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Problem and prospects for mathematics education

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Planning geometry lessons with learning platforms

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This paper investigates how mathematics teachers plan lessons with a recently implemented Danish learning platform designed to support teachers in planning lessons in line with a recent objective-oriented curriculum. Drawing on data from observations of and interviews with teachers, three mathematics teachers' joint planning of a lesson in geometry with a learning platform called Meebook is analyzed using the instrumental approach. It is concluded that the interface in Meebook orients the teachers work toward what the students should do rather than what they should learn, although the latter is a key intention behind the implementation of the platform. It is also concluded that when the teachers succeed in using learning objectives actively in their planning, the objectives support the teachers in designing lessons that correspond with their intentions. The paper concludes with a discussion of the dialectics between learning objectives and planned activities.

Keywords: Planning lessons, objective-oriented curriculum, learning platforms.

Introduction

Teachers' planning of lessons is an important aspect of teaching as the decisions made at this stage shape students' opportunities to learn (Superfine, 2008). Planning is especially important for mathematics teachers as techniques and tools are closely linked to mathematical conceptualizations (Haspekian, 2005). It is therefore essential that teachers' choices of resources and tasks resonate with the teachers' intentions of what the students should learn. Currently, an increased number of technologies are becoming available that support teachers in planning lessons (Johnson, Adams Becker, & Hall, 2015) by giving teachers access to new resources and allowing them to design their own materials (Gueudet, Pepin, Sabra, & Trouche, 2016). Although such technologies bring new opportunities, they also bring challenges as new resources and materials often require mathematics teachers to reconsider how environments that give the students the right opportunities to learn can be designed (Haspekian, 2005).

In Denmark, learning platforms are currently being implemented that are an exemplar case of new technologies that support teachers in planning lessons. Among other things, the learning platforms serve to give students, parents and teachers access to plans for students' learning progression, and the platforms are designed to support teachers in planning and sharing lessons (KL, 2014). The learning platforms share a number of characteristics with learning management systems (LMSs; see, for example, Watson & Watson, 2007), but the learning platforms also integrate affordances that are not typically associated with LMSs. Although LMSs typically are designed to handle all aspects of student learning, the learning platforms also support teachers in designing lessons by giving the teachers access to online curriculum materials and enabling the teachers to create their own. Previous research about platforms that support teachers' planning has identified a need to support

teachers in designing lessons and choosing resources that are in line with the teachers' intentions for students' learning (Hodgson, Rønningen, Skogvold, & Tomlison, 2010). Danish learning platforms were implemented in the wake of a recent curriculum reform that foregrounds learning objectives, and the idea is that learning objectives will support teachers in making choices that reflect the teachers' intentions for student learning. Although the learning platforms are already used widely in Danish primary schools, there is yet little research on how teachers plan lessons with these platforms. This paper investigates how Danish mathematics teachers plan lessons with one of the most widely chosen platforms, called Meebook (<https://meebook.com/>) and derives from a small-scale pilot study in an ongoing PhD-project. The paper contributes to the literature with the first empirical analyses of how Meebook mediates teachers' planning and discusses the consequences of this planning for the orientation of their planning and of the foundation on which teachers build their choices of resources and tasks. The data in the study consists of a case of three teachers' joint planning and individual interviews with the same teachers. I begin the paper by explaining the Danish context and some of the key ideas behind the implementation of the learning platforms. I then introduce the instrumental genesis framework and my methodological approach and analyze a case of three teachers' joint planning with Meebook. I conclude with a discussion about the dialectics between learning goals and planned activities in which I draw on a concept of rational and relation modes of planning (John, 2006; Superfine, 2008).

Context

In 2014, the national government decided that all municipalities in Denmark as part of building a national digital infrastructure would be required to purchase and implement a learning platform during the 2016/2017 school year. Instead of developing a common, national learning platform, the Government and Local Government Denmark (KL) allowed municipalities in Denmark to choose a platform that meets their needs. As the learning platforms are part of building a national digital infrastructure, some degree of uniformity was needed. KL therefore charted 64 functional requirements that the learning platforms must fulfill in order to be approved (KL, 2014). Among other things, these requirements included that the platforms should support the implementation of an objective-oriented curriculum reform and that they should support teachers in defining learning objectives for each lesson (KL, 2014). The idea is that teachers would begin their planning by defining a learning objective and then design or choose activities and resources that will allow the students to attain the objectives. Currently, six platforms are available that fulfill the 64 functional requirements of Local Government Denmark. These platforms differ in design, the amount and type of support that teachers are offered in planning lessons and how the national curriculum is thought to be part of teacher planning.

The school in which the present study took place is in a municipality that has chosen Meebook, one of the most widely chosen platforms. In contrast to some of the other available platforms (for example, <https://minuddannelse.net>), Meebook is characterized by an interface that allows teachers to choose how and when to integrate learning objectives in their planning. MinUddannelse, however, requires teachers to define a learning objective as the initial step of planning a lesson. The school had begun a gradual implementation of Meebook in December 2014 when the teachers

initially were encouraged by school leaders to experiment with the platform. In August 2015, school leaders made it mandatory for teachers to use Meebook to plan lessons in mathematics and native language education.

Meebook

Figure 1 illustrates Meebook’s interface to create a course. In this interface, the teacher defines what should happen in the lesson and which resources should be integrated. The learning objectives are in a separate tab that is illustrated in figure 2 and can be accessed at individual teachers’ convenience. However, a learning objective must be defined before the course can be saved.

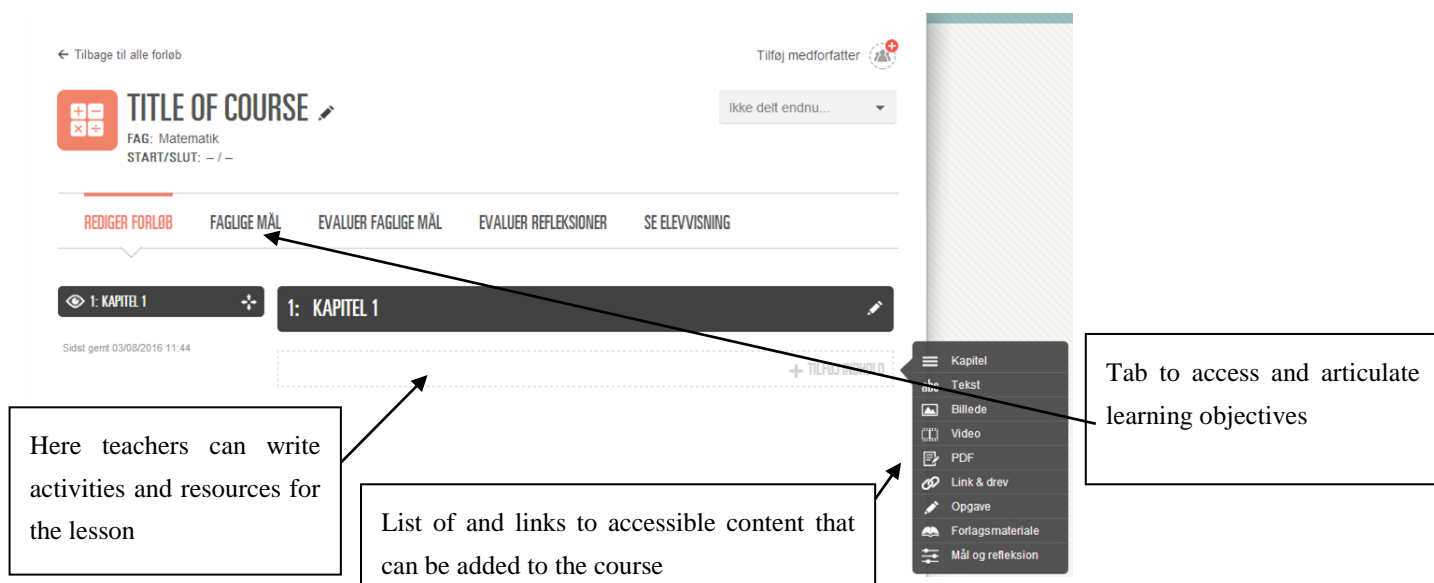


Figure 1: Meebook’s interface for teachers to plan a course/lesson (the teacher can add a chapter, text, a picture, video material, a PDF document, a hyperlink, a task or activity, e-textbook material or a student reflection)

Figure 2 illustrates the interface in Meebook where teachers can define learning objectives for the course. Here, the teachers can also access the learning objectives from the national curriculum through a link and select those that the teachers’ course or lessons address. The teachers can also define their own objectives.

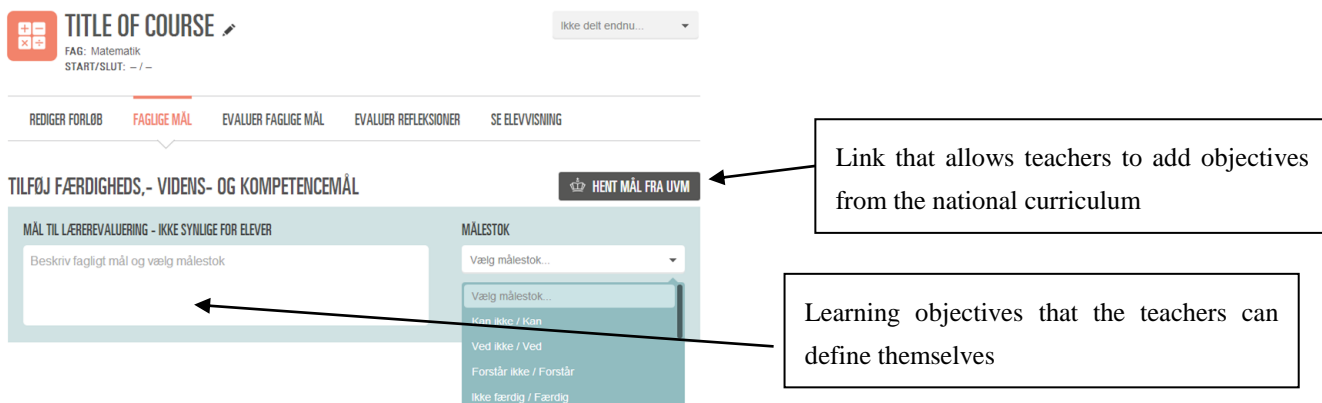


Figure 2: Meebook’s interface in the tab called “Add skill, knowledge and competence objectives”

Theoretical framework and research questions

In this paper, I draw on the instrumental approach (Guin, Ruthven, & Trouche, 2005). The instrumental approach is a framework developed to study the consequences of different kinds of tools, technologies and software for learning and teaching mathematics (Gueudet, Buteau, Mesa, & Misfeldt, 2014). A key aspect of this approach is the assumption that the relation between design and use is dialectic rather than one-sided (Haspekian, 2005). When a subject uses an artifact in an activity with a specific objective in mind, the artifact can shape the appearance of the activity or even force the subject to redefine the objective of the activity. The subject's use of the artifact can, however, also exceed the intended uses of the artifact. The latter is referred to as design that continues in use (Ejsing-Duun & Misfeldt, 2015).

The instrumental approach distinguishes between artifacts and instruments. An artifact is defined as a cultural social construct that offers mediations of human activity, and an instrument is defined as the product of a subject's use of the artifact for certain activities with a certain objective (Gueudet & Trouche, 2009). An artifact therefore *becomes* an instrument when the artifact is used by a subject. This process is called instrumental genesis and results in a change in the mediating artifact and in the activity the artifact is used for. These two opposite processes (the shaping and the being shaped) are referred to as instrumentation and instrumentalization (Haspekian, 2005). Instrumentation is the process in which the subject's use of an artifact shapes the artifact, while instrumentalization is the process in which the artifact shapes the subject's activity (Gueudet & Trouche, 2009). The approach also distinguishes between pragmatic and epistemic mediations (Rabardel & Bourmaud, 2003). Pragmatic mediations are the use of technology to perform a task (Rabardel and Bourmaud use the hammer as an example) while epistemic mediations are the use of technology that allows the subject to learn about the object by using the technology (Rabardel and Bourmaud use the microscope as an example). Finally, the framework distinguishes between different orientations of instrumentations and proposes three main orientations: orientations toward the object of the activity, toward other subjects or toward oneself (Rabardel & Bourmaud 2003). I use this framework to answer the following research question: Which mediations of the teachers' work occur as they plan lessons with Meebook, what are the consequences for the orientation of their work and for the foundation on which they build their choices of resources and tasks for the lesson?

Method

The data in this study consist of observations of a two 2-hour meetings during which three teachers collectively planned lessons and of individual interviews with the three teachers. The concerned teachers in general expressed a positive attitude towards Meebook though neither of them have previous experience using LMSs. The observations focused on 1) which materials and task that was chosen by the teachers, 2) whom or what their planning was directed toward and 3) and what the foundation of their decisions seemed to be. The meetings took place at the school the teachers worked and were documented by video recordings and field notes taken during the session. The video was recorded with a high-resolution camera that showed how the teachers maneuvered in

Meebook. All video recordings were subsequently transcribed as closely to the spoken word as possible and supplemented by the notes taken during the observation.

The interviews were carried out after the observations and supplied data about what the teachers found important to consider when planning lessons—in general and related to the sessions observed. The interviews also collected data about the teachers’ educational backgrounds and their seniority and were transcribed as closely to the spoken word as possible.

For this paper, I use a single case (Yin, 2014) that was selected from the criteria that it gives insight into the relation between the teachers’ planning practices and their use of the different interfaces in Meebook. Although the amount of data in this study is sparse, the case reveals important problems and prospects associated with supporting mathematics teachers’ planning with technologies, such as learning platforms. The case also identifies issues that future research in this area could consider.

Case

This case took place during three teachers’ joint planning of a lesson in geometry in middle school (students aged 10–11). The three teachers were Karen, Miriam and Gina. At the time this session took place, the teachers were two weeks into a three-week course on geometry. Karen is 29 and has 2 years of teaching experience, Gina is 40 years of age and has 5 years of experience and Miriam is 46 and has 22 years of experience teaching.

During the meeting, the teachers alternately discuss how to plan the lesson and write their decisions in Meebook in the tab illustrated in figure 1. While working in this tab, they decide that the students should work in groups and categorize the geometric figures they had been working with for the last two weeks (rectangles, squares, trapezes, parallelograms and rhombs). The teachers agree that each group should be given cardboard figures in the shape of these five figures and that the students should categorize the figures by placing them on an A2 piece of paper. Gina then openly poses the question whether the students should categorize the figures ‘freely’ or whether they should follow certain instructions. As the teachers discuss this matter without immediately reaching an agreement, Karen turns to the tab in Meebook where they have written the learning objectives for the course (illustrated in Figure 2). Karen reads the objectives aloud to her colleagues: “According to the objectives, the students should be able to distinguish between the five figures and categorize different types of figures according to their side lengths and angle sizes.” Miriam argues that if these objectives should be addressed, then the students should identify the figures *from* their properties and that they therefore should be given instructions to do so. The two other teachers concede. Gina then comments: “If we give them figures to categorize, how do we make sure that they actually talk about the properties of the figure?” This comment makes the teachers aware that there is a risk that the students will categorize the figures from what they spontaneously believe the figures look like. The teachers find this likely, as the students have been working with the same five figures for two weeks at this point. This method of categorizing the figures would not target the objective for the lesson. The teachers therefore agree to hinder this from happening by cutting the cardboard figures into shapes that are unlike the figures the students have been exposed to during the last two weeks (for example, a ‘crooked’ trapeze, as Miriam calls it). They believe that this will make it difficult for

the students to recognize the figures and that this will prime the students to actually investigate the properties of the figures and do their categorization from this. The teachers also decide to instruct the groups to take turns picking a figure from a pile of cardboard with the figures facing downward, then place the figure in the category on the A2 paper where they believe it belongs and explain to the rest of the group why they believe it belongs there.

Results

The teachers' planning of the lesson initially takes place in the interface illustrated in Figure 1. This interface in Meebook displays an overview of the resources available to the teachers and presents a blank field for them to fill. This blank field refers to the content of the lesson: which resources they will draw on and which activities they will include in the lesson. Meebook's visualization of the content as the first aspect of the lesson to consider seems to be reflected in the teachers' initial decision that the students should categorize laminated geometric cardboard figures and that this activity should be carried out in groups. At this stage, the teachers' activity is oriented toward the object (the lesson to be planned), and their objective seems to be to decide which resources and task to include in the lesson. This priority of the content contradicts all three of the teachers' statements in the interviews where they emphasized the importance of beginning their planning by defining the objectives for the lesson. Miriam expresses it in the following way: "We always begin our planning with the learning objectives. That way, we can find or design the resources and tasks that fit the objectives. That's the whole starting point when we plan lessons." This suggests that the teachers' use of Meebook leads to a shift in the orientation of their activity from being oriented toward learning objectives toward being oriented toward defining the content. A consequence is that the choice of the cardboard figures does not reflect considerations about which specific geometric learning the students should obtain. This choice seems rather to reflect that the current topic is geometry. In the interviews, Karen and Miriam stated that they found it important that students have the chance to verbally express themselves in mathematics, as they believe that this creates good opportunities to learn. It is possible that the teachers' choice of organizing the lesson in groups is a reflection of this belief. The teachers' choice of using cardboard figures and that the students should categorize the figures, however, rather seems to reflect an objective of deciding what the students *should do* than what the students should *learn*. As previously stated, a subject's use of an artifact in an activity can shape the appearance of the activity or even force the subject to redefine the objective of the activity. In this case, Meebook's visualization of the activity 'planning lessons' seems to instrument the teachers' activity and orient it toward deciding the content for the course instead of prompting discussions about what the students should learn and which resources and tasks would enable this learning to occur. The case does not clearly illustrate an epistemic nor a pragmatic mediation. The case however illustrates that the teachers' use of Meebook does not lead to a new understanding of how the lesson could be planned according to their intentions.

As the teachers' meeting continues, they discuss whether the students should categorize the figures freely or whether their categorization should be guided by specific instructions. This decision requires a basis, and to find this basis, Karen turns to the tab in Meebook's interface where the teachers previously have written the learning objectives for the course. By turning to the objectives,

the teachers become aware that the setting requires certain instructions if the learning objectives should be addressed. In this manner, the teachers use their knowledge about the students to anticipate how they would engage in solving a task and what learning in which this would result. This can be seen as an instrumentation of Meebook as the teachers merge two otherwise separate interfaces in Meebook. This results in the opportunity for an epistemic mediation of their activity that did not occur when the teachers worked in Meebook's *content* interface. As the learning objectives in Meebook become available for the teachers to use, they are enabled to explore their design of the lesson and modify it according to their intentions. At this point, the teachers' activity is characterized by a shift in orientation from the content of the lessons toward other subjects: the students, and more specifically, the students' learning. In other words, the teachers' activity shifts from being oriented toward what the students *should do* toward designing a lesson that creates opportunities for the students to *learn* something specific.

Discussion and conclusion

One of the main ideas behind implementing learning platforms in Denmark is the assumption that integrating learning objectives in the platforms will support teachers in choosing resources that correspond to the teachers' intentions for student learning. However, this pilot study suggests that it is not sufficient that learning objectives are integrated as a part of teachers' planning in the platforms, but that *the ways* the learning objectives are integrated in the design of technologies are important. In the case presented here, Meebook's interface separates the objectives from the content of the course that in this case implies that the teachers' choice of resources is separate from the learning objectives. Considering the importance of techniques and tools for mathematical conceptualizations, it is crucial that the choice of resources and tasks is carefully considered. This does not seem to be the case here. The case demonstrates that learning objectives can be valuable assets and work as epistemic mediators for teachers when they plan lessons. The teachers' use of the learning objectives enables the teachers to explore their lesson design and modify it so it corresponds with their intentions. However, it is remarkable that this opportunity arises as a consequence of the teachers' instrumentation of Meebook rather than of Meebook's instrumentalization of their activity. In addition, the initial choices (that the students should categorize cardboard figures in groups) are not changed or reconsidered during the session. In the case presented here, the teachers succeed in building a lesson with the cardboard figures and group organization a way that reflects the teachers' intentions. However, it remains to be unknown whether the teachers would have changed or discarded the cardboard figures or not if it turned out that these resources were incompatible with the learning objectives. This point suggests that this is an issue to be aware of in future research.

Previous research in mathematics teachers' planning distinguished between a rational and a relational mode of planning (John, 2006; Superfine, 2008). The rational mode views education as a linear input–output relation in which the planning begins by defining the objectives and resources/activities then are decided. The relational mode is planning focused on how students encounter each other, the mathematical content and with the teacher in a specific setting and the opportunities to learn arising thereof (John, 2006). The rational mode has been criticized for

resulting in lesson plans that overlook and fail to anticipate the complexity and contingency of educational contexts while the relational mode is often referred to as a ‘better alternative’ (John, 2006). The results in this paper challenge that these modes should be separated sharply. It is exactly when the teachers foreground the learning objectives that they are able to engage in a relational mode of planning and design tasks and resources in ways that reflect the teachers’ intentions. Through combining these modes, this potential is exploited, and neither the rational nor the relational mode in itself would enable this process. This result suggests that future research in this field could benefit from considering *how* learning objectives are integrated in technologies that support teachers’ planning and *what kind* of planning modes these objectives en- or disable.

References

- Ejsing-Duun, S. & Misfeldt, M. (2015). Programmering af robotenheder i grundskolen. Læring og Medier nr. 14, 2015.
- Gueudet, G., C., Buteau, Mesa, V., & Misfeldt, M. (2014). Instrumental and documentational approaches: From technology use to documentation systems in university mathematics education. *Research in Mathematics Education*, 16(2), 139–155.
- Gueudet, G., Pepin, B., Sabra, H., & Trouche, L. (2016). Collective design of an e-textbook: Teachers’ collective documentation. *Journal of Mathematics Teacher Education*, 19, 187–203.
- Gueudet, G., & Trouche, L. (2009). Towards new documentation systems for mathematics teachers? *Educational Studies in Mathematics*, 71(3), 199–218.
- Guin, D., Ruthven, K., & Trouche, L. (2005). *The didactical challenge of symbolic calculators: Turning a computational device into a mathematical instrument*. New York, NY: Springer.
- Haspekian, M. (2005). An “instrumental approach” to study the integration of a computer tool into mathematics teaching: The case of spreadsheets. *International Journal of Computers for Mathematical Learning*, 10(2), 109–141.
- Hodgson, J., Rønningen, W., Skogvold, A. S., & Tomlison, P. (2010). *På vei fra læreplan till klassrum – Om læreres fortolkning, planlegging og syn på LK06* (NF Rapport nr. 3, 2010). Bodø, Norway: Nordland Research Institute.
- John, D. (2006). Lesson planning and the student teacher: Rethinking the dominant model. *Journal of Curriculum Studies*, 38(4), 483–498.
- Johnson, L., Adams Becker, S., & Hall, C. (2015). *2015 NMC technology outlook for Scandinavian schools: A Horizon Project regional report*. Austin, TX: New Media Consortium.
- KL. (2014). *Aftale om konkretisering af det fælles brugerportalsinitiativ for folkeskolen*.
- Rabardel, P., & Bourmaud, G. (2003). From computer to instrument system: A developmental perspective. *Interacting with Computers*, 15(5), 665–691.
- Superfine, A. C. (2008). Planning for mathematics instruction: A model of experienced teachers’ planning process in the context of reform mathematics curriculum. *The Mathematics Educator*, 18(2), 11–22.
- Watson, W. R., & Watson, S. N. (2008). An argument for clarity: What are learning management systems, what are they not, and what should they become? *TechTrends*, 51(2), 28–34.
- Yin, K. (2014). *Case study research—Design and methods* (5th ed.). Thousand Oaks, CA: Sage.