Chapter 33
Adapting Teaching to Students' Needs: What Does It Require from Teachers?

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Abstract Teachers are increasingly expected to adapt their teaching to students' needs. This can be done by implementing differentiated instruction (DI) or assessment for learning (AfL). These concepts are regarded as two distinct approaches to identifying students' needs and adapting instruction accordingly. In the current study, we aim to identify empirical similarities and differences in teacher knowledge and skills required for differentiated instruction and assessment for learning respectively. Based on combined insights from two cognitive task analyses (CTA's), it appears that – in line with many other aspects of effective teaching – four phases are closely related for the task (either DI or AfL) as a whole: preparing a lesson series, preparing a lesson, enacting a lesson and, after this enactment, evaluating a lesson. The teacher skills required for DI and/or AfL in each of these phases are similar, however, the emphasis given to each skill differs in practice and this can be noted throughout all four interrelated phases. For AfL, the emphasis is on eliciting evidence during the lesson, for DI, the emphasis is on pro-active alignment of instruction and activities, based on students' needs. Since teachers need the same *underlying skills* to be able to perform either DI or AfL, we can hypothesize that teachers who are proficient at either DI or AfL, will also be able to develop and implement AfL or DI in practice.

Keywords Differentiated instruction · Assessment for learning · Teacher skills · Cognitive task analysis

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1 Introduction

An important precondition for effective teaching is that teachers continuously try to obtain a valid picture of the extent to which their students are progressing towards the learning objective(s), and adapt their teaching based on that picture. Two common approaches to adapting teaching to students needs are differentiated instruction (DI) and assessment for learning (AfL). Differentiated instruction can take place by tailoring resources, methods of teaching, requirements for student outcomes, activities for learning, and curricula to suit the student's readiness, their learning interest or their learning preference (Smale-Jacobse et al., 2019; Tomlinson et al., 2003). DI "is a philosophy of teaching rooted in deep respect for students, acknowledgment of their differences, and the drive to help all students thrive" (Smale-Jacobse et al., 2019, p. 1). With DI, students will be challenged in areas they are strong in while receiving support in areas they are weaker in (Corno, 2008).

There are different approaches to DI and effects of these vary. However, in their meta-analysis Deunk et al. (2018) found that DI has an overall small positive effect on student achievement in primary education. A similar study revealed there are not many well-designed DI studies in secondary education, but the ones that were found showed small to medium effects of DI on student outcomes (Smale-Jacobse et al., 2019). The aforementioned 'different approaches' can take place both between and within classes.

The implementation of Assessment for Learning, defined as "encompassing all those activities undertaken by teachers, and/or students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged" (Black & Wiliam, 2010, p.7). These 'modifications' are "decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited." (Black & Wiliam, 2009, p. 9). If teachers apply AfL in the classroom, this can lead to higher student achievement (e.g., Kingston & Nash, 2015). The effectiveness of AfL is due to its high focus on continuous short feedback loops as both teacher and student are more aware of the current status of students in their learning progress, and of the next steps to take for students to achieve more learning objectives (Black & Wiliam, 2018).

In previous empirical research, we have investigated the knowledge and skills teachers need to implement DI and AfL separately. In the current study, we will combine insights from theory and practice, in order to identify similarities and differences between DI and AfL with respect to required teacher knowledge and skills, and factors related to the (perceived) complexity of providing DI and implementing AfL. These insights can be used to optimize coherence in the implementation of both approaches, separately or simultaneously, in order to enhance effective teaching by adapting education to students' needs.

2 Theoretical Framework

2.1 Skills and Strategies for Differentiated Instruction

Van Geel et al. (2019) identified and sorted skills and strategies required for the implementation of DI based on an analysis of instruments that are used to measure DI. The first three categories concern aspects that take place before the instruction, categories four and five during instruction and the last category is about more general teaching.

The first category is mastering the curriculum, which means that teachers need to have sufficient pedagogical content knowledge (PCK). PCK refers to subject-matter content knowledge, as well as knowledge about how to teach subject-matter knowledge. This means that teachers need to know how to teach students with differences in cognitive abilities and be aware of the effects of different classroom practices for weak, average, and high ability students (Deunk et al., 2015). Second is the identification of instructional needs through the analysis of assessments (van Geel et al., 2019). This can be done, for example, through pre-assessment in which teachers assess the degree to which students already master the learning objectives and to identify students' prior knowledge (Smale-Jacobse et al., 2019).

Next, the teacher needs to be able to, based on the identified instructional needs, set appropriately challenging learning objectives for all students. To do so, teachers need to have insight into performance goals on different levels (Deunk et al., 2015) and be knowledgeable about the domain they are teaching. The fourth category is monitoring: the teachers should monitor the students' progress and achievement (van Geel et al., 2019). Teachers do this by asking questions, observing students, checking students' work, using tests, etc. Monitoring should happen continuously and not at fixed moments in time (Smale-Jacobse et al., 2019) and teachers should use the insights to identify students' current level of learning and understanding (Deunk et al., 2015).

Fifth, teachers should adapt their instruction, materials, and assignments for students of different ability levels (Deunk et al., 2015; van Geel et al., 2019). This should be based on what they have monitored (van Geel et al., 2019), and as learning needs change (which will be discovered through the continuous monitoring in step four), the adaptations should be updated accordingly (Smale-Jacobse et al., 2019). Sixth, and finally, there are also general teaching dimensions such as realizing a safe and motivating learning environment or teaching students specific skills. Good classroom management and students feeling safe, welcomed, and respected are important preconditions for DI (Smale-Jacobse et al., 2019).

2.2 Skills and Strategies for Assessment for Learning

The implementation of AfL in the classroom requires the coherent and cyclical use of several strategies and skills (Veugen et al., 2021), aimed at identifying where the learner is going, where the learner is, and how to get from where the learner is to

where they should be going. Black and Wiliam (2010) identified five categories of AfL-skills (Black & Wiliam, 2010). Teachers should: (1) identify, clarify and share learning intentions; (2) engineer effective discussions, tasks and activities that elicit evidence of learning, (3) provide feedback that moves learners forward. Furthermore, students have an active role – teachers should (4) activate students as learning resources for their own learning as well as (5) for the learning of their peers.

When applying AfL, teachers determine what the learning objectives are for lesson(series) in order to establish what a teacher intends for students to learn in a lesson (Wiliam, 2011). In order to do this well, it is important that teachers have sufficient pedagogical content knowledge, which helps them to think about which learning objectives and corresponding learning tasks are appropriate for specific groups of learners. These learning objectives are complemented by success criteria: parameters that indicate where students are with regard to meeting the learning objectives. Teachers can clarify the learning objectives and criteria for success for example through dialogue with students (Carless & Boud, 2018). This can mean that teachers together with students look at and discuss examples of end-products previously completed by students (i.e.. 'exemplars').

After clarifying the learning objectives, teachers can elicit evidence on students' learning progress and identify possible misconceptions through various assessment techniques, varying from more informal assessment techniques (e.g., on-the-fly observations or questions) to more formal assessment techniques (e.g., diagnostic tests). It is important to note that students can play an important role in eliciting evidence of their learning through self- or peer-assessment. Teachers may, for example, ask students to rate their own or each other's work based on earlier established criteria for success.

Based on the evidence that the teacher elicited through assessment techniques, the teacher can stimulate student learning by giving feedback or adapt instruction based on the evidence. The effect of feedback, however, is very dependent on the context in which it is given (Shute, 2007). When AfL remains teacher-centered, students lack insight in learning objectives and are unable to interpret feedback in a meaningful way (Brooks et al., 2021; Nicol & MacFarlane-Dick, 2006). Next to giving feedback, teachers can also decide to redirect their teaching efforts (Kippers et al., 2018). Through eliciting evidence, teachers may have established misconceptions in students' thinking regarding a certain topic or task. Instead of just asking students to re-try or re-think their solution, teachers may choose more fitting instructions, such as a worked example with a specific focus on the misconception.

Stimulating student agency in their own learning process is one of the key features of AfL. "Student agency refers to the quality of students' self-reflective and intentional action and interaction with their environment." (Klemenčič, 2015, p. 1). This can, for example, take the form of students formulating the criteria for success, or students that give each other peer feedback based on these criteria (Nicol & MacFarlane-Dick, 2006). Student agency is considered essential to the feedback literacy of students (Boud & Molloy, 2013). With increased student agency, students are more likely to be receptive to use feedback to redirect their learning efforts.

2.3   Combining Differentiation and Assessment for Learning

On the surface, DI and AfL may seem like quite different strategies: where AfL seems to emphasize the focus on gathering information ("assessment") to use as feedback, in DI the adaptation of the instruction is emphasized. However, to make the assessment in AfL 'for learning' or 'formative', the teacher should actively do something with the information they gather, such as adapting the instruction (Wiliam, 2011). Likewise, for a teacher to adapt their instruction to the learning needs of the students in DI, the teacher starts with determining what the learning needs of the students are by monitoring or gathering information (van Geel et al., 2019; Smale-Jacobse et al., 2019). The similarity in DI and AfL can most prominently be noticed in the importance of goal-orientation and evidence-informed decision-making. In both DI and AfL, teachers formulate explicit goals and deliberately design the teaching and learning activities with the aim of reaching these goals, taking differences between students into account. Assessing and monitoring students' progress and understanding is essential to inform teachers' decision-making with regard to the adaptation of these teaching and learning activities.

However, it remains yet unclear what applying DI or AfL in the classroom requires from teachers. The current study was therefore aimed at identifying the empirical similarities and differences between teacher skills and knowledge necessary for implementing DI and AfL, and identifying factors related to the (perceived) complexity. Although students and student ownership play an important role in both DI as well as AfL, since this chapter is focused on what adapting to students' needs requires from teachers, the focus is on the teacher.

3   Method

3.1   Context of the Study

In this chapter, we compare and combine insights from two studies: one into knowledge and skills secondary school teachers need to implement differentiated instruction, one into knowledge and skills required for the implementation of assessment for learning. Both these studies took place in secondary education in the Netherlands, where students enter secondary school around the age of 12 years. The Netherlands is known for a tracked system, students are assigned to a specific track based on their primary school performance. Three different tracks exist: pre-vocational (4-year program), senior general (5-year program), and pre-university (6-year program) (EP-Nuffic, 2015). In general, Dutch schools have a lot of autonomy, almost all decisions with regard to teaching, learning, and curriculum are made at the school level (OECD, 2008, 2010). Only at the end of their secondary education, students take part in national assessments (OECD, 2008). In general, secondary school teachers have a lot of freedom to shape their instruction.

3.2 Cognitive Task Analysis Procedure

Both DI as well as AfL are all about adapting teaching to students' needs. In the current study, we aim to identify what adapting teaching to students' needs requires from teachers. From previous research (e.g. van Geel et al., 2019) we know that providing differentiated instruction requires knowledge and skills that cannot be directly observed. In order to identify, analyze, and structure the skills and knowledge used by experts during the performance of a complex task a cognitive task analysis (CTA) can be performed (Clark, 2014). In this chapter, we therefore combine the outcomes of two CTA's that were performed to identify knowledge and skills required, one for the complex task of implementing AfL and one for the complex task of providing DI. In both CTA's, the steps as described by Clark et al. (2008) and refined by Van Geel et al. (2019) were applied: (1) collect preliminary knowledge, (2) identify knowledge representations, (3) apply focused knowledge elicitation methods, (4) analyze and verify data acquired, (5) format the results for the intended application.

In line with Van Geel et al. (2019), it was decided that the representation (step 2) would be (a) an overview in which all constituent skills, including the relationships between those skills are presented (also called: skill hierarchy) (b) an overview of the required knowledge to perform these skills, and (c) factors related to complexity of performing the task. In the two CTA studies, collection and analysis of data took place in an iterative process, where each stage of data collection was followed by a brief analysis, providing input for the next stage. In both CTA's, classroom observations were followed by semi-structured stimulated recall interviews. The CTA researcher asked the teacher to elaborate, in order to gather as much information as possible. In each CTA, after all interviews were conducted, an expert meeting was organized with the expert teachers as participants. In these expert meetings, a preliminary version of the skill hierarchy for the skill under investigation was developed and discussed. Next, content experts were consulted to verify and expand the findings from the previous steps. Both CTA's resulted in a skill hierarchy, including a detailed description of each skill and the desired level of performance (also called 'performance objectives'), and an overview of required knowledge. The CTA outcomes will be compared in order to identify similarities and differences between DI and AfL in practice.

3.3 CTA Participants

3.3.1 Participants CTA Differentiated Instruction

The focus in the CTA for DI was on mathematics. Eleven teachers, together teaching all levels and age groups of secondary education, participated in the classroom observations and stimulated recall interviews. Six of those teachers also participated

in the teacher expert meeting. Ten content experts (teacher educators, educational consultants, researchers and educational inspectors) participated in the second expert meeting.

3.3.2   Participants CTA Assessment for Learning

The CTA for Assessment for Learning was aimed at three secondary school subjects: English, Dutch, and chemistry. This focus was decided upon because these two languages are core curriculum, and chemistry is an important STEM subject (as well as the area of expertise of one of the researchers). Eight teachers (four for Dutch, two for English, two for chemistry) were each observed and interviewed for two lessons. Twelve teachers, of which four were also observed and interviewed, participated in the expert teacher meeting. In the content expert meeting, eight consultants and researchers participated.

3.4   Data Analysis

For the purpose of this chapter, a team of researchers (the first four authors of this chapter) discussed the findings from the two CTA's in order to identify similarities and differences between the skills required for DI and AfL. In this analysis, the labels, descriptions and performance objectives for each constituent skill were compared. The research team also compared the required knowledge and identified complexity factors for DI and AfL.

4   Key Findings

4.1   Skills

Although the wording in the two initial skill hierarchies differed, in-depth discussions and desired performance as described in performance objectives revealed striking similarities between the outcomes of the two separate CTA's. In Fig. 33.1 the two skill hierarchies of DI-instruction and AfL are therefore combined. In a skill hierarchy, constituent skills at lower levels enable the learning and performing of skills higher up in the hierarchy (e.g., Van Merriënboer & Tjiam, 2013). So, for example: in order to prepare a lesson series, it is required to be able to make a planning of a lesson series, and for planning a lesson series, it is required to be able to determine objectives. As can be seen in this overarching skill hierarchy, four phases that are closely related play an essential role for the task (DI or AfL) as a whole: preparing a lesson series, preparing a lesson, enacting a lesson and, after this enactment,
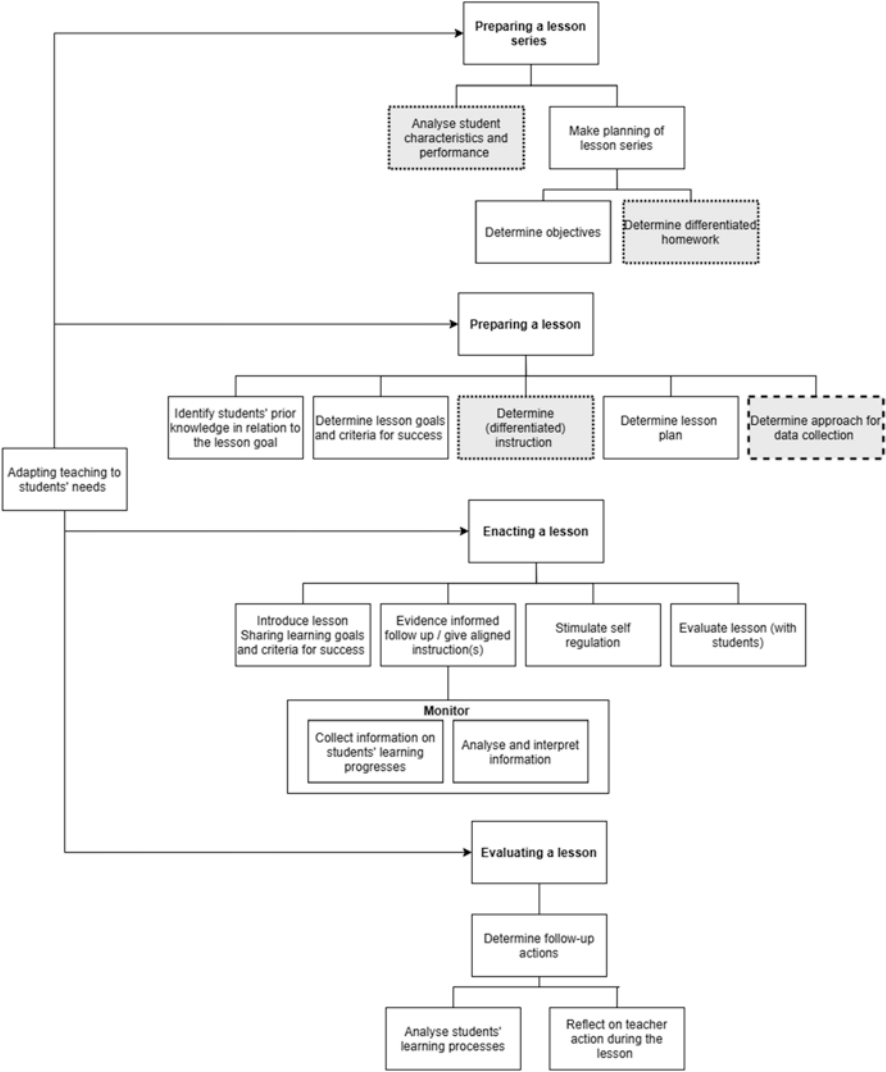
Fig. 33.1 Combined skill hierarchy for adapting teaching to students' needs
Note that skills represented with dotted lines exclusively stem from the CTA into DI, and the skill represented with dashed lines exclusively stems from the CTA into AfL.

evaluating a lesson. For teachers to be able to apply either AfL or DI, these four phases cannot be separated and seen as isolated activities. Coherence between the four phases is necessary for high-quality performance of the task as a whole.

Although the majority of skills appears similar across both AfL and DI, several skills are DI-specific (represented with dotted lines in Fig. 33.1) or AfL-specific (represented with dashed lines in Fig. 33.1). For both AfL as well as DI, teachers

need to prepare a lesson series. In order to do so, they make a planning (including *differentiated homework* for DI, e.g. teachers determine in advance which homework is suitable for challenging high-performing students and which homework will help low-performing to achieve the learning objectives) and determine objectives. For DI, the *analysis of student characteristics and performance* is also required in this preparation phase. This skill was not identified in the CTA for AfL. An explanation could be that for DI, teachers obtain a picture of their students' needs and progress for long-term preparation and possible adjustments in objectives. In the *lesson preparation phase*, both for AfL as for DI, teachers identify students' prior knowledge related to the lesson goal.

In the *lesson preparation phase*, one DI-specific and one AfL-specific skill were identified. For DI, teachers prepare differentiation instruction, they for example determine specific approaches to explaining the subject matter for high, average and low performing students. For AfL on the other hand, teachers specifically determine approaches for data collection: how will they, during the lesson, elicit information about students' progress, understanding, and/or misconceptions? This is strongly connected to the 'monitoring' skill during the lesson. However, teachers in the CTA for DI, did not explicitly mention that they prepare *how* they will monitor student understanding and progress during the lesson, whereas this was an explicit part of lesson preparation for teachers in the CTA study into AfL.

As can be noted from Fig. 33.1, during the phases *enacting a lesson* and *evaluating a lesson*, no AfL- or DI-specific skills were identified. This does not imply that AfL and DI are exactly the same, however, it does indicate that teachers need the same *underlying skills* to be able to perform either AfL or DI. A subsequent conclusion could be that teachers who are proficient at either DI or AfL, would probably also be able to perform the other task. Although the underlying required skills are similar, the emphasis given to each skill differs in practice and this can be noted throughout all four interrelated phases. For AfL, the emphasis is on eliciting evidence during the lesson. Teachers prepare their approach to data collection, during the lesson they analyze and interpret the information in order to utilize the insights for evidence-informed follow-up. For DI, the emphasis is on pro-active alignment of instruction and activities, based on students' needs. In order to do so, teachers collect information about their students' progress and understanding both in the preparation of a lesson series, and the preparation of a lesson, as well as by monitoring during the lesson. In general, it appears that students have a more active role in classrooms where teachers apply AfL. Although stimulating students' self-regulation in DI is also an important skill, the emphasis in DI is more on a pro-active approach by the teacher.

4.2 Required Knowledge

In both CTA's, next to required skills, required knowledge was identified. From the CTA into DI, three types of knowledge emerged: knowledge about students, subject matter knowledge, and general didactical-pedagogical knowledge. Basic elements

of teacher knowledge that were identified to be critical for applying AfL successfully are: domain knowledge, pedagogical content knowledge, knowledge of students' previous learning, and knowledge of assessment.

Knowledge about students (DI) is strongly related to knowledge of student's previous learning (AfL), although teachers in the CTA for DI stressed that it is not only of utmost importance to know about students' learning and performance, but also have insights into students' pedagogical needs. From the description of required subject matter knowledge (DI), it becomes clear that this encompasses domain knowledge (AfL) and pedagogical content knowledge (AfL). This knowledge is needed for teachers to be able to respond adequately to e.g. students' misconceptions and identify students' next steps in their learning process (Heritage, 2010). From the CTA into AfL, it was concluded that teachers need specific knowledge about assessment, various techniques for eliciting information, and how to apply these. From the CTA into DI, it appeared that teachers need general pedagogical didactical knowledge.

4.3   Factors Related to Complexity

It is generally assumed that adapting teaching to students' needs is a complex teaching skill. In order to support teachers in developing skills for adapting their teaching to the needs of their students, it is recommended to identify, and if possible: adapt, the external factors that influence the perceived complexity. This way, a sort of scaffolding is applied (Van Merriënboer & Kirschner, 2018): by providing teachers the opportunity to start with implementing DI or AfL in a less complex situation, they can focus on developing the skills necessary for DI or AfL. When teacher are able to apply their skills in a relatively less complex situation, the complexity of the situation can be increased. Since this (perceived) level of complexity of differentiated instruction and assessment for learning differs across situations (Van Geel et al., 2019), in the two studies expert teachers were asked to identify these factors related to complexity. In both studies, the same four general factors related to complexity were identified:

1. Student group composition: number of students, degree of diversity, classroom climate, students' task-orientedness.
2. Lesson content: topic, goal.
3. Curriculum material: assignments at different levels, diagnostic value of suggested instructional material, suggestions for remediation.
4. School support: facilities, duration of classroom hours, collaboration, testing structure and rules.

This list of complexity factors can provide a basis for developing a scaffolded professionalization trajectory, in which (beginning) teachers are encouraged to start implementing DI or AfL in situations with relatively low complexity, e.g. when teaching a rather easy topic to a rather homogeneous group of students.

5 Conclusion and Discussion

In this chapter, we aimed to identify empirical similarities and differences in required teacher knowledge and skills for adapting teaching to students' needs, by applying either assessment for learning or differentiated instruction. Studies into DI and AfL so far, seem to be mostly conducted separately, using their own terminology. However, based on the comparison of underlying skills and knowledge, required for either DI or AfL, identified by means of cognitive task analyses, it appears that teachers roughly need the same *underlying skills and knowledge* to be able to perform either DI or AfL. We can therefore hypothesize that teachers who are proficient at either DI or AfL, will also be able to develop and implement AfL or DI in practice. Since also in practice, there is an overlap in applied skills and strategies, it could also be assumed that teachers who apply AfL, differentiate their instruction based on the identified differences, or that teachers who apply DI, use AfL strategies to identify their students' needs.

We argue that the fields of DI and AfL and differentiation would benefit from greater integration to be able to reach the common goal of improved learning and achievement. Both approaches not only require largely the same underlying skills, they also complement each other. Teachers who would like to adapt their teaching to students' needs could benefit from combining the knowledge and skills required for DI and AfL. For example, teachers who are proficient in proving DI could strengthen their monitoring by explicitly determining approaches to data collection in their lesson preparation. On the other hand, teachers who implement AfL could improve their preparations by also analyzing student characteristics, and preparing differentiated instructions in order to be better able to adapt their teaching on the spot.

Since adapting teaching to students' needs is an important characteristic of effective teaching, both pre-service as well as in-service teachers could benefit from professional development activities aimed at enhancing the coherent combination of DI and AfL. The identified knowledge and skills required for high-quality integration of DI and AfL, from preparation to evaluation, can serve as basis for developing such (continuous) professional development programs.

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Kyra Meutstege studied cultural anthropology and educational science and now works a researcher at the University of Twente. In close cooperation with a regional secondary school board she is working on a project with regard to differentiated instruction for mathematics teachers. By means of a cognitive task analysis, the knowledge and skills a mathematics teacher in secondary education needs to give differentiated instruction and what factors influence the complexity of it were identified. Based on these insights, Kyra is now developing a professional development trajectory that will be implemented and evaluated in 2021–2023.

Dr. Jitske de Vries graduated cum laude for her bachelor in Psychology, followed by her master in educational science. She conducted her PhD at the University of Twente. In her dissertation, she evaluated two projects related to teacher professional development, aimed implementing assessment for learning in secondary schools: the InformED project in the Netherlands, and the FORMAS project in which she collaborated with international project partners from Cyprus, Greece, Belgium and The Netherlands.

Prof. Dr. Adrie Visscher is a full professor at the University of Twente and head of the Department of Teacher Development. In his research he investigates how the provision of various types of feedback to students, teachers and schools (e.g., classroom observation results, students' perceptions of teaching quality, students' ability growth, feedback to students who are working on assignments) can support the optimization of the quality of classroom teaching and student learning. As the receipt of such feedback often is the starting point for improvement-oriented actions his research also focuses on the characteristics of effective teacher professionalization.

Dr. Christel Wolterinck was a PhD student at the Department of Teacher Development at the University of Twente. Her research interests center on assessment for learning and enhancing teachers' professional development in the area of assessment and data use. She is also a school

leader, working at Marianum in Groenlo, a school for secondary education belonging to the Foundation Carmelcollege. Previously, she worked as a chemistry teacher for 14 years. Currently, her work focuses on implementing assessment for learning and data-based decision making, specific the continuing professional development of teachers in secondary education and stimulating practitioner research in the schools.

Prof. Dr. Kim Schildkamp is a full professor in the Faculty of Behavioural, Management, and Social Sciences of the University of Twente. Kim's research focuses on data-based decision making and formative assessment. She is a Fulbright scholarship recipient, which she used to study data use in primary and secondary education in Louisiana. She is the previous president of ICSEI (International Congress on School Effectiveness and Improvement). She has published widely on the use of (assessment) data and was, for example, editor of the book "Data-based decision making in education: Challenges and opportunities" and "The data team procedure: A systematic approach to school improvement.

Dr. Cindy Poortman is an associate professor at the University of Twente, the Netherlands. Her research and teaching focus on teacher and school leader professional development in Professional Learning Networks (PLNs). Examples are data teams, teacher design teams, and research practice partnerships. Leadership, sustainability, data use and assessment for learning are her themes of focus. Publications include data use papers and the book The Data Team Procedure (2018, Springer). She also co-edited Networks for Learning (2018, Routledge) and co-edits the Professional Learning Networks Book Series (2019-, Emerald). Cindy is one of the InformED project researchers.