacher. The instructions are more exploratory and the guides are more of a source from which the teachers choose ideas and activities to follow. Remillard and Reinke (2012) established that the guides they investigated could be more or less explicit or descriptive scripts, but all contained both explicit and descriptive statements and were therefore referred to as "blended scripts", i.e. mixed scripts. They further state that both the explicit, more "un-educative" scripts, and the descriptive scripts can function as a support for teacher learning and teaching since these physical resources affect how teachers use materials in practice as the teachers read, interpret and use different parts of the materials with respect to their own personal resources (Remillard, 2005).

### 2.2.2 Cultural scripts

As part of understanding curriculum materials and their capacity for supporting teachers in designing teaching, we noticed recurrent features in the investigated materials that we connect to cultural scripts. In educational research, cultural scripts were introduced to capture often unspoken, implicit and accepted cultural rules and norms that influence teachers' actions. Such cultural scripts are "commonly held assumptions within a 'cultural' group and provide a background for interpreting behaviours but do not describe, determine or predict behaviour of individual teachers" (Goddard & Weizbricka, 2004; Holvino, 2010). Within a certain culture, the scripts are widely shared, but not all teachers in the same country use exactly the same methods. Furthermore, cultural scripts are learned implicitly through observation and participation. As such, we partly learn indirectly how to teach through years of participation in classroom life, while we are typically unaware of some of the most widespread attributes of teaching in our culture. Typically, these invisible scripts are so deeply embedded that the teachers within the culture do not even realize they guide their attitudes and behaviours (Stigler & Hiebert, 1999; 2009). In the third study we attempt to capture something about the Finnish cultural script as reflected in the teacher guides.

National patterns[8] of mathematics teaching, as a way to distinguish teaching in one country from that in another, have mostly been studied in cross-cultural studies and through video recordings, in search of what teachers actually do in the mathematics classroom (Clarke et al. 2007; Stigler & Hiebert, 1999; 2009). Various concepts and descriptions such as cultural scripts (Stigler & Hiebert, 1999; 2009), lesson signatures (Givvin, Hiebert, Jacobs, Hollingworth & Gallimore, 2005) and the characteristic pedagogical flow (Schmidt et al. 1996) are used, but the literature does not provide distinct

[8] A national pattern is formed as a country-specific recurrent activity for teaching.

differentiations between the concepts and they are often used interchangeably. Stigler & Hiebert (1999; 2009) recognize four recurrent activities[9] in samples of single lessons as a way to characterize teaching, and create a national pattern of what teachers do during instruction. Clarke et al. (2007) observed the same recurrent activities as Stigler and Hiebert (1999; 2009), but in sequences of ten lessons, as a way to view the potential pattern in teaching. We draw on the analytical constructs developed within cross-cultural classroom research when examining cultural scripts of the Finnish teacher guides with respect to the view of effective teaching[10] (cf. Corey, Paterson, Lewis & Bukarau, 2010).

In this chapter, I have described the theoretical stances where the teacher guides and teachers collaborate in a complex relationship. The relevant research is also exposed. In the next chapter, I describe the methodology of this thesis.

[9] The recurrent activities in the USA lessons are: reviewing previous material; demonstrating how to solve problems for the day; practicing; correcting seatwork and assessing homework.

[10] The term *effective teaching* is widely used in research (e.g. Ball, Thames & Phelps, 2008; Franke, Kazemi & Battey, 2007; Stigler & Hiebert, 1999; 2009; Rowland & Ruthven, 2011), but there is no universal definition of good or effective mathematics teaching. Instead, it depends largely on the educational traditions and values in a certain country.

# CHAPTER 3

# Methodology

In this chapter, I first briefly describe the Finnish educational context and rationales for the selection of the teacher guides. Secondly, I highlight the three analyses separately and connect them to the specific aims and research questions. I end this chapter by discussing the trustworthiness and ethical aspects applicable to the methodology.

## 3.1 Context and selection of the guides

### 3.1.1 The Finnish context

The school system in Finland is an inclusive nine-year compulsory basic education with no special tracing. The teachers are well educated with a master degree, and free to choose what curriculum materials to use. The national core curriculum (Finnish National Board of Education, 2004) provides an overall outline for school education, which the locally designed curriculum at municipality level defines. Finland has a rather long tradition, since the 1980s, of commercial curriculum materials being produced by teams of teachers and other experts, such as university teacher educators in mathematics education (Niemi, 2012). The representatives of publishers are informed along the process of the curriculum reform by the National Board of Education but no national inspection of school materials exist.

### 3.1.2 Selection of teacher guides

The selection of teacher guides was based on two criteria. Firstly, I wanted to explore teacher guides in mathematics for the Grades 1-6. Secondly, I sought to cover more than 80 percent of the Finnish market, corresponding as closely as possible to the current situation.

I based my choice on a Finnish study conducted by Joutsenlahti and Vainionpää (2010) which states that the three textbook series I studied covered 86.9 percent of the Finnish market in 2008. I chose the three largest series:

Nu[11] covers 57.5 percent of the market, while JT[12] covers 25.3 percent. NMJ[13] is relatively new on the market, and covers approximately 4.1 percent. Only 1.2 percent of Finnish-speaking guides are not included in this study, and the other 12 percent not included are the guides for the Swedish speaking population in Finland (ibid. p. 142), which is beyond the scope of this thesis. I chose a sample of one teacher guide for each series for Grades 1, 3 and 6. This provides an opportunity to investigate teacher guides along the different school years and reveal patterns associated with the curriculum materials at primary school level. Appendix 1 shows the Finnish teacher guides studied.

## 3.2 Analytical approaches

Different analytical approaches are used in the three studies. The results of one study influenced which aim and research questions were created for the next study. Figure 2 below highlights the three studies' aims and research questions (abbreviated RQ) in relation to which analysis was conducted in the separate studies.

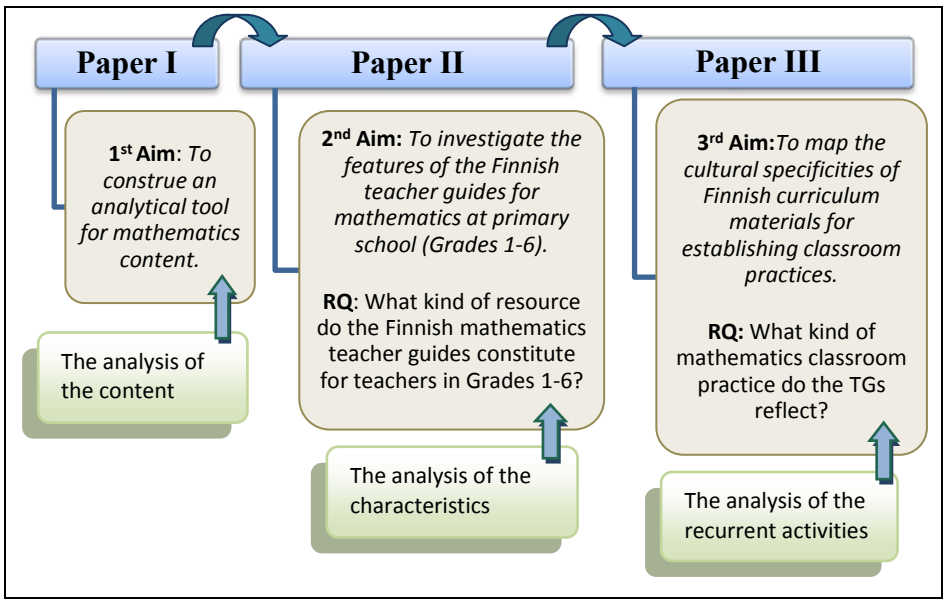


Figure 2. How the aims and questions are related to the analyses

[11] Short for Numeracy (Original title: Laskutaito)
[12] Short for Jack-of-all-Trades (Original title: Tuhattaituri)
[13] Short for New Math Journey (Original title: Uusi Matikkamatka)

### 3.2.1 The analysis of the content

In the first study (Paper I), a framework to fit mathematics was constructed based on Davis and Krajcik's (2005) guidelines, and five predetermined categories were converted into an analytical tool (see Figure 3).

| Category | Description of the categories |
|---|---|
| 1a) General knowledge of students' ideas and strategies | Describes if students might have particular ideas about mathematical concepts and exemplifies common strategies among students. |
| 1b) Suggestions for how to encounter students' ideas and strategies | Offers suggestions for how to deal with and encounter various ideas and strategies to enhance students' learning and prevent future difficulties. |
| 2) Concepts and facts | Illustrates the concepts and facts within mathematics such as history, field of application, derivations, methods, proofs, correct terminology. |
| 3) Progression and connections | Shows the mathematics progression throughout the school years as well as connections between mathematical topics; for example, explains the future development of methods and concepts. |
| 4) Rationales behind the activities/tasks | Supports the teacher's actions in practice beyond the curricular materials by connecting theory and practice, and exposing the central ideas in the national curriculum and research results for promoting teachers' autonomy. |
| 5) Activities or tasks for teaching | Support for the teacher's ability to act in practice by offering suggestions with respect to the design and enactment of lessons, tasks, formative assessment, individualization of teaching, homework, etc. |

Figure 3. The analytical tool

The first three categories for educative curriculum materials help teachers add important new ideas to their repertoires (e.g. about subject matter or students' likely ideas) and, thus, the educative elements can help teachers develop their knowledge base. Each of the four first categories could contribute to increasing both the curricular and personal resources and consequently help teachers find productive ways of adapting curriculum materials. The fifth category promotes a teacher's ability to act by helping him/her in the design and enactment of the teaching, rather than merely be an implementer of a given set of curriculum materials.

The procedure of the analysis: to be better able to identify the different categories, a template (not exhaustive) was constructed containing examples of the five categories in the analytical tool (see Appendix 2). This was both preceded and followed by discussions with colleagues in several cycles. Each teacher guide was then analysed separately and coded with three ratings. The Finnish materials did not present their content as the predeter-

mined categories in the analytical tool. The categories overlap to a certain extent, since the same sentence or example in the guides could be included in two or more categories and thus reflects several aspects, which was resolved with the encoding. At first, this created some confusion, since it was crucial to keep the categories distinct by keeping them as complete and mutually exclusive as possible (Bryman, 2012). The predetermined categories found in the guides were marked in a matrix using simple coding, with the following ratings: (+) when the category occurred sporadically, for example on some lesson pages/information pages/chapter pages[14]; (++) when the category occurred regularly in every chapter and also in several lessons; (-) when the category was absent. The purpose of this analysis was to develop the categories and to examine the extent to which teacher guides offer potential support for teacher learning by checking the extent to which the various guides meet the criteria for educative curriculum materials. The advantage of this method is that the researchers are made conscious of what to look for. But, at the same time, it does not capture the quality of the support offered to the teachers (cf. Denscombe, 2009) nor the number of times the support is present, only its regularity.

The development and evaluation of the functionality of the analytical tool was done in collaboration with research colleagues. It was a strength that we discussed and analysed the guides together first, in this way consolidating the tool. The five predetermined categories (see above, p. 21) that were tested showed that Category 1 should be kept but divided into 1a and 1b, 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.

The results of the first study (for more detail, see Paper I), which correspond to the first aim of the thesis, indicated that it could be valuable to conduct a more extensive investigation of teacher guides, as the tool was found to be functional. Thus, the investigation proceeded with the characteristics of nine Finnish teacher guides in the second study.

### 3.2.2 The analysis of the characteristics

In the second study (Paper II), the analytical tool developed and evaluated in the first study (Paper I) was used to analyse the content in the extended sample of guides. In addition, the guides were also analysed qualitatively in terms of their form[15]. One way to characterize curriculum materials is base the characterization on their structure, i.e. what they offer the readers in ex-

[14] All the Finnish teacher guides were clearly divided into these three sections/pages.

[15] *Form* in the second study refers to the structure, visual look/appearance and method of communication (voice). The form mediates a certain meaning to the reader, which influences how she/he engages with the material (cf. Remillard, 2012).

ternal appearance of representations and activities (Remillard, 2005). Another way to capture the features of the teacher guides is to include the notion of "form" that encloses not only the structure but also the look and the voice (cf. Remillard, 2012).

The procedure of the analysis: the procedure of analysing the content has already been described (in 3.2.1). The procedure of analysing the form: the *first phase* was to read through all nine guides in order to identify the look, which refers to the visual appearance of the materials, since I was not familiar with the guides. Next, I proceeded from the table of contents and investigated the guides more closely in order to more clearly identify their general content and structure (Johansson & Svedner, 2006). Next, the focus was on the structure, which refers to how the material is organized and what it contains. Focus was also on the voice, which refers to how the materials communicate with the reader, as well as on the extended information in order to discern what kind of package the materials offer. This allowed me to grasp the general content and form of every guide. In the *second phase*, the three guides were compared within their series in order to grasp every series' common form and general content. Finally, in the *third phase*, all separate but similar parts of the teacher guides were investigated as a way to reach a collectively common understanding of what the Finnish guides contain in general and what their joint form is (see results of the analysis of content in Appendix 3).

As to the analysis of the form of the guides this qualitative analysis was carried out in the sense that each teacher guide was read and reread in full, from cover to cover, one guide at a time while recurrent headings and activities were noted in an effort to build a picture of the form as well as to obtain a general picture of the guides, it allowed us as researchers to have the freedom to seek the meaning of the text and also allowed categories to emerge from the data. Thus, the concern of the second study was how to present the analysis and explain how you capture something which is not easily explained since qualitative approaches involve interpreting and understanding the implicit in the investigated text (Bryman, 2012).

### 3.2.3 The analysis of the recurrent activities

The analysis in the third study (Paper III) draws on the results of the second study that showed that every lesson in the Finnish teacher guides contains the same kind of recurrent activities. Clarke and Mesiti (2003) use form and function as a framework for analysing the events in a lesson (see also Clarke et al. 2007). They used form and function when analysing video recordings of lessons from real-life where they observed the frequent "events" that also occurred in a specific order. I draw upon Clarke et al.'s notions (2007) of

form[16] and function when analysing the recurrent activities available in every lesson in the teacher guides. We apply these concepts to investigate the activities included in each lesson in the Finnish teacher guides. The following is an explanation of the concepts (Clarke et al., 2007) (a sample can be found in Appendix 4).

Form illustrates the visual features and social participation of an activity.

- *Visual features*: describe how the activity is visualized or what it exhibits.
- *Social participation*: describes the activity on the basis of the involvement of presumptive actor(s) and the manner in which they participate.

Function illustrates the intention, action, inferred meaning and outcome of the activity.

- *Intention*: describes why the activity could be implemented.
- *Action*: describes how the activity could be implemented.
- *Inferred meaning*: describes how the activity is relevant to learning.
- *Outcome*: describes expected results of the activity and what it should lead to.

Using the concept of form distinguished who would carry out the various activities presented in the guides, while the concept of function helped to determine how, and possibly why, the activity should be done. These two concepts together determined how a possible activity could be used in teaching, and generated a picture of the possible enacted classroom reflected in the guides. The activities shaped pattern that delivered the joint picture of the possible Finnish classroom.

The third study drew my attention toward the conclusions possible to draw from the work investigating the notion of a cultural script. These considerations were connected to how it is possible to obtain cultural scripts by analysing teacher guides. This was followed by many discussions and loops of thinking before the conclusion that recurrent activities create routines which can describe cultural scripts; that is, cultural rules and norms that influence and guide teachers activities within a specific cultural-educational context. In this study, these activities are only regarded as possible events. Nevertheless they are manifested in the Finnish guides produced in the specific cultural-educational context. Most of the Finnish teacher guides highlight the same activities indicating that they are regarded as important and

[16] Form, in the third study, refers to the visual features and social participation of an activity.

that they are likely to occur as Finnish teachers frequently use their guides to a great extent (e.g., Pehkonen, et. al., 2007). These activities jointly form a pattern or a script of a possible Finnish classroom. However, I cannot say anything about if and how these activities are actually carried out in the mathematics classrooms. The results of the third study are described in Paper III, corresponding to the third aim.

Summing up the different analytical approaches used in the three studies:

In *the first study* (Paper I), a framework derived from Davis and Krajcik's (2005) guidelines was developed, tested and evaluated. This framework was converted into an analytical tool, described in Section 3.2.1. The unit of analysis was the predetermined categories in the analytical tool. This first study corresponds to the first aim of the thesis.

In *the second study* (Paper II), the modified analytical tool from the first study was used to analyse the content of nine Finnish teacher guides. In addition, the *form* of the teacher guides was also analysed. The unit of analysis was the content and form of the guides. This analysis is described in Section 3.2.2, and corresponds to the second aim of the thesis.

In *the third study* (Paper III), the jointly emerged recurrent activities of the teacher guides from the second study were analysed as a way to find a possible cultural script reflecting Finnish mathematics classrooms. The units of analysis were the form and function (Clarke et al. 2007) of the recurrent activities. This analysis is described in Section 3.2.3, and corresponds to the third aim of the thesis.

## 3.3 Trustworthiness and ethical considerations

Assessing the quality of qualitative and quantitative research has different requirements. Instead of the quantitative terms: validity, reliability and generalizability, qualitative researchers most often use trustworthiness based on four concepts: *credibility*, *transferability*, *dependability* and *confirmability* (Bryman, 2012). These do not express the same requirements of the replicability but do require higher transparency. I consider the four concepts for trustworthiness since the qualitative parts dominate the studies. When carrying out the three studies in this thesis, I have tried to both keep in mind and follow Mason's (2002) four key words: "thorough, careful, honest and accurate" (p. 188) and, therefore, I have, attempted to make all the analyses transparent (cf. Bryman, 2012).

As for *credibility*, the analysis in the pilot study was conducted in close co-operation with the first four authors. The following analyses have been conducted by me and then further discussed and reasoned about together with co-writers of the papers, agreeing on the findings and the interpretations made of them (cf. internal reliability in Bryman, 2012). Here, the main con-

cerns were related to the development of the categories and the rating, since it is impossible to design coding that does not incorporate any interpretation. In both the first and second studies, the predetermined categories found were marked in a matrix using simple coding, with a three-step rating: (+); (++); (-). I deem that this simple coding minimized the probability of differing ratings, since there were not many levels to reconsider and the three coding were clearly separated. Hence, the subjectivity was minimized by analysing the content systematically and a simple method of rating was used.

As for *transferability* and replicability, I have conducted analyses of documents on Finnish teacher guides that cover approximately 90 percent of the Finnish market using three different methods of analysis. The different analyses provide both breadth and depth. My intention has been to clearly describe in a convincing way how the studies have been carried out, even though it is not entirely possible within qualitative research to demand the same degree of replicability as in quantitative research, in which both objects and settings can be replicated. In this study, the objects – the teacher guides – do not change, but the interpretations by different researchers can vary.

As for *dependability*, 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 relates to the aims and the research questions. Further, we claim to have an insider-outsider perspective in the second study. 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). An outsider's and an insider's descriptions are simply 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.

*Confirmability* relates to objectivity. I have obtained distance to my assumptions and preconceptions by relating the data to collectively developed frameworks and by the triangulation of parts of the data analysis. Other researchers, that is, co-authors have been critical reviewers throughout the whole line and the results have been confirmed jointly.

Finally, I have also taken into consideration the ethical principles of the Swedish Research Council (Vetenskapsrådet, 2002). However, since this thesis is based on the text analysis of commercially available documents and includes no informants, I need not take any more account of the guides other than carefully and honestly investigating them.

In this chapter, I have described the methods and analytical approaches used, as well as provided the methodological and ethical considerations. In the next chapter, I present a summary of the included papers with focus on the results.

# CHAPTER 4

# Summary of the papers

In this chapter, I describe the three papers included in this thesis. I focus on the results as both theory and methodology have already been elaborated on in previous chapters. In Paper I, we developed and tested an analytical tool and analysed the educative features[17] of teacher guides for mathematics in Grade 1 from Finland and Sweden. The analytical tool developed and modified in Paper I was then used as a starting point for the analysis of nine Finnish teacher guides for Grades 1, 3 and 6 in Paper II. Paper II is an investigation of these guides' characteristics – that is, both content and form – as a way to convey what kind of resources they constitute for teachers at primary school level. Papers II and III were written in relation to the same empirical data. Paper III entails delving into the fifth category of the analytical tool, and aims to map the Finnish cultural script of classroom practices that the guides seem to reflect.

## 4.1 Paper I

**Title:** Analysing mathematics curriculum materials in Sweden and Finland: Developing an analytical tool (Hemmi, Koljonen, Hoelgaard, Ahl & Ryve, 2013).

This 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 with quite similar school systems but different teaching styles: Sweden and Finland. One rationale for using a comparative approach was that through a process of investigating similarities and differences in various countries' curricular materials, we could reveal some taken-for-granted and hidden aspects (cf. e.g. Andrews, 2010) of teachers' work in classrooms. Such findings could, in turn, 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. It is this aim

[17] The teacher guides' *content* as related to five categories (see further 3.2.1).

that is of the greatest significance in this thesis. To accomplish these aims, we developed and tested an analytical tool based on educative features derived from Davis and Krajcik (2005) and originating from Ball and Cohen (1996). The theoretical stances in this study are in line with Brown (2009) and we emphasize that teachers and curriculum materials (artefacts) participate together in a collaborative relationship in teachers' professional practices (for more detail, see section 2.1). In this paper, we conducted content analysis consisting of both quantitative and qualitative features (for more detail, see section 3.2.1) on 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 categories, while the other Finnish guide (FIN 1) deals extensively with these topics and can thus be regarded as a resource for potential teacher learning in practice. The other Swedish guide (SWE 1) totally lacks these qualities, and is therefore not regarded as resource for potential teacher learning in terms of the categories. Both Finnish guides focus on lesson plans with additional ideas for teaching, 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 categories could be connected to differences in teachers' work in practice.

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, when the fifth category was very general and hence, of minor help for describing the qualities of the resources offered by the teacher guides.

## 4.2 Paper II

**Title:** Investigating Finnish teacher guides for Grades 1-6 as a resource for teaching mathematics (Koljonen, Hemmi & Krzywacki, manuscript in progress).

In this study, we take a closer look at the most commonly used teacher guides for mathematics for Grades 1-6 in Finland. These guides covered almost 90 percent of the market in 2008 (Joutsenlahti & Vainionpää, 2010). The characterization of the guides is done at two levels: 1) the content and 2) the form, and we intend to answer the following research question: *What kind of resource do the Finnish mathematics teacher guides constitute for teachers in Grades 1-6?* Theoretically this study is embedded in a socio-

cultural frame where the teacher guides are considered mediating artefacts, tools that are cultural products of evolution (Vygotsky, 1978; Wertsch, 1998). Specifically they are seen as resources for the design of mathematics classrooms as they constitute an important component in the interplay between the teacher and teacher guides Brown (2009) (for more detail, see section 2.1). In this paper we conduct an analysis of both the educative content in relation to the analytical tool developed in study 1, and the specific form of the guides (see further in section 3.2.2).

The analysis reveals that the teacher guides are organized around single lessons focusing on a certain mathematical topic while the lessons form a period dealing with the same mathematical area. Thus, all the teacher guides have organized the support they offer in relation to single lessons as well as for certain periods and are therefore regarded as a resource for teachers to be used in everyday teaching work (cf. Krzywacki, Pehkonen & Laine, 2012). The examined teacher guides provide the most consistent and extensive support in relation to the design of teaching, Category 5. A variety of activities such as mental calculation, problem-solving and games are accessible for teachers to freely choose in order to design a suitable lesson that fits their specific educational context. In addition, the first category, General knowledge of and suggestions for how to encounter students' ideas and strategies, and Category 3, Mathematical progression and connections, were also rather widely represented in the guides while expanded information about mathematics beyond the level demanded of students (Category 2) was not so usual. However, the use of mathematical concepts was rigorous and one of the series included explanations for all the central concepts, something that could enhance a teacher's mathematical content knowledge depending on the previous knowledge of the teacher. As to the topics connected to Category 4, rationales behind the general ideas where well represented while the rationales behind the suggested activities were only sporadically identified in the guides. The characterization of the form of teacher guides reveals that all the Finnish guides were blended, i.e. they contain both explicit and descriptive statements (cf. Remillard and Reinke, 2012) This characterization is based on how the text and its voice are presented in the guides. However, five of the guides can be predominantly considered descriptive scripts with resource-centric orientation. These guides tend to talk to the teachers and communicate the main ideas i.e., they are coaching the teachers while four of the guides are closer to explicit scripts with procedure-centric orientation. These guides tend to speak through the teachers and focus on the precise actions or words i.e., teachers are implementers of the given lessons.

The findings in this study suggest that the examined guides do not fully meet the educative requirement discussed originally by Davis and Krajcik (2005), as support for teacher learning is not regularly available in all the categories. Yet, general knowledge about as well as suggestions for how to

encounter students' ideas and strategies, are provided in all the guides except in MJ6. The guides use correct mathematical terminology, but little is provided to enhance teachers' own mathematical content knowledge. Despite the variety of optional activities presented in the guides, the rationale behind the suggested activities is explicitly discussed only occasionally. Davis and Krajcik (2005) regard this as a critical component for teacher learning that is often missing in curriculum materials. However, the Finnish teacher guides offer a great deal of different activities for each lesson and, hence, can be regarded as enhancing teacher learning in practice.

The study shows that the content and the form of the Finnish teacher guides are very similar, exhibiting great consensus. The Finnish materials can be seen as a resource for teachers' everyday work in both planning and enactment in the classroom. However, our results suggest that the teacher guides are not mainly intended for teacher learning concerning general educational issues or mathematical aspects. We discuss the findings in relation to the educational context in Finland. This study focuses on one of the components in the interplay between teacher and curriculum material and hence, further investigations are needed to shed light on how teachers learn from and apply the ideas presented in the guides when designing their mathematics classrooms.

## 4.3 Paper III

**Title**: Finnish mathematics classrooms as construed by nine teacher guides (Koljonen, Hemmi & Ryve, manuscript in progress)

This study aims to map the cultural specificities of Finnish curriculum materials for establishing classroom practice in the most commonly used Finnish teacher guides for Grades 1-6 in mathematics. The analysis aims to answer the following research question: *What kind of mathematics classroom practice do the Finnish teacher guides reflect?* Theoretically this study is based on the concept of cultural script that refers to often unspoken, implicit and widely accepted cultural rules and norms that influences and affects teachers' actions but do not determine individual teacher behaviour (Holvino, 2010) (for more detail, see in 2.2.2). Furthermore, the Finnish teacher guides that are extensively used by Finnish teachers (e.g., Joutsenlahti & Vainionpää, 2010) are also influenced by cultural scripts. The recurrent activities identified in the teacher guides are analysed qualitatively in terms of their form and function (Clarke et al., 2007) (for more detail, see section 3.2.3). The characterization of the activities then serves as a basis for a description of what kind of mathematics education the Finnish teacher guides reflect.

The mathematics classrooms that emerge from the analysis reveal a relatively shared view in all the teacher guides, which could indicate a quite homogenous Finnish cultural script concerning mathematics teaching in Grades 1-6.

The analysis of the Finnish teacher guides reveals that the presentation is organized along lessons or, more precisely, potentially enacted lessons containing certain activities. The six recurrent activities always present in the Finnish teacher guides are: 1) whole-class interaction; 2) mental calculation; 3) problem-solving; 4) games; 5) students working in their textbooks; and 6) homework. These six recurrent activities outline the Finnish lesson pattern. Furthermore, the analysis of the recurrent activities reveals that the Finnish guides appear to be a manual for how to work with the corresponding student textbook and simultaneously maintain focus on every lesson with a spotlight on core aspects. The analysis also shows that the guides systematically offer structure and ideas for the enacted classrooms, whereby the lesson is comprised of a) communication and participation in the whole class; b) variation with established routines, offered by the different activities included; c) all students have the opportunity to learn within the same mathematical topic where homework is seen as an extension of learning. Functions of the various activities are connected, besides to learning of and communication with the current topic, to differentiation while keeping the students engaged within the same topic of mathematics, to formative judgement and to maintaining students' motivation.

In the next chapter, the most significant conclusions of this thesis are discussed, as are how and to whom the practical implications of this thesis are relevant.

# CHAPTER 5

# Conclusion and discussion

This final chapter is divided into three sections. The first section is structured according to the three aims of the thesis and I will highlight and discuss the most significant conclusions of each study separately. Thereafter, I turn to the practical contributions of the thesis and discuss them in relation to whom the contributions benefit as well as how. Finally, a suggestion for further studies is pronounced.

## 5.1 The conclusions and considerations of the results

In connection with the first aim the thesis provides theoretical contributions when modifying Davis and Krajcik's (2005) five guidelines from science into an analytical tool of five categories that are useful for mathematics education. The analytical tool has been developed in three ways through each of the three individual studies: Firstly, when constructing an analytical tool for mathematics; Secondly, when testing and modifying the tool; Thirdly, when elaborating the fifth category of the tool. In the following, each of these items will be considered.

When the analytical tool was constructed and tested in the first study, it seemed to work well regarding the first four categories. However, when the fifth category was analysed, the tool was of minor help, as this category is more qualitative in nature and appeared to embrace broader dimension (Hemmi et al., 2013). The tool was then used on a larger sample in the second study of the thesis and further slightly modified to its present appearance (see p. 21). It appeared that all the categories had to be refined during the whole analysis (Koljonen, Hemmi, & Kryzwacki, manuscript in progress). In the third study, we tested another method of analysis to deepen in the qualitative aspects of the fifth category. It turned out that additional eyeglasses are necessary in order to capture the quality of the content (Koljonen, Hemmi & Ryve, manuscript in progress). This constructed analytical tool is a frame that makes the researchers conscious on what content to look for in teacher guides in relation to previous research and ideas about educative curriculum material (e.g., Davis & Krajcik, 2005; Schneider & Krajcik, 2002). These ideas are produced in another cultural-educational context that

the one we have focused on. Nonetheless, the conclusion is that the analytical tool is functional when investigating these kinds of educative aspects in mathematics teacher guides.

The second aim corresponds to the research question posed in the second study (Paper II). The study reveals new empirical results as well as confirms already identified results when searching for the answer to: *What kind of resource do the Finnish mathematics teacher guides constitute for teachers in Grades 1-6?* The result shows that the Finnish teacher guides, on the whole, are relatively uniform with respect of their content and form. In the following, I will discuss the differences emerging in these two analytical levels.

Within the analysis of the content some differences emerged within the five educative categories and it applies in particular: Category 1, Category 2 and Category 4. The support for general knowledge as well as suggestions for how to encounter students' ideas and strategies (Category 1) emerged in two forms of *general support* and *specific support*. Only one of the textbook series (NMJ) sporadically includes both general and specific support. Research has shown that teacher guides need to provide support for teachers in both the general ideas about mathematics teaching and the more targeted and specific pedagogical support of teaching mathematics (Beyer & Davis, 2009) in order to enhance teachers' learning. The mathematical content concerning concepts and facts identified (Category 2) were only sporadically beyond the level of what is expected of students and thus limited support for teachers to deepen in mathematics was offered by the guides. Further, the rationales behind the *specific activities/tasks* (Category 4) were scant in the Finnish teacher guides. To clarify, there was barely any information about the rationales behind the activities or tasks presented on the lesson pages. Only one of the textbook series (JT-series) offered regularly this kind of support. One reason for this can be that the Finnish teachers typically are familiar with teacher guides as they are part of their teacher education (Krzywacki et al., 2012) and therefore expected to be conscious about the rationales behind the suggested activities. Davis and Krajcik (2005) emphasize that curriculum materials should contain both rationales as well as knowledge for teachers in order to be educative for both teachers as well as students. The reason why category 4 was yet marked as regularly (++) during the analysis of the content was that the guides (Nu- and NMJ-series) did offer rationales for the big ideas on the information or/and on chapter pages, as well as that all teacher guides made linkage to the national core curriculum.

The analysis of the form reveals a very coherent picture of the Finnish teacher guides. Nevertheless, some interesting differences were also found and I will discuss them focusing the three types of form: the look, the structure and the voice. Research demonstrates that the form of the guides, will

likely affect practise on how teachers use a material (Valverde et al., 2002). The biggest difference regarding the look is that MJ 6 is printed in black and white whereas the other guides are printed in colour. This makes the guide less appealing and more difficult to orientate in. The most obvious difference regarding the structure are providing by JT teacher guides as they do not contain any chapter pages. Since they also lack well-filled introductory pages, this could cause that necessary information to teachers is lost, such as, underlying assumptions, working methods, how to work with the materials and so on. The differences regarding the voice of the teacher guides are identified dividing the guides into two groups where five of the guides tend to "talk to" the teacher by offering a source for teachers to pick ideas and activities from, whereas four of the guides tend to "talk through" the teachers by guiding to a great extent both teachers' actions and wording throughout the lessons presented (Remillard, 2005; Remillard & Reinke, 2012). However, all of them can be regarded as blended as they include both descriptive and explicit scripts (cf. Remillard & Reinke, 2012). The similarity of the guides suggests that Finnish teachers could quite easily recognize and relate to new materials and develop routines using them. Differences in the voice could be a way to offer support for teachers with different experiences but this requires further empirical studies.

*To conclude,* all the Finnish teacher guides have organized the support around every single lesson and offer assistance linked to the practice – primarily support for design of teaching and hence, for teacher learning in practice. The selection of activities that support teaching is rich (Category 5). At the same time, the guides act as an extension and a simplification of the national curriculum (Niemi, 2012). The Finnish teacher guides are regarded as resources for the teachers to use in his/her everyday teaching work (cf. Krzywacki et al., 2012) rather than a source for deepening theoretical knowledge. The findings in this study are thus not completely in line with Davis and Krajcik's (2005) ideas on educative materials. The Finnish guides offer rather practical support for teachers than enhance teacher learning in line with the ideas in earlier research (e.g. Beyer & Davis, 2009; Grossman & Thompson, 2008). Further, my study demonstrates that the characteristics of the guides are relatively coherent in Finland which could be contrasted to recent studies of Swedish teacher guides where larger differences emerge (Ahl, Koljonen & Hoelgaard, in press; Hemmi et al., 2013; Hoelgaard, Hemmi & Ryve, in press).

The conclusion in connection with the third aim posed in the third study (Paper III) is related to the research question: *What kind of mathematics classroom practice do the Finnish teacher guides convey?* Next, I will summarise the following items below: 1) the activities included in all lessons and 2) the emerged classroom practice. The six recurrent activities of all the lessons in the Finnish teacher guides that emerged from the analysis are: whole-

class interaction, mental calculation, problem-solving, games, students' work with textbook tasks, and homework. Together they constitute a potential enacted Finnish classroom and suggest a relatively strong consensus on the characteristics of teaching in Finnish classrooms. The guides advocate structures and ideas for the lessons that support: a) communication in the whole class; b) variation with established routines, offered by the different learning activities; c) all students' opportunity to participate and d) differentiation while keeping all students within the same mathematical topic. The six activities with the structure and the routines together helped us to paint a picture of classroom practice promoted in the Finnish teacher guides – a possible representation of the Finnish cultural script (cf. Corey, 2010).

The analysis reveals a lesson pattern that delivers a joint and relatively strong consensus concerning both the organization and the teaching in Finnish classrooms. These results could be seen as one important piece in understanding the Finnish classroom practices but further studies are needed to elaborate how teachers use curriculum material (Brown, 2009; Brown & Edelson, 2003; Remillard, 2005). Concerning, the general view of curriculum materials, I notice an interesting difference between Finland and Sweden. In Sweden, there has been a vigorous debate among different actors within the educational settings about the use of curriculum materials; that is, whether or not to use curriculum materials in mathematics education in order to implement good/effective teaching. In Finland, on the other hand, there has not been such a debate. Instead, Finnish teachers have regarded teacher guides as highly important for mathematics teaching and the guides are also therefore widely used (Joutsenlahti & Vainionpää, 2010) and appreciated (Niemi, 2012). This might suggest that the general view of using curriculum materials might differ between the countries.

## 5.2 Practical contributions

As shown above, the Finnish teacher guides exhibits striking similarities, with respect to content and form as well as the kind of support they contain and the classroom practise they reflect. These results could be used for practical purposes in the development of teacher guides. The results could be used by the publishing houses and the curriculum authors as a way to refine and develop the curriculum materials to become more functional and used (cf. Krzywacki et al., 2012; Niemi, 2012). However, it is important to stress that one cannot simply import a material from another cultural-educational context without making adjustments or adaptations (cf. Tarr et al., 2006; 2008).

Intuitively I know that no curriculum materials can be complete and fit all teachers and classrooms. Nevertheless, it is important for teachers to be

aware of the rationale behind the structure and content of the guides in order to be able to use them in an appropriate manner. Well-designed material could in particular benefit teachers who have not had a possibility of studying mathematics and/or mathematics teaching at the university and teachers who want to develop/ change their way of designing and conducting mathematics teaching (cf., e.g., Beyer & Davis, 2009). Finally, a teacher has the responsibility to evaluate the content of curriculum materials against current policy documents in both Finland and in Sweden. Hopefully, the results of this study and in particular the analytical tool developed in this study could serve as one frame for teachers to structure the comparison between curriculum materials and the national syllabus.

## 5.3 Further research

The next step enthused of the thesis could be to study the actual and real teacher-curriculum relationship.

My research has shown that there are few studies focusing on teacher-curriculum relationship in the Nordic countries. Since I have in the thesis examined one component of this relationship, curriculum materials, it would be interesting to investigate teachers' PDC – Pedagogical Design Capacity (Brown & Edelson, 2003) and the interplay between a teacher and curriculum materials. That would be a way to understand how teachers perceive and mobilize existing resources to design instruction (Remillard, 2005) as well as to understand how specific educational contexts influence this interplay (e.g. Hemmi & Krzywacki, in press).

# Summary in Swedish

Tidigare forskning visar att läromedel, så som elevernas lärobok och lärarhandledningar är den resurs som används i huvudsak som grund för matematikundervisning. Finsk forskning visar dessutom att finländska lärare (åk 1-6) i stor utsträckning använder lärarhandledningar i själva undervisningen och även för att planera och organisera sin undervisning. Studiens *övergripande syfte* är att se vilken typ av resurs de finländska lärarhandledningar utgör för läraren, men också att belysa vilken typ av klassrum som dessa lärarhandledningar verkar främja, då lärarna använder de uppgifter och aktiviteter som presenteras i lärarhandledningarna. Studien är genomförd som en dokumentanalys av tre läroboksserier i matematik för grundskolans årskurser 1, 3 och 6. Det är totalt nio lärarhandledningar som har analyserats. Dessa tre läroboksserier täcker nästan 90 procent av de lärarhandledningar som användes i och på finska skolor under år 2008. Avhandlingen består av tre studier. I den *första studien* som också betraktas som pilotstudie, utvecklade vi ett analytiskt verktyg som bygger på Davis och Krajcik's idéer om "lärande läromedel". I den *andra studien* fördjupar vi resultaten från pilotstudien genom att analysera ett större urval med samma ramverk. Den andra studien visar att de flesta kategorier kopplade till idéer om lärande läromedel är väl representerade i de finska lärarhandledningarna. Analysen visar också att det finns en bred enighet om både innehåll och form i lärarhandledningarna och vi identifierade sex återkommande aktiviteter som är närvarande på varje tilltänkt lektion. Vidare visar analysen att egenskaperna hos de finländska lärarhandledningarna erbjuder rika och varierande resurser för lärare i det dagliga arbetet vid både planering och genomförande av matematikundervisning. Den *tredje studien* är en fördjupning i analysverktygets femte kategori för att finna vilket stöd de erbjuder för att designa undervisning. Där kartlägger och karakteriserar vi det kulturella skript utifrån de finska lärarhandledningarna genom att analysera både *form* och *funktion* av de gemensamt föreslagna återkommande aktiviteterna. Vi identifierade en relativt homogen klassrumspraktik som lyfter fram helklassinteraktion, variation med hjälp av olika typer av aktiviteter, möjlighet för alla elever att delta och läxor som en förlängning av lärande av lektionens innehåll. Avhandlingen mynnar ut i en diskussion av resultatens slutsatser och dess praktiska implikationer, vilket kan vara av intresse för forskare, läromedelsförfattare men även för lärare, rektorer och kommuner som vill utveckla och förbättra undervisningen i matematik. Avhandlingen bidrar till den internationella forskningsdiskursen om läromedel i stort och om lärarhandledningar i synnerhet.

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