

Resources for planning and teaching mathematics: a Swedish upper-secondary school case study

Marcus Gustafsson, Jorryt van Bommel & Yvonne Liljekvist

To cite this article: Marcus Gustafsson, Jorryt van Bommel & Yvonne Liljekvist (20 Nov 2023): Resources for planning and teaching mathematics: a Swedish upper-secondary school case study, Journal of Curriculum Studies, DOI: [10.1080/00220272.2023.2281912](https://doi.org/10.1080/00220272.2023.2281912)

To link to this article: <https://doi.org/10.1080/00220272.2023.2281912>



© 2023 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 20 Nov 2023.



Submit your article to this journal [↗](#)



Article views: 141



View related articles [↗](#)



View Crossmark data [↗](#)

Resources for planning and teaching mathematics: a Swedish upper-secondary school case study

Marcus Gustafsson , Jorriyt van Bommel  and Yvonne Liljekvist 

Department of Mathematics and Computer Science, Karlstad University, Karlstad, Sweden

ABSTRACT

This study investigates resource use by upper-secondary mathematics teachers in the context of collaborative planning. A thematic content analysis is conducted on audio-recorded teacher discussions in order to find out what resources are used by the teachers, how they are used, and for what reasons. The findings show that although teachers use a variety of resources to support their instructional enactment as well as instructional design, there is a difference in how they use different resources to support different planning practices. For instructional design, curriculum resources provide support for the mathematical content, while social resources, self-generated documents, and cognitive resources provide support for the design of instructional activities. Authority is given by teachers to curriculum resources, but conflicts of authority emerge in discussions, when teachers' abilities to exert their agency are not supported by curriculum resources. We discuss the findings in relation to authority and resource use, as well as for established conceptualizations of resources. The findings bear practical implications for the design of curriculum resources.

ARTICLE HISTORY

Received 30 June 2023

Accepted 2 November 2023

KEYWORDS

Mathematics teachers; curriculum resources; planning; upper-secondary school; collaborative

Introduction

Of the many different things that teachers do in the pre-active phase of teaching, planning is probably the most important. The wealth and variety of instructional materials available, the emphasis on meeting school or district objectives, and the wide range of student aptitudes in most classrooms are but a few of the factors that virtually necessitate thinking and planning for the term, coming weeks, or even the next day. (Yinger, 1979, p. 163)

When mathematics teachers plan their teaching, they draw on many different resources, and they are influenced by many different actors (e.g. Adler, 2000, Grundén, 2020, Pepin & Gueudet, 2020). Teacher guides and mathematics textbooks are resources that are commonly used by these teachers in this planning. However, in recent decades, much has happened in terms of what Yinger refers to as 'the wealth and variety of instructional materials available'. Digitalization has led to a greater availability of digital resources, and the implementation of new official reform curricula in many parts of the world has caused the pool of resources to grow rapidly in both number and diversity so that the needs of the new curricula may be met.

In Tyler's (1950) classical description of planning, a four-step process is outlined: specifying objectives, specifying knowledge and skills, selecting and sequencing learning activities, and evaluating outcomes. The planning practice is, however, more complex and cyclic (John, 2006, Wraga, 2017), and experienced teachers rarely follow standardized planning models; instead, planning is

CONTACT Marcus Gustafsson  marcus.gustafsson2@kau.se  Department of Mathematics and Computer Science, Karlstad University, Karlstad, Sweden

© 2023 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

a creative process (Cevikbas et al., 2023, Hall & Smith, 2006) where curricular goals and disciplinary subject-matters are transformed and adapted (Bieda et al., 2020, Randahl et al., 2023). Drawing on the work of Young and Muller (2016), we understand the main purpose of teaching to be enabling students to fully acquire ‘powerful knowledge’ to understand and interact with the world. However, such knowledge presupposes a well-designed recontextualization, that is, teacher planning, to reframe different discourses in the practice of planning lessons and teaching (cf. Bernstein, 1999). Advanced planning and preparation presuppose advanced epistemic considerations in order to construct and sequence activities that can build knowledge (Bieda et al., 2020, Cevikbas et al., 2023, Jakobsson et al., 2022).

Swedish teachers spend about 25 percent of their working hours each week planning their teaching (OECD, 2020), a figure which is comparable to most OECD countries. However, research has shown that teachers do not find the time they have for planning and preparation to be sufficiently organized (Nordgren et al., 2021). It is, therefore, important that resources designed to support teachers in their planning can be used efficiently, meaning not only to save time for teachers, but also taking different aspects into account, thus make efficient use of the time available.

Further, it is well established that collaborative cultures among teachers are also supportive of student learning (e.g. Vescio et al., 2008). The establishing of collaborative settings focused on the quality of teaching goes beyond in-lesson activities; that is, it also incorporates planning what to do, how to do it, and forming arguments on why a given lesson is a well-designed one, student activity, etc.

Many studies on teacher planning are directed at in-service teachers or novice teachers (Cevikbas et al., 2023). In this article, we use data from planning team meetings of experienced teachers (i.e. when they collaboratively plan their teaching) to shed light on actual planning practices of teachers and what resources are used in these practices. This design enables a unique insight into authentic mathematics teacher practice in the context of collaborative lesson preparation. Through these discussions, how resources are used in the planning practices of teachers become apparent.

In mathematics education research, questions concerning the resources teachers use and what this use of resources looks like in practice have gained interest over recent decades (Fan et al., 2013, Pepin et al., 2017, Remillard, 2005). In a Swedish context, research has focused on teacher guides for primary school (Hoelgaard et al., 2014) and how they are used by teachers (Ahl et al., 2005, van Steenbrugge & Ryve, 2018), as well as teachers’ use of digital instructional resources (Remillard et al., 2021). This emphasis in the research on primary schools might be connected to the fact that most commercially produced student textbooks for primary school come with extensive accompanying teacher guides directed at teachers, with the result that teacher guides are a common resource for teachers. However, a brief review of commonly available textbooks showed us that this does not seem to apply to upper secondary school to the same extent. Only one of the major publishers has a printed teacher guide that aims to support teaching broadly, while most of the other major publishers support teachers only by offering extra student tasks, tests, and, occasionally, activities. Upper-secondary school teachers in Sweden are subject specialists, and their teacher education programme has for many years targeted building teacher capacity to transform subject knowledge into teaching knowledge. This could be a possible reason for a lack of external support in terms of for example content specific support associated with curriculum materials. Internationally, some research has targeted secondary school teachers’ resource selection and use (Siedel & Stylianides, 2018), but in Sweden less effort has been made to investigate what resources upper secondary school teachers use and what this use looks like.

There is a need for more knowledge on upper secondary school teachers’ use of resources when planning: what resources they draw upon and for what reasons. Our study aims to fill this knowledge gap. Insights generated from this study could be used to help identify resource needs and to make more efficient designs to support teachers in this practice.

As a guide to our study, the following three research questions capture the different characteristics of the use of resources:

- (1) What resources do Swedish upper-secondary school teachers draw upon when collaboratively planning lessons?
- (2) How do they use these resources?
- (3) Why do they use these resources the way they do?

Background

The above quote of Yinger (1979) refers to ‘instructional materials’ and the objectives that need to be met by teachers using these resources. Over time, ‘Curriculum materials’ has come to be the predominate term for describing resources designed and produced to help enact curricula as intended by policy writers by supporting teaching enactment and student learning in a classroom setting in a way that aligns with the specific content and goals of a grade level or course. In this way, curriculum materials are *curricular* in nature. The word *materials* emphasizes the physical nature of the materials, which are often student textbooks with accompanying manipulatives. A possible reason for such synonymous expansion of curriculum *materials* into curriculum *resources* could be to suggest the inclusion of not only analogue but also digital and less obviously material resources. The terms are sometimes used interchangeably, but in this text, the choice of term used is context-dependent.

The potential impact that curriculum resources can have on teaching practice has been well discussed in research. Ball and Cohen (1996) were among the first to propose curriculum materials as important factors in professional development for teachers and as sources of change of practice in line with reformed curricula when new materials are designed and implemented.

Conceptualization

The conceptualization of ‘resources’ in the context of mathematics education has evolved in recent decades, with the aforementioned increasing availability due to globalization and digitalization.

On the macro level, resources may correspond to what Adler (2000) called *basic resources*, like buildings, chairs, or electricity. Resources may also correspond to administrative measures, such as class size, teacher-per-student ratio, or money spent on teaching materials, and some research has focused on these kinds of resources and their effect on student outcomes (see, for instance, Cohen et al., 2003).

On a more practice-based micro-level, many of the resources used are curriculum resources, which Pepin and Gueudet (2020) define in the Encyclopedia of Mathematics Education as ‘all the material resources that are developed and used by teachers and students in their interaction with mathematics in/for teaching and learning, inside and outside the classroom’ (p. 172–173), including text resources (such as textbooks, teacher curriculum guidelines), other material resources (calculators or manipulatives) or digital-/ICT-based curriculum resources (such as interactive e-textbooks). When it comes to digital curriculum resources, a distinction is made from educational technology, with the reasoning being that digital curriculum resources sometimes, but not always, make use of educational technology in their designs. Remillard (2018) uses the term ‘instructional resources’ for all tools that support and guide instruction, and ‘curriculum resources’ for ‘print or digital artifacts designed to support a program of instruction and student learning over time’ (p. 71). Therefore, in her conceptualization curriculum resources are a sub-set of instructional resources.

Further, Pepin and Gueudet (2020) acknowledge that there are other non-material resources that teachers use to enact curriculum, such as social resources (e.g. a conversation with a colleague directly or on the web/forum), and cognitive resources (e.g. frameworks/theoretical tools used to work with teachers), but they don’t elaborate on these other types of resources. Adler (2000) also used an extension of resources to include socio-cultural resources, such as language and time, as well as the knowledge of teachers.

In this article, we generate an analytical framework from these different conceptualizations that is further described in the 'Methods' section.

Different types of resources

Much research on resources in mathematics education has revolved around curriculum resources. The most common curriculum resource is the student textbook, and its role in the teaching and learning of mathematics has been thoroughly researched (for example Fan et al., 2013). In Sweden, individual work in student textbooks through all grades has been common practice (Boesen et al., 2014, Jablonka & Johansson, 2010, Johansson, 2006, Tengberg et al., 2022), which implicitly means that the student textbook has been a common resource used by teachers.

The importance of the student textbook in a Swedish context is reflected on in research that considers the content of these textbooks, considering, for example, how textbooks for upper-secondary school deal with problem solving (Brehmer et al., 2016, Jäder et al., 2020), proofs (Bergwall, 2021), or a specific mathematical topic like quadratic equations (Sönnnerhed, 2011).

Digitalization has led to research on the use of digital resources, including how these resources are used in class (e.g. Fahlgren et al., 2021) for students to work with or to watch (e.g. van Bommel & Palmér, 2021, Vinerean et al., 2023) and for teachers to use as preparation in their planning practice (e.g. Liljekvist et al., 2021).

In an interview study with 26 secondary school teachers, Siedel and Stylianides (2018) mapped a 'resource "pool of possibilities"' (p. 119), an inventory of resource choices available to teachers in England. They found there was an extensive list of websites used as specific resources, besides generic resources like student textbooks, colleagues, or other physical materials or digital materials in shared folders. In addition, Kock and Pepin (2019) mapped resources used by teachers. They conducted a survey with secondary mathematics teachers in France about resources used for lesson preparation and found that teachers were mostly led by the school's mathematics textbook, including its digital materials, and that other used resources for lesson preparation were national syllabi documents, teacher notes, and conversations with colleagues.

The complex relationship between teachers and curriculum materials

A considerable amount of research has been conducted on the way teachers use curriculum materials (Remillard, 2005). Remillard's research shows that the relationship between teachers and curriculum materials is complex due to the various standpoints and perspectives one can take in researching the relationships, from the perspective of the teacher to the perspectives of the curriculum material. Teachers can, for example, be said to either follow, participate with, or design their teaching based on curriculum materials, and teachers' beliefs and knowledge affect how they interpret and choose to use these materials (Remillard, 2005). The curriculum materials themselves differ in their voice, design, and type of content, and aim to affect the practices of teachers in different ways.

However, few studies have investigated the reasons for using and choosing resources. In the study by Siedel and Stylianides (2018), the authors developed what they call a teacher's resource 'pre-disposition taxonomy' (p. 120), a set of reasons for choosing certain resources in their teaching practice. They found uses of both specifically named resources and general resources, and they constructed six main themes of what drives teachers' resource selection.

These themes are teacher-driven (focusing on the teachers' own needs), student-driven (focusing on their students' needs), mathematics-driven (mathematical content is handled in a way aligning with the teachers' views on how certain concepts should be taught), constraints-driven (availability (or lack thereof) of a resource, such as time or money), resource-driven (user-friendliness), and culture-driven (cultural setting of, for example, other teachers around them using the resources).

Stemming from a northern American teaching context where teaching historically has revolved around a central (physical) student textbook and a teacher guide, Brown (2009) coined the terms *offloading*, for using the material 'as it is', *adapting*, for tailoring it slightly to suit the teacher's need, and *improvising*, for creating new instructional passages based on the intent of the original material. Remillard (2019), building on Brown (2009), sees the use of materials as a design process where teachers' internal resources in terms of their knowledge, goals, and beliefs along with external resources in terms of curriculum materials create instructional outcomes for the intended teaching. This relationship between teachers and resources is also called a participatory relationship. Adler (2000) used the term *re-sourcing* as a way to emphasize that teachers use and re-use resources in new ways all the time. Similar to re-sourcing, Gueudet and Trouche (2009) and also Trouche, Gueudet and Pepin (2020) broadly define teachers' work using resources as *documentation work*. In their *Documentational approach to didactics* (DAD), the outcome of a teacher's specific use of a specific resource is called a *document*. Teachers' total amount of documents constitutes a *resource system* that evolves as they progress in their professional development through their practice, a process called *documentational genesis*. On a general level, 'teachers' work with resources includes selecting, modifying, and creating new resources, in-class and out of class' (Trouche et al., 2020, p. 237), terms of use that correspond somewhat to those of Brown (2009).

DAD (Trouche et al., 2020) and the ideas described above of Remillard (2018) and Brown (2009) all see the relationship between teachers and curriculum materials as relational. This can be seen with the understanding that teachers are either designers of teaching who cooperate in a participatory relationship with the materials to create instructional outcomes (Brown, 2009) or that they perform documentation work within their resource system in a documentational genesis (Trouche et al., 2020). Remillard (2019), in her comparison (p. 177), claims that the participatory relationship and the documentational approach are two different conceptualizations that share a similar socio-cultural perspective.

We acknowledge that the use of curriculum resources can also be situated in a subset of the notion of teacher agency (e.Biesta et al., 2015). In this setting, teacher agency is not something teachers 'have' but rather something they 'do', and it can be understood as 'an emergent phenomenon of actor-situation transaction' (Biesta et al., 2015, p. 626) or as in the definition by Toom et al. (2015): '[...] willingness and capacity to act according to professional values, beliefs, goals and knowledge [...]' (p. 616). It is our understanding that teachers' planning using resources comprise such phenomena, and that the ability of teachers to exert agency can be affected by the characteristics of different resources. For mathematics, support for teacher agency can be obtained from curriculum resources but, at the same time, teacher agency can be constrained by grade-level standards (Rich, 2021).

Methods

Data generation

In this study, the practice of three groups of upper-secondary mathematics teachers was studied as part of a wider project. The teachers all worked at one school teaching students of the age of 16–18 and in three different mathematics course working teams. All teachers partaking in the study were licenced teachers and had at least five years of teaching experience. They were familiar to each other and had worked together in different groupings before, however not organized in small planning teams focusing on a specific mathematics course.

The empirical data in this study consists of audio-recorded planning team meetings. The meetings took place during the years 2019–2020 (before Covid and then during the early stages of Covid) and were audio-recorded for each group by the participating teachers themselves. Research assistants stored these recordings according to data regulation rules and classified the discussions by type of content.

In these meetings, upper-secondary teachers meet and plan upcoming lessons. The agendas for these meetings are loosely defined, and the hierarchical differences between participants can be

Table 1. Data used in this study.

Teacher group	Participants	Treated recordings	Total length
Group 1	4–5	2, transcribed	114 min
Group 2	2–4	5, notes	265 min
Group 3	3–4	6, notes	252 min

considered low. As a result, the meetings are discussions in nature. Different meetings have different focuses, with some being more closely connected to lesson planning.

The audio recordings analysed in this study contain discussions that explicitly focus on planning in one of several ways: the planning of parts of, or the whole of, an instructional sequence, the planning of a lesson, or the planning of a sequence of lessons. Planning is here regarded as all work associated with lesson preparation.

Table 1 shows the recorded team planning meetings, spread over the three teacher groups. For this study, a step-wise selection of recordings was made in order to gain familiarity with the data and to prepare for the analyses, in line with the analytic procedure described in the next section.

First, recordings from two meetings by Group 1 were chosen in order to survey the material. These recordings were chosen because they included lesson planning, involved many teachers, and were among the lengthier of the recordings. These were transcribed by the first author as tidied-up statements of what teachers said in the planning-team meetings, omitting background noise and using time-stamping for the data to be navigable. Since the focus of this study is on what, how, and why resources are used, it was only relevant to know what was said, not by whom. This step contained preliminary analyses of the corresponding use of the mentioned resources.

Second, five recordings from Group 2 were listened to in order to find a larger pool of the mentioned resources and how they were used. While listening to these recordings, notes were taken on resources as they emerged in the planning team meetings and partial transcriptions were made.

Third, four recordings from Group 3 were listened to in order to find reasonable saturation in types of resources and their use.

Finally, three more recordings were listened to in order to validate themes. In total, the recordings used in this study run to 631 minutes in length.

Analytic procedure

Conceptualization of resources and their use

A resource has been conceptualized in this study in accordance with the definition of curriculum resources and other types of resources posed by Pepin and Gueudet (2020). Our a priori understanding of what specific resources may be then covers a wide range of resources, exemplified by material resources like textbooks, curriculum guidelines, calculators, digital resources like digital tools and curriculum materials, as well as non-material resources like conversations with colleagues or cognitive resources such as frameworks or theoretical tools. Adler's (2000) notions of language and time, or of teacher knowledge, are not considered resources in the sense of being units of analysis.

Unlike Siedel and Stylianides (2018), we do not distinguish specific and generic resources in terms of named or non-named resources. For example, 'Matematik 5000', and 'the textbook' are considered the same.

The teachers talk about resources in both present, future, and past tense, and in these discussions the use of these resources can therefore already have happened, be intended to happen in the future, or be being used right at the moment of discussion. In our analysis, this distinction of use with respect to tense has been ignored, and instead, all statements concerning the use of resources by teachers have been treated equally. The assumption is that the use is the same, no matter at what point in time it takes place.

Initial analysis of resource occurrence and use

To answer the research questions, the first two transcribed planning meetings were initially subjected to a thematic coding analysis (c.f. Robson and McCartan, 2016, Braun & Clarke, 2006) by the first author, aided by a mix of NVivo, Microsoft Word, and Excel.

The first step of the analysis was done here with regard to what resources were used (RQ1) and how they were used (RQ2). Preliminary codes ($n = 115$) were generated, where resources were coded (including the passages surrounding them) as a unit of analysis, with notes of corresponding use for each mentioned resource (see coding examples in Table 2). The reason for this use (RQ3) was also noted in cases where this was made explicitly clear through the teacher's statement. A teacher was only coded as the resource 'colleague' if (s)he was specifically referred to by another teacher in the planning meetings.

In the second step, the coded resources were grouped into themes of different types of resources and related to the conceptualizations, including both material and non-material resources. Coding was conducted deductively according to the nature of the resources included, but themes were constructed independently from the conceptualization (inductively). Notes from the four discussions from Group 3 showed that the new resources mentioned here were, if any, only on the specific level and not on the thematized level, which led us to believe that reasonable saturation had been met in regard to RQ1.

At this point, the passages surrounding the resources provided the basis for creating themes of types of use (RQ2). Indications of reasons (RQ3) were found implicitly through analysing the use of resources and sometimes explicitly through what were expressed as reasons for this use by the teachers in the discussions, but themes could not be satisfactorily created.

Extended analysis of reasons for resource use

So far, preliminary ideas of themes had been found for implicit reasons for the use of certain resources. However, since explicit reasons given by teachers were still perceived as rare in the discussions, another approach was taken to focus semantically on teachers' statements using the transcripts from the two discussions from Group 1. This was done using words associated with expressions of wants, needs, and reasons, not necessarily focusing on resource use. This analysis allowed us to see things we would not have found associated with resources explicitly, but which we could find implicitly by triangulating the rationale of the thematized resource use to the expressed wants and needs of teachers.

A coding manual of words signalling reasons (Table 3) was created to generate units of analysis and applied to the first two transcribed discussions from Group 1, rendering 87 statements. Such units consisted of the sentence that contained the word and sometimes the previous or following sentence to frame the context. The signal words were both verbs that signal agency, together with

Table 2. Coding examples.

Excerpt	Specific resource	Type of resource	How is the resource used here?	Explicitly stated reason for use
T1: No, we don't, because in the national tests all alternatives are accepted, for example x to the power of 0.5, x to the power of one half"	National test	Official document	Used as an authority to decide on what level a mathematical content should be included and taught.	To give argument to why a certain representational appearance should be taught.
T2: And then that last thing, to do it in GeoGebra T3: Yes, that was the last thing [...] here is so much I would like to try to explain, the tangent, you can see here that it is, that the derivative is 1.5'	GeoGebra	Dynamic software	Intended to be used in teaching to elicit and represent important mathematical concepts.	None

Note: T1, T2 etc. are in this text used as placeholders in dialogues, not as markers for unique individuals.

Table 3. Words signalling reasons.

Swedish words (verbs)	Closest English translation	Swedish words (conjunctions)	Closest English translation
vilja	want	så, så att	so, so that, then
behöva	need	för, för att, eftersom	because, since, to
måste	have to	därför	that's why
borde	should		
tänka, tro, tycka	think		
önska	wish		
mena	mean		

conjunctions that often precede subordinate clauses that give reasons. This list was extended during the initial coding process when reasons were identified without being coded according to the coding manual.

As an example, in this analysis the following teacher statement: ‘I want them [the students] to think about what the derivative at a specific point means’ would first be identified because of the use of the word ‘want’ and then coded as reasons being both ‘importance of eliciting mathematical ideas’ and ‘importance of considering students intended in-class experience’. This statement was associated with arguing for the design of a sequence within a resource being a lesson plan. These types of sometimes overlapping descriptions were eventually used to construct the finished themes and the final formulations as seen in the findings section.

Ethical considerations

The study was conducted according to the ethical guidelines for research projects at Karlstad University (Dnr. C2018/100). All participation took place with informed consent.

Findings

The findings in this study are reported in three steps corresponding to the research questions posed. The section ends with a concluding summary of the findings for the three research questions and how they are related.

What resources are used? (RQ1)

The unit of analysis was specific exemplars of resources mentioned in the teachers’ discussions. The units were thematized into types of resources and related to the conceptualizations by Remillard (2018) and Pepin and Gueudet (2020). Table 4 shows a list of the mentioned resources and how they are conceptualized. The analysis shows a diversity of resources emerging in the teachers’ conversations in the form of curriculum resources, digital resources, and cognitive resources, as well as internal resources in the form of documents and social resources.

How are they used? (RQ2)

The use of the resources consists of supporting three practices of mathematics lesson planning: support for deciding what should be taught and in what order, support for deciding how (and sometimes why) it should be taught, and support for enacting the teaching. The themes of resource use are therefore correspondingly defined here as tools that provide *support for mathematical content*, *support for instructional design* and *support for enactment*.

Table 4. List of resources used.

Units of analysis Specific exemplars	Thematized terms	Conceptualized terms
The main student textbook	Student textbooks	Curriculum Resources
Reference student textbook		
National course plan	Official documents	
National tests		
National test associated formula sheet		
Nokflex	Digital curriculum resources	Curriculum Resources/Digital resources
Kunskapsmatrisen ['Matrix of Knowledge']	Calculator	Digital Resources
Physical graphing calculator	Dynamic software	
GeoGebra		
Desmos		
GeoGebra Classroom	Platforms	
Onenote		
Google	Websites	
Wikipedia		
Old lesson notes	Self-generated resources	Documents
Colleague's text		
The local course plan		
Results from pre-test, post-test, exit ticket, diagnostic test		
A visited didactic lecture	Events	Social Resources
Colleagues	Human resources	
SSDD/Tysta läraren ['Silent teacher']	Didactic models	Cognitive Resources

Support for mathematical content

Support for mathematical content targets the didactical 'what' question of teaching, the subject content of the lesson plan. This has the sub-categories of *mathematical units*, *mathematical tasks*, and *mathematical representations*.

Mathematical units means a number of concepts of varying sizes depending on the context, making up a unit to be taught either as part of a lesson or as a lesson itself. These are selected from the student textbook or the official documents, and sequencing takes place with the help of the local course plan and other student and reference textbooks.

Mathematical tasks can be of any form. They are the most prominently treated resource content, taken from a wide range of resources. The student textbook, reference textbooks, online curriculum resources, and the national tests all contain tasks that are used in planning, sometimes being modified. At times, the teachers create their own tasks in their self-generated resources in the form of their lesson plans. At other times, certain types of tasks are sought from different places online.

Mathematical representations mean the way a mathematical concept or property is depicted, for example, symbolically or graphically. Since mathematical content and tasks can have different representations, one could claim that this is not a category by itself. However, this category corresponds to the representation being the subject of discussion rather than of the content or task itself. Choice of representations is supported by considering prior national tests, the formula sheet, the student textbook, and reference textbooks and websites.

Support for instructional design

Support for the instructional design of lesson activities targets the didactical 'how' and 'why' questions of teaching. Cognitive resources such as the ideas of SSDD¹ or 'Silent teacher'² are used as support for the design of instructional activities. Social resources in the form of colleagues that permeate all planning discussions, both explicitly by being referred to and implicitly through their participation in discussions, support the creation and modifications of instructional activities. Documents in the form of self-generated resources, for example, old lesson notes or the lesson

plans forming the context of discussion, all give support for the intended teaching. Results from tests such as pre-tests or exit tickets also help guide the design of instruction.

Support for enactment

Some statements of resource use are aimed at the enactment of teaching in a classroom setting. This includes the intended use of curriculum resources, such as the student textbook containing mathematical content and tasks, and digital platforms like GeoGebra classroom or OneNote for delivering tasks. Other tools for students to use include the formula sheet connected to the national test and digital tools like dynamic software or the graphing calculator. These tools are meant for students to work with in class but also sometimes for teachers to use in demonstrations.

Why do they use them this way? (RQ3)

Three themes focusing on the importance of practical and didactic reasons were constructed: *to handle practical context*, *to conduct teaching*, and *to consider the students*.

These themes were obtained by combining the expressed reasons generated through the themes of use and the linguistic analysis procedure.

To handle practical context

This theme includes notions from statements made that address the context of Swedish upper-secondary school mathematics teaching. Within this theme, some sub-themes were constructed: To relate content to official curriculum, to relate to the main curriculum material and local course plan, to time- or size-manage, and to ensure functionality in enactment. A description with example quotes can be found in [Table 5](#).

To conduct teaching

This includes sub-themes: what the teacher should do, what the teacher should show, what the students should do, and what the students should see, experience, realize, or live in enacted lessons. These four themes are closely intertwined, as illustrated by the excerpt with a teacher’s reasoning about the instructional design within a self-created lesson plan presented in [Table 6](#).

To consider the students

This includes sub-themes: future understanding, mastering of skills, pre-knowledge, and student-group properties. A description with example quotes can be found in [Table 7](#). It is important to note here that within the conducting teacher theme, aspects of students are also taken into consideration with concern to what students are meant to see, do, or experience through the teaching.

Table 5. Sub-themes of *to handle practical context*.

To handle practical context	Example quotes
To relate content to official curriculum	T1: Do we need to teach this? T2: I’m checking the curriculum now Was there a difference quotient on the national test last time? I don’t think I have seen that’
To relate to the main curriculum material and the local course plan	Because, this is before . . . in our course plan it comes before the definition of the derivative
To time- or size-manage	I think that one is enough, because it will take too much time otherwise. It will be too ambitious and then there’s no time for any other
To ensure functionality in enactment	. . . and then we can just change the function, and we can change “h”, and we see what happens to the quota
To facilitate the planning situation	can’t we share a word document?

Table 6. Sub-themes of *to conduct teaching*.

To conduct teaching	Example quote
Regarding what the teacher should do	So, first I want to do one of these[points to some mathematical example], where we just calculate ... the slope of the secant ...
Regarding what the teacher should show	and then I want to show directly ... when there is a very small distance in between ... When there is a small delta x, then we see ... just the secant even if it ... the graph is drawn below ... we see it a bit unclear ... it is 0.1 in between there, over there it is 001 in
Regarding what the students should do	ble to see it ... and so I want them to evaluate ... the derivative on that on now[...] here I will get a ... close value that is close to ... 4 I
Regarding what the students should see/ realize/experience/live	guess ... , and on the last one when they evaluate the derivative, then it is 4, so that they see the difference ... so this ... I want to point out that the last one is not a difference quotient

Table 7. Sub-themes of *to consider the students*.

To consider the students	Example quotes
Regarding their future understanding	I think it will be an advantage that we'll take the definition of the derivative later
Regarding the mastering of skills	We want them to be able to read the formula sheets too
Regarding their pre-knowledge	Pre-knowledge, handling powers with real exponents, because it's very important that they know how to
Regarding the student group properties	Then I think: this will take a really long time for most students

The use of resources when collaboratively planning lessons

Altogether, the findings show that the practice of collaboratively planning lessons draws both on and from a variety of resources in different ways. In [Figure 1](#), some resources support the 'how' and 'why' of instructional design (documents, social resources and cognitive resources) and others support the 'what' of instructional design (curriculum resources and digital resources).

The final say in resource use

In Sweden, teachers have great autonomy. Steering documents offer guidance on a general level, under which guidance teachers are free to select instructional activities as they see fit, including the choice of resources used in the classroom or drawn from in planning. However, the relationship between teachers and curriculum material is relational (Brown, 2009, Remillard, 2018, Trouche et al., 2020); therefore, what is given 'the final say' – the authority—is an important aspect when it comes to teachers' use of resources. For instance, Ball and Cohen (1996) talk about curriculum materials in terms of important actors and as changers of practice. However, curriculum materials may or may not be given authority by teachers. By connecting the findings regarding resource use with reasons to use, patterns can be seen embedded in the different resources.

By seeking support for mathematical content, external resources are given authority in the handling of the practical context of what to teach. Examples of such external resources are curriculum resources in the form of the student textbook and the official documents, and both the national course plan and the national tests, as illustrated by the following quotes:

T1: Do we need to teach this?

T2: I'm checking the national course plan now.

Was there a difference quotient on the national test last time? I have not seen it, I think.

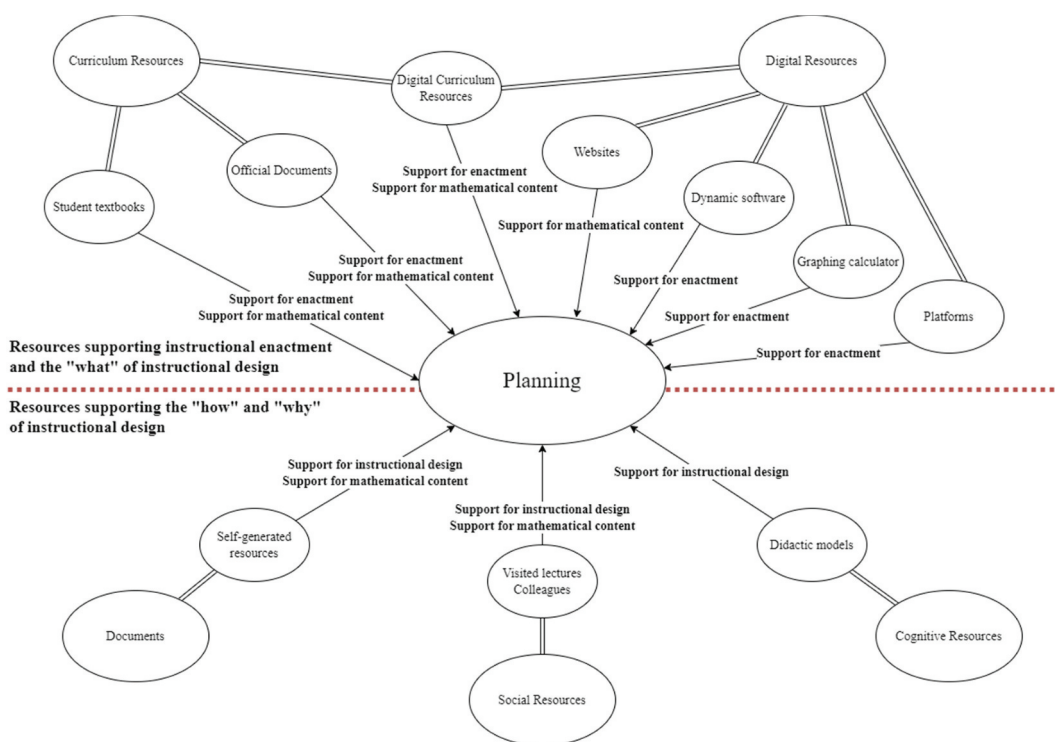


Figure 1. A scheme for resource use when collaboratively planning lessons.

Teachers also follow the document of the locally constructed course plan, which is constructed following the student textbook. As student textbooks usually are constructed based on the national course plan, it can therefore be said to be grounded in the same external authority.

When seeking support for enactment, authority is given to resources, ensuring the functionality of what teachers need the resources to do for them (apart from just being available). The functionalities of resources that teachers seek include the distribution of mathematical tasks and units to students in class, functionalities which curriculum resources like the student textbook, or digital resources like online platforms, provide:

I have to let them [the students] do exercises [in the textbook].

Then I thought that they will get some examples to work on in GeoGebra classroom.

Another functionality sought is helping represent mathematical concepts dynamically, where authority is given to digital tools such as Geo

In GeoGebra, if one takes an exponential function where the base is a slider, and then one takes the derivative of it, they [the students] can see that there is a value that makes the graph of the derivative and the graph of the function identical.

Resources that help facilitate planning include digital tools for sharing lesson plans or the components thereof. Management of time or size is something that has no clear authority in any specific resource but rather is affected by organizational constraints, a construct not considered in this study.

In seeking support for the design of instructional activities, authorities for conducting teaching come from social resources in the form of the teachers themselves or from cognitive resources in the form of didactic models. The teachers are the ones creating, selecting, and modifying instructional

activities, working with documents in the form of lesson plan elements in the discussions. In doing so, they use each other for ideas:

T1: In 'B' I write, if you scroll up a bit, it was three different, this one was with fractions, and this was with 4 divided by x to the power of 3, and then I had 6 the square root of x , considering I later have the example.

T2: In this SSDD that comes here, it is the same 6 square root of x as in the last example, did you mean that?

T1: Yeah, I don't know if it's right or wrong, but it was my thought or help each other out by collaboratively giving suggestions.

T1: A constant I think is good, but it is harder sometimes with x ; they[the students] have a hard time differentiating.

T2: Either x or constant, or both maybe?

T3: It's too much ... my thought was that it would be the same for ...

T4: It's good because this with the equation can be tricky enough, and then it can feel good to have the derivative done so that one does not have to think about ...

Emerging conflicts of authority

According to the constructed themes, curriculum resources are given authority in deciding on the mathematical content to be taught. However, the authority of the textbook is at times questioned or negotiated through the discussions, for example, in relation to the choice of representations

It bothers me that there's "y" in the textbook, and then there's "y" again, but it means different things

the range of available tasks

There's only geometrical applications, seems weird

the content focus

I think it's a bit stupid in the textbook that there's so much focus, my student puts in so much energy trying to figure out why it's n times 180

or the textbook's assumptions about the students

They assume in the books that the students should make connections, there's not so many explanations really.

However, one teacher balances the pros and cons:

The textbook is after all ... we need it for structure.

When a teacher claims a mathematical content is not present in the official document of a national test, this content may still be taught because one teacher believes that it could increase student understanding. The digital online resource 'Kunskapsmatrisen' is given authority for its support for enactment and support for mathematical content. However, it is also questioned when its classifications do not fit the teachers' ideas of what the courses should include in terms of content.

Discussion

This study has provided insight into the authentic collaborative planning practice of Swedish upper-secondary school teachers. The teachers in this study draw both on and from a vast and diverse body of resources, with different types of uses and reasons, emphasizing a ‘resource system’ (Trouche, Gueudet, & Pepin, 2020) nature of this practice. Three questions have been leading our research: What resources are drawn upon, how resources are used, and why resources are used in the way they are.

The types of resources used were in line with previous studies (Siedel & Stylianides, 2018, Kock & Pepin, 2019). However, compared to the findings of Siedel and Stylianides, our teachers did not use a wide range of online resources. We found it fruitful to include non-material resources like social resources and cognitive resources, as described by Pepin and Gueudet (2020). This benefit is twofold: it helps to emphasize the importance of teachers being social resources for each other in a collaborative setting, and it is helpful to separate a cognitive resource from the teacher who uses it. From the findings in this study, we propose an elaboration on the concept of instructional resources proposed by Remillard (2018), as we see two types of resources supporting instruction: one type supporting mathematical content and another type supporting instructional activities. When no teacher guide is used, curriculum resources support instruction of the mathematical content and are used as tools in in-class enactment. The teachers in our study did not use external curriculum resources for instructional design, but used documents and social and cognitive resources. Therefore, expanding on Remillard’s (2018) definition of instructional resources, we suggest including teachers and didactic models as instructional resources. This is an important contribution to our understanding of the benefits of collegial planning.

External resources differ in the way they support different aspects of instructional design. The ‘how’ and ‘why’ of teaching is only sought externally in terms of cognitive models, while mainly traditional curriculum resources like textbooks and national curricula support ‘what’ mathematical content should be taught. Following Remillard’s (2005, 2019) types of use, our teachers appear to follow the curriculum resources in terms of the support they give for mathematical content, but participate with or design the ‘how’ of teaching based on these resources, mainly drawing on social or cognitive resources. This could be a consequence of the absence of corresponding teacher guides supporting the instruction included in the curriculum materials. We see evidence of resource use as selecting, modifying, and creating new resources, as proposed by Pepin and Gueudet (2020) in the teachers’ planning discussions.

Relating to Brown (2009), teachers in our study do have a main curriculum resource in the form of the student textbook, from which they seem to offload support for mathematical content by selecting sequencing of topics, representations of mathematical concepts, and tasks for classroom demonstration and student work that also support enactment. Other curriculum resources in terms of the national curriculum, consisting of the course content description, official formula sheet, or national tests, are also used for offloading support for representations and tasks in enactment. However, where Brown emphasizes that offloading means using ‘as it is’, our interpretation is that the teachers in our study generally do more adaptation work. They adapt (or modify) the main curriculum resources in terms of selecting content to be included or excluded, for example, by omitting topics or tasks for students to work with and by rearranging the order of topics. Adaptation of curricular resources is one of the cornerstones of teachers’ planning. Working together and using resources in this way seems to facilitate teachers’ thinking given the time constraints.

It is possible that the many different resources used in our study differ a lot from the context of Brown’s (2009), where a textbook, a teacher manual, and manipulatives made teaching more ‘straightforward’. The teachers in this study do, however, seem to seek offloading. This can, for example, be seen when they want to find readily made tasks or GeoGebra scripts, without having to create them from scratch themselves. In many ways, our teachers improvise from the main curriculum material through designing and creating their own new instructional activities for intended

teaching. They utilize social and cognitive resources in the group to coordinate and sharpen the quality of teaching, thus making planning more efficient.

From the themes on reasons for use, we see that our teachers exert agency by using resources when they want to make things work practically in enactment. This enables them to manage their role as teachers and to include students' previous and intended experiences and group properties.

Although the student textbook still seems to have a grip on the practice of teaching, as indicated in the Background of this paper (Boesen et al., 2014, Jablonka & Johansson, 2010, Tengberg et al., 2022), our data shows that teachers complement the student textbook with other instructional activities, rather than just planning for facilitating its use by students in the classroom.

However, when the structure or the content offered by the textbook does not comply with teachers' ideas of teaching or on how to design student-centred instruction, authority is shifted by teachers towards other resources. In other words, teacher preferences guide teacher agency to overcome the constraints of material resources, in line with the findings of Rich (2021). This, for example, means going to other resources like reference textbooks, or going online, to find tasks and to find alternative sequencings or representations of the mathematical content that better accommodate the teachers' ideas on conducting teaching or considering students.

The authority given to official documents is also interesting. The national course seems to be relatively unquestioned, possibly because its formulations allow for wide interpretations. It is also written with the intention of guiding teaching, making it a clear curriculum resource. In this study, we find that its use is limited, especially the parts containing mathematical content descriptions, but not the parts that concern instruction. The fact that teachers go back to the national course plan at times, bypassing the operationalization of the course plan in the student textbook, shows how the authority of the textbook is actually questioned.

The national tests are other official documents that are given authority in supporting mathematical content and also enactment. This is interesting, as these tests are not principally designed to guide instruction, but rather to assess student knowledge on a large scale. Despite this, the teachers' ideas of the assumed content of the national tests, that is, 'what comes on the test?', help guide them in selecting mathematical content to include as they modify their lesson plan components. Prior³ national tests are also used as tools in enactment, as tasks from them are used as tasks or teacher demonstrations are unmodified.

When it comes to instructional design, social resources, meaning the teachers, are the ones given total authority. It seems that teachers want to focus on providing rich opportunities for students to develop conceptual understanding.

In many of the intended instructional activities found in their lesson plan components, instances supporting this can be found. This can be seen in the many statements that students are intended to see, live, or experience mathematical content, both in general and in relation to specific concepts. Some of these statements also include the seeing of differences in and contrasting and sequencing of content to build a deeper understanding of a concept, resembling ideas from variation theory (Marton & Booth, 1997). This occurrence of such ideas may be due to the external authority given to the cognitive resource of SSDS (Barton, 2018), a didactic model with variation theory as one of its principles.

The self-generated resources and documents, including pre-tests, post-tests, exit tickets, or diagnostic tests, are also used as support for instructional design, as they help modify lesson plan elements by adding didactic information on the students' pre-knowledge. The lesson plan itself, in whatever form it may take, can also be said to be a document.

Another important finding in relation to resources given authority is that of the dynamic software used for enactment. One possible explanation is that its innate functionality of dynamically representing mathematical concepts to represent change resonates with the view on teaching that teachers in this study conveyed through the discussions. The use of other digital resources with less functionality, like online platforms for sharing information or delivering tasks, are not discussed with the same intensity, a fact that may indicate that they are more taken for granted as everyday tools.

One possible explanation for the creation of instructional activities by teachers themselves as seen here could be the ‘good teacher doctrine’, a concept meaning that ‘good teachers’ do not use externally produced curriculum materials, but instead create the resources that they need for teaching (Remillard, 2016). If this is the case, authority could reside in outside expectations of teachers, in line with the findings of Grundén (2020).

Limitations

The obvious limitation of this study concerns the transferability of the practice shown. The discussions are different in nature for reasons corresponding to the individuals and contexts of each particular group. However, the ways in which the resources are used in the groups are similar. One could, of course, argue that there could exist groups with other patterns of resource use, but our findings indicate that it is likely that similar resource use can be found in many teacher groups’ practices.

When teachers plan collaboratively and discuss teaching, a need for explanation, argumentation, and motivation emerges. Such discussions are rich in eliciting of teachers’ rationale for choices made in planning. What is being presented to other teachers may be influenced by social group dynamics mechanisms; however, this is not the focus of our study. When it comes to the use of resources, it can be assumed that in collaborative planning the same resources come into play as would be the case for individual planning and that the ways in which resources are used are also similar. The research project did not specifically focus on the resource use of teachers when planning collaboratively, and, therefore, it is assumed that what is being said in these discussions reflects the reality of the planning of these teachers.

The construct of teachers being social resources for each other while at the same time being the acting subject observed is problematic. However, to be able to show the patterns we believe we have uncovered in this paper, it is important to consider this two-fold role of teachers in this study.

For the social resources, we have not distinguished the people themselves from the *conversations* with the people because a conversation with a person is the main way to interact with that person as a resource and, thus, make that person a resource. Therefore, it makes sense not to differentiate. By separating cognitive resources from the teachers who use them, we can give these types of tools credit in how they affect the practice of teachers planning teaching; in fact, in this study, these cognitive resources were found to be the only external resource of authority supporting instructional design.

Conclusions

The findings show that teachers, when planning collaboratively, use a variety of resources in a variety of ways. To support instructional design, teachers use each other to a great extent, while external resources mainly support the mathematical content to be taught and the enactment. This highlights the benefits of collaborative planning. The reasons for using different resources depend on teachers’ ideas with regard to handling the practical context, handling the teaching, and, in while doing so considering the students. Planning collaboratively means utilizing social and cognitive resources in the group to coordinate and sharpen the quality of teaching. Teachers exert their agency by giving authority to resources, depending on the resource’s ability to support them in the different aspects of their planning practice. Whenever a resource currently used does not meet these standards, new resources are sought that will accommodate this need.

Implications

If the practice of using resources in planning situations described in this study is representative of an unneglectable share of upper-secondary school mathematics teachers, then instructional change from curriculum reform cannot happen through the production of new student textbooks alone, since instructional change seems to stem from colleagues, self-generated resources, and cognitive resources, not from commercially produced curriculum resources.

To meet the practice described in this study, external resources that support teachers in instructional design would need to be able to be given authority by teachers. For that to occur, and to better support teachers in planning, resources aiming to provide such support could be conceptualized as a 'helpful colleague' offering rationale and instructional guidance with activity tips. This could also have an impact on instructional design for individual planning, as the social resource of a colleague is absent in such practice, meaning that the meaningful resource of the design of instruction is missed out on.

One may think that it is obvious or self-explanatory that support for instructional design should not be provided by materials, but it is obvious from the content of the discussions that the amount of time allocated to creating new instructional activities is, however meaningful it may seem for the teachers, truly vast.

Notes

1. Same Surface Different Depth, didactic model found in Barton (2018).
2. Didactic model for teaching based on ideas of Gattegno (1972).
3. In Sweden, new National tests are created every year. Some tests are publicly released after use.

Acknowledgments

This work is a part of the project Collegial Planning and Preparation as Subject-didactical School Improvement which was granted [LUN2019/31] support by the Faculty Board for Teacher Education, Karlstad University as part of the ULF project (Education, Teaching, and Research) funded by The Swedish Ministry of Education and Research, and the Swedish Research Council [VR 2021-04766]. Special thanks to our colleagues in the 'Collegial Planning' research group and to our colleagues in the Mathematics Education group at Karlstad University, for valuable comments on earlier drafts of the article.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by Karlstad University and Vetenskapsrådet.

ORCID

Marcus Gustafsson  <http://orcid.org/0000-0001-6259-6944>
Jorrit van Bommel  <http://orcid.org/0000-0001-6525-9871>
Yvonne Liljekvist  <http://orcid.org/0000-0002-7956-8795>

References

- Adler, J. (2000). Conceptualising resources as a theme for teacher education. *Journal of Mathematics Teacher Education*, 3(3), 205–224. <https://doi.org/10.1023/A:1009903206236>

- Ahl, L., Gunnarsdóttir, G. H., Koljonen, T., & Pálsdóttir, G. (2005). How teachers interact and use teacher guides in mathematics—cases from Sweden and Iceland. *Education*, 20(3–4), 179–197.
- 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), 6–14. <https://doi.org/10.3102/0013189X025009006>
- Barton, C. (2018). *How I wish I had taught maths: Reflections on research, conversations with experts, and 12 years of mistakes*. John Catt Educational.
- Bergwall, A. (2021). Proof-related reasoning in upper secondary school: characteristics of Swedish and Finnish textbooks. *International Journal of Mathematical Education in Science and Technology*, 52(5), 731–751. <https://doi.org/10.1080/0020739X.2019.1704085>
- Bernstein, B. (1999). Vertical and horizontal discourse: An essay. *British Journal of Sociology of Education*, 20(2), 157–173. <https://doi.org/10.1080/01425699995380>
- Bieda, K. N., Lane, J., Evert, K., Hu, S., Opperman, A., & Ellefson, N. (2020). A large-scale study of how districts' curriculum policies and practices shape teachers' mathematics lesson planning. *Journal of Curriculum Studies*, 52(6), 770–799. <https://doi.org/10.1080/00220272.2020.1754921>
- Biesta, G., Priestley, M., & Robinson, S. (2015). The role of beliefs in teacher agency. *Teachers & Teaching*, 21(6), 624–640. <https://doi.org/10.1080/13540602.2015.1044325>
- 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 Behavior*, 33, 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://doi.org/10.1191/1478088706qp063oa>
- Brehmer, D., Ryve, A., & Van Steenbrugge, H. (2016). Problem solving in Swedish mathematics textbooks for upper secondary school. *Scandinavian Journal of Educational Research*, 60(6), 577–593. <https://doi.org/10.1080/00313831.2015.1066427>
- 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* (pp. 17–36). Routledge.
- Cevikbas, M., König, J., & Rothland, M. (2023). Empirical research on teacher competence in mathematics lesson planning: Recent developments. *ZDM—Mathematics Education*, 1–13. <https://doi.org/10.1007/s11858-023-01487-2>
- Cohen, D. K., Raudenbush, S. W., & Ball, D. L. (2003). Resources, instruction, and research. *Educational Evaluation and Policy Analysis*, 25(2), 119–142. <https://doi.org/10.3102/01623737025002119>
- Fahlgren, M., Brunström, M., Dilling, F., Kristinsdóttir, B., Pinkernell, G., & Weigand, H. G. (2021). Technology-rich assessment in mathematics. In A. Clark-Wilson, A. Donevska-Todorova, E. Faggiano, J. Trgalová, H. -G. Weigand (Eds.), *Mathematics education in the digital age* (pp. 69–83). Routledge.
- Fan, L., Zhu, Y., & Miao, Z. (2013). Textbook research in mathematics education: Development status and directions. *ZDM*, 45(5), 633–646. <https://doi.org/10.1007/s11858-013-0539-x>
- Gattegno, C. (1972). *Teaching foreign languages in schools: The silent way* (2 ed.). [rev.] ed.). Educational Solutions.
- Grundén, H. (2020). Planning in mathematics teaching—a varied, emotional process influenced by others. *LUMAT: International Journal on Math, Science and Technology Education*, 8(1), 67–88. <https://doi.org/10.31129/LUMAT.8.1.1326>
- Gueudet, G., & Trouche, L. (2009). Towards new documentation systems for mathematics teachers? *Educational Studies in Mathematics*, 71(3), 199–218. <https://doi.org/10.1007/s10649-008-9159-8>
- Hall, T. J., & Smith, M. A. (2006). Teacher planning, instruction and reflection: What we know about teacher cognitive processes. *Quest*, 58(4), 424–442. <https://doi.org/10.1080/00336297.2006.10491892>
- Hoelgaard, L., Hemmi, K., & Ryve, A. (2014). Teaching by the book: What kind of classroom practice do three different teacher guides for year 1 promote? In H. Silfverberg, T. Kärki & M. S. Hannula (Eds.), *Proceedings of Nordic research in mathematics education*, Turku (Åbo), Finland, June 3–6, 2014 (pp. 163–172).
- Jablonka, E. & Johansson, M. (2010). Using texts and tasks: Swedish studies on mathematics textbooks. In B. Sriraman, C. Bergsten, S. Goodchild, G. Pálsdóttir, B. Dahl, B. D. Söndergaard, & L. Haapasalo (Eds.), *The first source-book on Nordic research in mathematics education* (pp. 363–372). Information Age Publishing.
- Jäder, J., Lithner, J., & Sidenvall, J. (2020). Mathematical problem solving in textbooks from twelve countries. *International Journal of Mathematical Education in Science and Technology*, 51(7), 1120–1136. <https://doi.org/10.1080/0020739X.2019.1656826>
- Jakobsson, M., Randahl, A. C., & Nordgren, K. (2022). Planification et préparation collégiale des cours en Suède. *Revue internationale d'éducation de Sèvres*, 90, 127–137. <https://doi.org/10.4000/ries.13000>
- Johansson, M. (2006). *Teaching mathematics with textbooks: A classroom and curricular perspective* (Doctoral dissertation, Luleå tekniska universitet).
- John, P. D. (2006). Lesson planning and the student teacher: Re-thinking the dominant model. *Journal of Curriculum Studies*, 38(4), 483–498. <https://doi.org/10.1080/00220270500363620>
- Kock, Z.-J., & Pepin, B. (2019). Secondary school mathematics teachers' selection and use of resources. In U. T. Jankvist, M. Van den Heuvel-Panhuizen, & M. Veldhuis (Eds.), *Eleventh Congress of the European Society for Research in Mathematics Education* (Vol. 16, p. 2019). Utrecht, the Netherlands: Freudenthal Group; Freudenthal Institute; ERME.

- Liljekvist, Y. E., Randahl, A. C., van Bommel, J., & Olin-Scheller, C. (2021). Facebook for professional development: Pedagogical content knowledge in the centre of teachers' online communities. *Scandinavian Journal of Educational Research*, 65(5), 723–735. <https://doi.org/10.1080/00313831.2020.1754900>
- Marton, F., & Booth, S. A. (1997). *Learning and awareness*. Psychology press.
- Nordgren, K., Kristiansson, M., Liljekvist, Y., & Bergh, D. (2021). Collegial collaboration when planning and preparing lessons: A large-scale study exploring the conditions and infrastructure for teachers' professional development. *Teaching and Teacher Education*, 108, 103513. <https://doi.org/10.1016/j.tate.2021.103513>
- OECD. (2020). *TALIS 2018 Results (volume II)*. TALIS. <https://doi.org/10.1787/19cf08df-en>
- Pepin, B., & Gueudet, G. (2020). Curriculum resources and textbooks in mathematics Education. In S. Lerman (Ed.), *Encyclopedia of mathematics education*. Springer. https://doi.org/10.1007/978-3-030-15789-0_40
- Pepin, B., Gueudet, G., & Trouche, L. (2017). Refining teacher design capacity: Mathematics teachers' interactions with digital curriculum resources. *ZDM*, 49(5), 799–812. <https://doi.org/10.1007/s11858-017-0870-8>
- Randahl, A., Liljekvist, Y., Jakobsson, M., & Nordgren, K. (2023). Föreställningar om kunskap och lärande i lärares planeringssamtal i matematik och historia [Concepts of knowledge and learning in teachers' planning conversations in mathematics and history]. *Utbildning & Lärande*, 17(2), 99–113. <https://doi.org/10.58714/ul.v17i2.15859>
- 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. (2016). How to partner with your curriculum. *Educational Leadership*, 74(2), 34–38.
- Remillard, J. T. (2018). Examining teachers' interactions with curriculum resource to uncover pedagogical design capacity. In L. Fan, L. Trouche, C. Qi, S. Rezat, & J. Visnovska (Eds.), *Research on mathematics textbooks and teachers' resources* (pp. 69–88). Springer.
- Remillard, J. T. (2019). Teachers' use of mathematics resources: A look across cultural boundaries. In L. Trouche, G. Gueudet, & B. Pepin (Eds.), *The 'resource' approach to mathematics education* (pp. 173–194). Springer.
- Remillard, J. T., Van Steenbrugge, H., Machalow, R., Koljonen, T., Krzywacki, H., Condon, L., & Hemmi, K. (2021). Elementary teachers' reflections on their use of digital instructional resources in four educational contexts: Belgium, Finland, Sweden, and US. *ZDM –Mathematics Education*, 53(6), 1331–1345. <https://doi.org/10.1007/s11858-021-01295-6>
- Rich, K. M. (2021). Examining agency as teachers use mathematics curriculum resources: How professional contexts may support or inhibit student-centered instruction. *Teaching and Teacher Education*, 98, 103249. <https://doi.org/10.1016/j.tate.2020.103249>
- Robson, C., & McCartan, K. (2016). *Real world research: A resource for users of social research methods in applied settings*. Wiley.
- Siedel, H., & Stylianides, A. J. (2018). Teachers' selection of resources in an era of plenty: An interview study with secondary mathematics teachers in England. In L. Fan, L. Trouche, C. Qi, S. Rezat, & J. Visnovska, (Eds.), *Research on mathematics textbooks and teachers' resources* (pp. 119–144). Springer.
- Sönnerhed, W. W. (2011). Mathematics textbooks for teaching: An analysis of content knowledge and pedagogical content knowledge concerning algebra in Swedish upper secondary education (Doctoral dissertation, Institutionen för Pedagogik, kommunikation och lärande).
- Tengberg, M., van Bommel, J., Nilsberth, M., Walkert, M., & Nissen, A. (2022). The quality of instruction in Swedish lower secondary language arts and mathematics. *Scandinavian Journal of Educational Research*, 66(5), 760–777. <https://doi.org/10.1080/00313831.2021.1910564>
- Toom, A., Pyhältö, K., & Rust, F. O. C. (2015). Teachers' professional agency in contradictory times. *Teachers & Teaching*, 21(6), 615–623. <https://doi.org/10.1080/13540602.2015.1044334>
- Trouche, L., Gueudet, G., & Pepin, B. (2020). Documentational approach to Didactics. In S. Lerman (Ed.), *Encyclopedia of mathematics education*. Springer. https://doi.org/10.1007/978-3-030-15789-0_100011
- Tyler, R. W. (1950). *Basic principles of curriculum and instruction, syllabus for education*. UCP.
- van Bommel, J., & Palmér, H. (2021). Enhancing young children's understanding of a combinatorial task by using a duo of digital and physical artefacts. *Early Years*, 41(2–3), 218–231. <https://doi.org/10.1080/09575146.2018.1501553>
- van Steenbrugge, H., & Ryve, A. (2018). Developing a reform mathematics curriculum program in Sweden: Relating international research and the local context. *ZDM*, 50(5), 801–812. <https://doi.org/10.1007/s11858-018-0972-y>
- Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching & Teacher Education*, 24(1), 80–91. <https://doi.org/10.1016/j.tate.2007.01.004>
- Vinerean, M., Liljekvist, Y., & Brandl, M. (2023). Didactical usefulness of interactive mathematical maps: Designing activities supporting prospective teachers' learning, *NOMAD. Nordic Studies in Mathematics Education*, 3–4.
- Wraga, W. G. (2017). Understanding the Tyler rationale: Basic principles of curriculum and instruction in historical context. *Espacio, Tiempo y Educación*, 4(2), 227–252. <https://doi.org/10.14516/ete.156>
- Yinger, R. (1979). Routines in teacher planning. *Theory into Practice*, 18(3), 163–169. <https://doi.org/10.1080/00405847909542827>
- Young, M., & Muller, J. (2016). *Curriculum and the specialization of knowledge*. Routledge.