Chapter 4
Differentiating instruction to stimulate student talent development: A year-long study of teachers' interactive cognitions[1]

Abstract

Despite the considerable interest in differentiated instruction in education practice and research, it is still the case that little differentiated instruction has been observed in practice. This study investigated teachers' interactive cognitions regarding differentiated instruction, to improve the support available to teachers in implementing this pedagogical approach. Four teachers participated in stimulated recall interviews in the context of talent development lessons in the lower years of a secondary school. Each teacher was observed for four lessons over two semesters and interviewed shortly afterwards using video clips from various teacher-student interactions. The interview data were analyzed to determine how learner-centered the teachers' interactive cognitions were and which student characteristics (readiness, interest, and/or learning profile) the teachers took into account. We concluded that the interactive cognitions varied between and within teachers regarding learner-centeredness and the student characteristics they considered. For example, for two out of the five categories of teacher-student interactions, teachers mainly considered students' readiness, whereas in another interaction they mainly considered interest. Thus, this research study indicates that the variety in teachers' interactive cognitions should be considered both in subsequent research and in efforts to support teachers as they implement differentiated instruction.

[1] This chapter has been submitted in adapted form as:

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4.1 Introduction

There has been a great deal of research into differentiated instruction (DI) both in the Netherlands and abroad (Bosker & Doolaard, 2009; Graham et al., 2008; Dutch Inspectorate of Education, 2016; Tomlinson et al., 2003). DI is usually defined as taking differences between students into account in the process, product and content of teaching, whether proactively or reactively (Bosker & Doolaard, 2009; Tomlinson et al., 2003). Many studies have addressed the extent to which teachers respond to differences between students (Graham et al., 2008; Dutch Inspectorate of Education, 2016) and the effects of these actions on their students' learning outcomes (Deunk, Doolaard, Smale-Jacobse, & Bosker, 2015). A study examining teachers' perceptions of and knowledge about DI (Brighton, 2003) found that teachers consider DI to be important, given its positive effects on students' learning outcomes and motivation (Deunk et al., 2015). However, secondary school teachers often see it as impractical for classes of 25-30 students (Janssen, Hulshof, & Van Veen, 2016). In this study, we tried to gain more insight into how teachers attempt to cater for differences between students in their lessons and the interactive cognitions regarding their attempts. Greater insight into teachers' interactive cognitions during lessons should enable better support to be given to them for their classroom practice. An important assumption for this study was that different teachers may have different interactive cognitions which affect how they adapt their practices, depending on the teacher him/herself, specific characteristics of the student the teacher is interacting with and the type of learning activity. For this reason, it is not suitable to provide support to teachers as they implement DI in a one-size-fits-all approach.

The questions that we set out to answer in this study were: *What interactive cognitions regarding differentiated instruction do teachers have during teaching? How do they take different student characteristics into account in these interactive cognitions?*

The method we used to explore interactive cognitions *during* teaching was stimulated recall interviews (SRIs). On this basis, we obtained more insight into the variety of context-specific interactive cognitions that the teachers had while they were teaching.

4.2 Theoretical framework

4.2.1 Differentiated instruction

The concept of differentiated instruction

Differentiated instruction can take two forms: between classes and within classes. Between-classroom DI can be seen, for instance, in the structure of secondary education in the Netherlands (as explained in 1.2.2), which tracks students in different school levels (Bosker & Doolaard, 2009). Within-classroom DI occurs when the teacher makes pedagogical choices to take differences between students in a class into account. Regardless of whether it is being organized within or between classes, DI can be seen as "an approach which proactively takes individual differences between students into account" (Mastropieri et al., 2006; Richards & Omdal, 2007; Tomlinson et al., 2003). According to this definition of DI, which can be considered academic DI, differences between students can generally be divided into three different types of student characteristics (Tomlinson et al., 2003): *readiness*, *interest* and *learning profile* (section 1.2.1). By taking these student characteristics into account, the teacher creates an environment in which each student can be successful and develop his/her academic potential to the full (Subban, 2006). In addition to academic DI, cultural DI can also be distinguished. In this latter type of DI, taking into account cultural differences between students is more at the forefront, whereas in academic DI, students' cognitive capabilities and talents are more central (section 1.2.1) (Severiens, 2014; Tomlinson et al., 2003). In this study we adhere to the definition of academic DI.

Research into differentiated instruction

Various studies have provided evidence for DI's positive influence on students' performance at school (Deunk et al., 2015; Mastropieri et al., 2006; Richards & Omdal, 2007). In fact, DI contributes to higher learning outcomes in students of different age groups. Deunk et al. (2015), for example, point in their review to the cognitive effects of DI by ability grouping: various positive effects on the language skills of children in nursery school and on the reading skills of primary school students. Higher scores on standardized physics and chemistry tests were found by Mastropieri et al. (2006) and Richards and Omdal (2007) as a result of DI in secondary schools. In the study by Mastropieri et al. (2006), the DI consisted of students working in small groups of two or three on physics and chemistry tasks which were adapted in level of difficulty to be suitable for the students' abilities. The DI in Richards and Omdal's study (2007) took the form of *tiering*, a method which involved dividing the students into three ability groups. Then the content, process, and product of the series of lessons central to the research project was tailored to suit the knowledge and skills of the students.

These studies found positive learning outcomes because of successful implementation of these methods of DI (Deunk et al., 2015; Mastropieri et al., 2006; Richards & Omdal, 2007). The implementation usually involved a lengthy and intensive process geared to the effective implementation of DI. The teachers were coached in this by researchers and workshop leaders and/or a supply of materials developed by the researchers was provided which students could work on at different levels (Deunk et al., 2015; Mastropieri et al., 2006; Richards & Omdal, 2007). However, that implementation is by no means always effective is clear from a recent report of the Dutch Inspectorate of Education (2016), which concluded that there is still very little DI being practiced in secondary school classrooms in the Netherlands.

The complexity of differentiated instruction

DI is a complex task for teachers whether they are coached or not. This is because it requires them to make conscious and reasoned choices in what they do (Denessen & Douglas, 2015). As explained in section 1.3, these decisions should preferably be taken proactively at different levels. However, because of the large classes and lack of planning time, this is a great challenge for secondary school teachers (Janssen et al., 2016; Janssen, Westbroek, Doyle, & Van Driel, 2013). In practice teachers make many decisions about how to teach a student during classroom teaching, when the situation demands it. Thus, alongside proactive DI, they are usually also engaged in reactive DI (Denessen & Douglas, 2015). It is important, therefore, when supporting teachers to implement DI, not only to focus on the proactive form, but also on the choices they make in the classroom, or the teachers' interactive cognitions during teaching.

4.2.2 Teachers' interactive cognitions

Interactive cognitions during classroom teaching

Our research addressed teachers' interactive cognitions *during* teaching. Research on teachers' cognitions frequently refers to the concept of practical knowledge in this context (Meijer, 1999; Verloop, Van Driel, & Meijer, 2001). Teachers' practical knowledge is the knowledge that underlying the teachers' actions and can be seen as comprising two elements: (1) knowledge and beliefs; and (2) interactive cognitions (see 1.3.2). Therefore, research that only looks at teachers' knowledge and beliefs does not, by definition, give a complete picture of what guides their actions, argue McAlpine, Weston, Berthiaume, and Fairbank-Roch (2006). To study what goes on in teachers' heads when they are teaching, we also need their interactive cognitions (McAlpine et al., 2006; Meijer, Verloop, & Beijaard, 2002). Interactive cognitions are dynamic. They are cognitions that a teacher, consciously or unconsciously, has when

operating in a complex situation, such as many interactions in the classroom (Meijer et al., 2002). This term, in our opinion, conveys the idea that it concerns the teachers' consideration as they are making choices in their approach to students.

In this study, we set out to explore the particular interactive cognitions that come into play when teachers are trying to take differences between students into account during classroom teaching. This led us to focus on different student characteristics. By focusing on this we gained more insight into the extent to which teachers make allowances for differences between students in their unconscious and deliberate actions; in other words, to what extent their interactive cognitions incline towards differentiated instruction.

Interactive cognitions concerning student characteristics

In this study, we operationalized DI by investigating how the teachers' interactive cognitions were centered on the students and which student characteristics (readiness, interest or learning profile) the teachers mainly took into consideration when adapting their teaching to meet individual students' needs (Subban, 2006). When a teacher is aware of differences in *readiness*, *interest* and/or the *learning profiles* of students in a class, and tries to bridge the gap between those characteristics and the material to be learned, that teacher is engaged in learner-centered teaching (Bransford, Brown, & Cocking, 2000). A teacher that engages in learner-centered teaching, assigns competence and ability to all students (Turner, Christensen, & Meyer, 2009). In practice this means, for instance, that the teacher adapts the instruction during the lesson (and the lesson preparation) to meet the needs of the class or of a small group of students, because those students either do not have an adequate understanding of the material or do not find it interesting, but without those students feeling to be incompetent. The extent to which teachers do or do not take student characteristics into account in their interactive cognitions when they are teaching determines the extent to which their teaching can be described as

learner-centered. Where several student characteristics are considered, or where the instruction is adapted to small groups or individual students, that teacher's approach is said to be highly learner-centered (Bransford et al., 2000; Turner et al., 2009).

To sum up, this study set out to explore whether and which student characteristics were included in teachers' interactive cognitions when they were making choices about how to approach students during teaching. In other words, we investigated whether teachers took into account students' *readiness*, *interest* and *learning profiles* and, if so, how they did that. How the teachers took student characteristics into account was defined in this study by how learner-centered their interactive cognitions were.

The interactive cognitions were identified and recorded in the context of GUTS. We believed that this context would enable us to obtain a good picture of how teachers allow for differences between students in their teaching. A stimulated recall method (McAlpine et al., 2006; Meijer, 1999; Nguyen, McFadden, Tangen, & Beutel, 2013) was used to explore individual teachers' different interactive cognitions during the GUTS lessons. By specifically doing this with different teachers during different types of interactions (such as setting goals, giving instruction and giving positive attention), we produced a varied picture of their interactive cognitions. In doing so, we hoped that this study would lead to a better understanding of the complexity of reactive DI in classroom teaching, which could lead to indications for supporting teachers as they implement DI in their day-to-day teaching practice.

4.3 Method

4.3.1 Context: Differentiated challenging of talent in school

This study took place in the second year (2014-2015) of the implementation of GUTS (see 1.4). This year, students then had eight extra lessons in one of the three subjects they chose. The teachers

designed these lessons and incorporated four criteria: (1) enrichment; (2) autonomy; (3) higher order thinking skills; and (4) differentiated instruction. This last aspect was the key aspect for the purposes of our research.

4.3.2 Participants

Four teachers volunteered to work with us in the current study; two of these teachers (Alex and Carla) also participated in the study described in chapter 3. Table 4.1 provides a summary of basic facts relating to the four teachers' experience. The teachers were approached by the PhD candidate, who aimed as far as possible to recruit teachers of different subjects and with varying degrees of experience.

Table 4.1 Relevant details of participating teachers

Teacher (gender)	***Alex (m)***	***Carla (f)***	***Emma (f)***	***Frank (m)***
Subject	Math	Art & Design	French	Dutch
Years' experience	4[a]	7[a]	35	2
Years' experience with GUTS	1	1	0	1
Education	University	Higher Professional Education	University	University

[a] Alex's and Carla's years' of experience differ from their years' of experience in Table 3.1, since the study described in this chapter took place one year after the study described in chapter 3

All the teachers had set up a project for the GUTS lessons which they would work on over eight lessons per semester. Alex, who had about 15 students in the first semester and about 20 in the second, had designed a series of lessons for both semesters around a demo for a

computer game in which the students could build rockets and launch them into space. The students had a different aim each lesson, for example, in one lesson the aim was to orbit the moon. Carla had designed a different project for each of the two semesters and she had about 25 students in her class both times. In the first semester, the students had to produce a painting showing characteristics of the Dutch Golden Age. For example, a student could choose a well-known painting from the Golden Age and copy it in a more modern style but in a way that made it still recognizable as originating from the Golden Age. In the second semester, each student had to choose a work of art and draw a copy of it. After that each student had to produce 24 sketches based on their own drawing so that their own drawing would run into that of the next student. In this way, a video recording of all of the students' sketches would create the impression of one drawing merging and changing into the next. Emma had set up a fictitious exchange with a French secondary school for the first semester (about 16 students). The students had to organize this and think about all kinds of issues that would arise, from composing fictitious emails to the school to arranging where the Dutch students would sleep when they visited France. In the second semester (about 18 students) they had to work in groups to produce a mini play after first watching a French film for inspiration. Frank had different projects for the two semesters and also smaller projects within the semesters. In the first semester about seven students in the class worked on language style and poetry among other things. For example, they had to rewrite a poem in the language of the street. In the second semester, the 17 students spent the first four lessons debating. After that they spent two lessons examining certain aspects of language in depth. In the remaining lessons the students had to set up, carry out and present a mini investigation into some aspect of the Dutch language.

4.3.3 Instruments

We used stimulated recall interviews (SRIs) to investigate the teachers' interactive cognitions (see also chapter 3). In this study, we tried to help teachers to relive their lessons by letting them watch parts of the lessons we observed on video and asking them what was going on in their heads at that specific moment, what they were thinking while teaching the lesson.

During the recording of the videos, observations were noted in an adapted version of the 'Classroom Observation Form for Summative Assessment of Differentiated Instruction' (Tomlinson, Brimijoin, & Narvaez, 2008). The form was adapted so that the observations would not be summative assessments of the teachers, by not only noting whether a particular type of action took place or not, but also what that interaction looked like at the time. In addition, we made some changes to the form to make it more suitable for the Dutch school context. For example, an item that asks whether the teacher at least meets a 'state learning standard' in the lesson was taken out. The resulting adapted version consisted of five categories of actions instead of eight. An overview of these five categories and a short description of them can be found in Table 4.2, whereas the complete observation for can be found in Appendix A.

4.3.4 Procedure

Data collection

Each teacher took part in four SRIs – two per semester in the 2014-2015 school year. In these SRIs, we showed video clips with different types of teacher-student interactions, as in chapter 3.

One clip was selected for each category on the observation form (see Table 4.2 for a summary of the categories) that fulfilled as far as possible the following criteria: (a) clarity of the recording; (b) visibility of the teacher and students involved in the interaction; and (c) best fit with the category to which it is allocated. For the category *instruction*

and classroom routine we chose two video clips. This is because the idea with this category was to compare interactions with two different students or groups of students, in order to get a good idea of possible differences in the teacher's approach to teaching different students. If it was not possible to find a clip within a category of sufficiently high audio and visual quality, a second clip was selected to improve the chance of obtaining usable data.

Table 4.2 Brief descriptions of categories of teacher-student interactions

Type of interaction	Description
Starting position/setting goals	The teacher is explicit in setting goals and/or tries to establish the context/starting position by explicitly or implicitly incorporating students' prior knowledge into the lesson.
Student assessment	The teacher arranges a (pre-)assessment of the students (and adapts the lesson in the light of the results).
Attention for the individual	The teacher ensures that the individual is central to the lesson and is given attention. This involves giving students a role in planning/evaluation/ sharing their achievements.
Instruction and class routine	The teacher uses different routines in the class, e.g. direct whole class instruction, individual and small group work.
Positive, supportive learning environment	The teacher ensures a positive learning environment by praising students or through other positive approaches.

The teachers watched the selected clips one at a time during the SRIs. The recording was paused after each fragment and the teacher was asked: "What were you thinking here?" If a teacher found it difficult to answer this question, they were then asked to explain what they were doing in the fragment and this often flowed naturally into talking about their thoughts at the time. Asking the teachers what they were

thinking during the lesson was intended to get them to make their interactive cognitions explicit. The SRIs lasted for 30-60 minutes and took place in empty classrooms or the staff room, wherever the teacher felt most comfortable. Audio recordings were made of the interviews which were later transcribed verbatim for later analysis.

Data analysis

The analysis of the transcribed interviews consisted of six phases. Preceding this analysis, the PhD candidate studied the transcripts in detail to familiarize herself with their content. Then, the first phase of the analysis was performed. In this phase, we retrieved the interactive cognitions from the transcripts of the SRIs. To this end each SRI of each teacher was divided into five parts (corresponding with the five categories of teacher-student interactions) and put into a summary. As a result of this process five summaries were produced for each teacher; one for each type of interaction containing the interactive cognitions for that type of interaction from the four SRIs with that teacher. The part of a teacher's answer which revealed information about the reasons why this specific *interaction,* with that/those *student(s)*, took place in that *manner*, was treated as an interactive cognition and so included in the summaries. One of the summaries, for example, was labelled *context/goal setting*, the same as the interaction category. That document contained the interactive cognitions for that interaction that emerged from the four SRIs. In Alex's first SRI, for instance, there was his interactive cognition during this interaction: "I just tell them what they are going to do. (…) there is nothing exciting about second-year math. [So] in order to do things that are more exciting, you need more skills or it has to be something like [this program], where you are not doing math, but playing with something that you'll be able to do with math in the future." We also checked at this stage whether the teachers' interactive cognitions were congruent with the category into which they had been placed in the first instance during the observation.

In the second phase, the content of the teachers' interactive cognitions was analyzed and described. The interactive cognitions were annotated with information on how the interactive cognition was learner-centered, that is how the teacher was trying to take account of individual students and which students. To this we added whether teachers considered student characteristics, and if so, which.

The third phase was the production of matrices: one for each semester. We summarized the interactive cognitions from the same semester in the matrices under each interaction category. The reason for producing a separate matrix for each semester was that a block of GUTS lessons took up one semester, so this method brought the interactive cognitions from one block of lessons together. The summaries of all the teachers were brought together into one matrix, while maintaining the separation between teachers and interactions (see Table 4.3 for an example of part of this matrix). If for a specific interaction, no interactive cognitions were discussed for a particular teacher, we entered no summary in the matrix but noted 'not applicable', see: Alex – student assessment (Table 4.3). Phase four was the production of more generic descriptions of the teachers' interactive cognitions based on the summaries in the matrices. These descriptions were then put into new matrices. Characteristics, details and the like that could be seen as typical of that teacher and his/her subject were left out as much as possible, naturally ensuring that the essence of the interactive cognition remained intact. The purpose of this was to enable comparison of the interactive cognitions of different teachers and comparison of the two semesters. Thus, the summary for Alex from Table 4.3 became: "students from the school year in question are interested in how to learn certain subject knowledge and skills and the aim of the series of lessons and the explanation should take account of this."

Table 4.3 Matrix with summaries of teachers' interactive cognitions during student-teacher interactions in semester 1

Type of interaction	**Carla**	**Frank**	**Emma**	**Alex**
Context/ goal setting	The teacher tries either to establish what level the students are at, or she assumes that there is a certain point from which the students can progress, and she tries to provide such help and instruction that they can make progress at their own tempo and level. She does this within the time constraints and the scope of the task in hand, with a particular focus on helping students who are behind to achieve a certain minimum standard.	The teacher reviews previous lessons with the students to establish what prior knowledge they have or what they have learned in previous lessons. He gives them tips on how to use their prior knowledge in the current assignment and, on another occasion, he tries to get the students to a point where he thinks that they need to be in the first couple of minutes of the lesson in order to make further progress in the lesson.	The teacher has one ultimate goal for all the students in the first instance, which she helps them to reach. As soon as the students seem to have reached that goal or are getting close, she helps them to exceed it. In both cases she always starts from what the students already know, recognizing that there are differences between what students know, and takes this as the starting point for helping them to reach their goals.	The teacher believes that he has designed a task that is more fun for the students, given the current level of their knowledge and skills. The teacher has tried to make a virtue of their lack of knowledge and skills by allowing them to approach the subject in a different way. He offers them methods that he thinks are fun. In doing this he does not make any direct distinctions between students.
Student assessment etc.	The teacher is actively working…	The teacher wants to know…	The teacher ensures that during the lesson…	n/a.

In phase five we compared the interactive cognitions of different teachers and the two semesters for similarities and differences. As the aim of our research was to investigate what interactive cognitions teachers had and not which interactive cognitions occurred most frequently, matching interactive cognitions were combined, regardless of which teacher or which semester they originated from. Next, we indicated whether students' *readiness*, *interest* and/or *learning profiles* were considered in the interactive cognitions. To show differences between interactive cognitions and the type of learner-centeredness even more clearly in the matrices, the interactive cognitions were listed vertically under each interaction. For the type of learner-centeredness we mainly looked at who the teachers directed their interactive cognitions at and how. Interactive cognitions at the top of the matrices were more centered on the whole class or specific groups of students and those at the bottom were more centered on individual students. If, for example, a teacher mainly took into consideration characteristics of a whole class of students or a certain age group, this would appear above an interactive cognition that took account of characteristics of individual students. An example is provided by this interactive cognition in *context/goal setting*: "students have progressed at different rates in earlier lessons and this is each student's individual starting point for a new lesson, which you can respond to in a class discussion or by summarizing the progress in class by offering them general suggestions that they can each use in their own way to achieve their goals." This interactive cognition was labelled with the student characteristics *readiness* and *learning profile*.

The sixth and final phase was undertaken to show the variation more clearly and to enable the content of the interactive cognitions to be described better. The categories with teacher-student interactions were divided into subcategories which, for example, were related to what the teacher hoped to achieve through the interaction. *Context/goal setting*, for example, was subdivided into: *Aim of context/goal setting* and

students' prior knowledge. By *students' prior knowledge* was meant what prior knowledge the teacher assumed/knew the students had and to which (s)he ultimately geared his/her interaction. This stage ultimately produced Tables 4.4 to 4.8, which are discussed in the results section.

An audit of the last stage of the analysis was performed, so that we could guarantee the quality of the analysis (Akkerman, Admiraal, Brekelmans, & Oost, 2008). An independent auditor compared the outcomes of stage five with those of stage six and then checked them for visibility, comprehensibility, and acceptability. The independent auditor approved the analysis on these three points.

4.4 Results

4.4.1 Context/goal setting

Table 4.4 shows the teachers' interactive cognitions of DI while they were establishing the context and/or setting goals with the students. The interactive cognitions in this category of teacher-student interactions can be divided into two subcategories: those that the teachers had in relation to the aim of their specific approach to setting goals (*aim of context/goal setting*); and those that they had in relation to their considerations of the prior knowledge that the students brought to the lessons (*students' prior knowledge*).

The teachers' interactive cognitions in the subcategory *aim of context/goal setting* varied from primarily teacher-centered (Frank's first interactive cognition in Table 4.4) to those aimed at the goals of individual students (the last interactive cognition of Carla and Emma in Table 4.4). The first interactive cognition is primarily teacher-centered because it starts from what the teacher wanted to know. Frank considered it important to know what happened in the previous lesson during which he was not present. Frank said: "Of course, they are the best ones to tell us what they did last time. Now, (…), there were two

Table 4.4 Interactive cognitions of DI relating to context/goal setting (R=readiness; I=interest; LP=learning profile)

Teacher-student interaction	Interactive cognitions		Student characteristic	Teacher
Context/goal setting The teacher is explicit in setting goals and/or tries to establish the context/starting position by explicitly or implicitly incorporating students' prior knowledge into the lesson.	**Aim of context/goal setting**	• teacher knows the situation regarding the last lesson		Frank
		• class:		
		○ understands connection between lessons	R	Alex, Frank
		○ understands the purpose of the series of lessons and is motivated to work toward it	I	Alex
		○ understands concept and can work further toward the same goal	R	Alex
		○ is starting from the same starting position and can work toward the same goal	R	Frank
		○ understands the purpose of the series of lessons and how to work toward it thanks to interim target	R	Alex, Carla
		• individual:		
		○ student can build on his/her own achievements and so reach his/her own goals	R; R+LP	Carla, Emma
	Students' prior knowledge	• n/a.; teacher wants to know what happened in the last lesson		Frank
		• class:		
		○ related to standard of year group	R	Carla, Frank
		○ related to interest of year group	I	Alex
		• groups within the class, related to knowledge of concepts	R	Alex
		• individual:		
		○ related to progress since previous lesson(s)	R	Carla, Emma
		○ related to standard and personal background	R+LP	Carla

students who really spoke out and after that, of course, I'm going to go over it again. But it is mainly about reviewing it, what they have learned from it, what they have done."

The interactive cognition that both Carla and Emma expressed was centered on individual students. It was about letting them proceed at their own pace so that they could reach their own goals. This quotation from Emma illustrates this: "They already knew what they had to do: try to think up other situations and compose dialogues about them. So I gave them a couple of examples to look at and they had to think up the rest themselves: what were they going to choose, what did they have to watch out for and how would they do that, and how could they apply what they already knew to new topics."

With this interactive cognition the teacher is taking into consideration the students' achievements (*readiness*) with respect to the aim of the series of lessons. Carla defined this interactive cognition as follows: "Last time she didn't really understand what she had to do. (…) So I showed her some examples of paintings from the Golden Age and said that she could start working from there, because she, she doesn't knuckle down to her work, it's laziness rather than tiredness, she's really very unresponsive and because of that (…)we are going to persevere with this now." This quotation shows that the teacher is not only taking the student's *readiness* into account but also, with her unresponsiveness, a personal trait (*learning profile*). Similar variation was found with respect to *students' prior knowledge*, namely a continuum from focused on the teacher to focused on the level and personal background of individual students.

It is also striking that the interactive cognitions relating to *aim of context/goal setting* were mainly formulated by the teachers at class level, while for *students' prior knowledge* the interactive cognitions were more widely distributed over individual students and the class. However, looking at the class, what emerges is not so much

characteristics of a particular class, such as the level, but assumptions based on the year group of the students in that class.

Overall, what we found with respect to this teacher-student interaction was that the interactive cognitions relating to this interaction were mainly based on the *readiness* of the students.

4.4.2 Student assessment

Table 4.5 provides some insight into the teachers' interactive cognitions of DI relating to *student assessment*. The interactive cognitions that the teachers had when assessing the students fell into three subcategories: aim of the interaction (*aim of the assessment*), what was being assessed (*assessment of*), and who had initiated the assessment (*assessment by*). Table 4.5 shows a less varied picture in the interactive cognitions relating to student assessment by the different teachers than that which was found in the area of setting goals. The absence of Alex in this Table is conspicuous. It is explained by the fact that after checking the agreement between the teachers' answers and which type of observed interaction they had been classed under in the analysis, it turned out that all of Alex's interactions that had been observed as student assessment did not belong there. Possible explanations for this could be that Alex does less student assessment in his lessons than other teachers, or that the way he does his assessment did not become clear in the observation as assessing students. The interactive cognitions of the other three teachers that emerged from the 12 interviews are summarized in Table 4.5 in two to three points in each of the three subcategories.

Table 4.5 Interactive cognitions of differentiation during student assessment (R=readiness; I=interest; LP=learning profile)

Teacher-student interaction	Interactive cognitions		Student characteristic	Teacher
Student assessment The teacher arranges a formative (pre)-assessment of the students (and adapts the lesson in the light of the results).	**Aim of assessment**	• to offer direct help with current problem	R	Frank
		• to help students with a poor attitude to work to change their attitude	I	Emma
		• to be able to offer individual support during the lesson	R	Carla
	Assessment of	• individual students		
		○ progress	R	Emma, Frank
		○ attitude to work	I	Emma
		○ standard of work	R	Carla
	Assessment by	○ questions from students	R	Frank
		○ teacher	R; I	Carla, Emma, Frank

The variation in learner-centeredness for *aim of assessment* can be seen in the differences between the interactive cognitions of Frank and Carla. Frank said that he assessed the students to offer them help with the current problem so that they would then be able to make progress with the assignment: "I hoped this short interruption would help her to get back to work." Carla explained that for her the aim of the assessment was to enable her to tailor the support she offered to the students taking their individual abilities into account. An example of how she then guided a student is provided by this quotation: "That's why I gave him an option to try it on sketch paper first and then I said I'd get back to him [the trick is to simplify the task]." The learner-

centeredness of what the teachers assessed (*assessment of*), and of who guided the assessment (*assessment by*) varied minimally. Teachers always assessed individual students and assessment was guided by the students' questions or whether the teachers went around all the students to check how they were getting along.

In general, it is clear that *readiness* was the student characteristic that occurred most frequently in the teachers' interactive cognitions relating to student assessment, and *learning profile* was not found at all during this type of interaction.

4.4.3 Attention for the individual

Table 4.6 shows the teachers' interactive cognitions while they were paying attention to individual students and involving students in planning lessons. Regarding the *aim of attention for the individual*, it became clear that the teachers had different interactive cognitions while providing that attention. An example of a teacher's interactive cognition connected with students' motivation can be seen in this quotation from Alex: "These two are in the middle, so if I support them and help them a bit, they may come to like it and manage to get something done. But if I don't do that, they can become distracted and give up." In the case of the other two interactive cognitions, the teachers considered it important that the students got an idea of their progress and achievements. An example of this is provided by Emma who explained why she had given her students a particular assignment as part of the project: "Also that it is their responsibility, they have the autonomy, (…), because they decide what they are going to investigate, it's their choice. (…) [This assignment] is for them, so that later they can say to themselves: 'OK, I've done that and that and all that in this and that way and that's why I did it like that'."

Table 4.6 Interactive cognitions of differentiation related to attention for the individual (R=readiness; I=interest; LP=learning profile)

Teacher-student interaction	**Interactive cognitions**		**Student characteristic**	**Teacher**
Attention for the individual The teacher ensures that the individual is central to the lesson and is given attention. This involves giving students a role in planning/ evaluation/ sharing their achievements	**Aim of individual attention**	• to take advantage of motivation in order:		
		○ to prevent loss of motivation during completion of the task	R+I	Alex, Frank
		○ to motivate students to take a broader interest in the subject	I	Alex
		• to give students an idea of:		
		○ their progress, so that they can experience a sense of responsibility and autonomy	I+LP	Emma
		○ their achievements, so that they can build on these in the current and subsequent tasks	R	Carla
	Student characteristics	○ class	I+LP	Emma
		○ students with a certain level of motivation:		
		○ poorly motivated and poorly performing students	R+I	Alex, Frank
		○ well-motivated students	I	Alex, Frank
		○ individual students	R	Carla

Table 4.6 shows that the student characteristic *interest* was the one that occurred most frequently in the teachers' interactive cognitions. This means that the interactive cognitions during the teacher-student

interaction *attention for the individual* were mainly based on a different student characteristic from those that the teachers had during the interactions *context/goal setting* and *student assessment*, which mainly seemed to be based on the *readiness* of the students.

4.4.4 Instruction and class routine

Table 4.7 shows how the teachers' interactive cognitions during teaching and classroom routines were learner-centered and which student characteristics were taken into account. These interactive cognitions are broken down into two subcategories: *aim of instruction* where the interactive cognitions show what the teachers were aiming at with their instruction; and *aimed at* where the interactive cognitions indicate who the teacher aimed his/her instruction at. The interactive cognition under *aim of instruction* that is least learner-centered is directed at the expectations the teacher (Frank) had. Frank said that he gave the observed instruction because it was necessary to keep the class discussion going, as the debate threatened to come to a halt: "I had to intervene here because nothing was happening, the discussion fell silent, the whole debate. (…) This [was] the proposition that most students had chosen and I knew that nothing had been said about it, or too little, certain elements were missing." An example of an interactive cognition centered on individual students was provided by Carla and was directed at one student who is given appropriate instruction to enable him to complete the assignment within the terms of reference in a way that suits him and challenges him: "Typically he had chosen the simplest with two lines and then a red plane or so and then I think, yes, you need to challenge yourself a bit more (…) and I don't know his style, but I know that it was very easy for him to produce that very simple picture, with those two lines. That's why I said 'just take a look at [that other painting]'."

Table 4.7 Interactive cognitions of differentiation related to instruction and classroom routine (R=readiness; I=interest; LP=learning profile)

Teacher-student interaction	Interactive cognitions		Student characteristic	Teacher
Instruction and classroom routine The teacher uses different routines in the classroom, e.g. whole class instruction, individual and small group work	**Aim of instruction**	• to hold a class discussion that proceeds according to the teacher's expectations	R	Frank
		• individual students may:		
		○ complete the task as intended	R+I	Alex
		○ complete the task	R+LP	Emma
		○ complete at least part of the task by the end of the series of lessons	R+I	Frank
		○ be allowed to complete the task in their own way	R+I	Emma
		○ be allowed to complete the task in a way that the student challenges him/herself	R+I	Carla
	Aimed at	○ class	R	Frank
		○ types of students:		
		○ under time pressure	R+I	Frank
		○ with questions	R+LP	Emma
		○ with problems	R+I	Alex
		○ all students, individuals	R+I	Carla

In the interactive cognitions that show who the teachers were taking into account while they were teaching, three types of learner-centeredness were observed: (1) an interactive cognition where it is clear that the instruction had to be addressed to the whole class; (2) interactive cognitions concerned with students from a particular 'group', i.e. those with problems, questions, or those experiencing time pressure; and (3) an interactive cognition where the teacher has geared the instruction to all the students as individuals. In the interactive cognitions aimed at groups of students, we found that the teachers did

always take students' individual characteristics into consideration, as this quotation from Frank illustrates: "[He] was obviously having some difficulty finding a good poem. Of course, I said to him 'yes, now listen, you could just take some song lyrics', it's kind of the same principle, not exactly a poem, but you could say that the two genres often overlap. (…) and he may just have something in his head like: 'I like that song.'"

When Table 4.7 is compared with Tables 4.4, 4.5 and 4.6, it is noticeable that all of the interactive cognitions in this Table apart from one contain two student characteristics, whereas in the three interaction categories discussed earlier, there was only one. In Table 4.7 it was a combination of *readiness* and *interest* that occurred most frequently – the two student characteristics that also occurred most frequently in Tables 4.4, 4.5 and 4.6, but there they were usually found on their own and not combined.

4.4.5 Positive, supportive learning environment

Finally, Table 4.8 distinguishes a number of interactive cognitions in which different forms of learner-centeredness are present. This category is also subdivided into two subcategories: (1) *aim of the support*, in which the teachers' interactive cognitions relate to their aims in engaging in certain positive approaches and providing specific support to the students; and (2) *assumption*, in which the interactive cognitions describe the basis on which the teachers offered their support. It is clear from *aim of the support* that the variation within the interactive cognitions shows that by adopting these positive approaches the teachers were trying in different ways to establish a situation where the students would always be able to make progress with the task. In one interactive cognition, for example, this was combined with the idea of increasing the students' motivation, as Alex explained in an interview: "They need a bit more explanation about how to balance [the rocket] correctly. (…) And I enjoy helping the boy,

Table 4.8 *Interactive cognitions of differentiation related to the provision of a positive, supportive learning environment(R=readiness; I=interest; LP=learning profile)*

Teacher-student interaction	Interactive cognitions		Student characteristic	Teacher
Positive, supportive learning environment The teacher ensures a positive learning environment by praising students or through other positive approaches	**Aim of the support**	• to help the student to make progress with the task and:		
		○ to become more motivated	R+I	Alex, Frank
		○ to be able to use knowledge gained through praise from the teacher given with explanations when completing parts of the task later	R+LP	Emma
		○ to be able to use knowledge gained through praise from the teacher given with explanations to fulfil his/her own goals later	R+LP	Carla
	Assumption	• individual student:		
		○ who has done something well in the task	R+I	Alex, Frank
		○ every student does something well and/or has a good attitude to work	R+LP	Carla, Emma

because he failed his math. (…) He's just lazy, he's bright enough, he just doesn't want to work." In another interactive cognition, this was combined with ensuring that the students could complete personal targets with positive support from the teacher Carla: "Because she can paint awfully well and I know that, but I also know that she's a bit of a perfectionist and because of that it can take a very long time. (…) that's why I wanted to encourage her to focus on the things that she

has already done well." Two interactive cognitions were observed in the subcategory *assumption*, both of which were centered around the individual student: the first where teachers assume that a student should be praised when they have done something well in the assignment, and the second where the teachers assume that all students do something well at some point in the lesson and they should all be praised for this.

Table 4.8 shows that the teachers' interactive cognitions were always coupled with two student characteristics and that, after *readiness*, *learning profile* occurred most frequently in the interactive cognitions.

The tables above show that the teachers always – with one exception – included student characteristics in their interactive cognitions. The student characteristic that occurred most frequently was *readiness*, but this also depended on the teacher-student interaction to which the interactive cognition related. In the areas of *instruction* and *providing positive support*, teachers often took two student characteristics into consideration. Our results also show that nature of learner-centeredness in the teachers' interactive cognitions varied from directed at the class to directed at the individual student.

4.5 Discussion and conclusion

4.5.1 Discussion, conclusion and limitations

The research questions in this study were: *What interactive cognitions regarding differentiated instruction do teachers have during teaching? How do they take student characteristics into account in these interactive cognitions?* To enable us to answer these questions, four secondary school teachers participated in stimulated recall interviews in which they were asked about their interactive cognitions during different types of teacher-student interactions in their lessons.

The results show that the interactive cognitions of the teachers in our study were mainly directed at the student characteristic *readiness*, whether or not in combination with the *interest* or *learning profiles* of their students. They took the *readiness* of their students into account in a number of different ways. Within the different categories of teacher-student interactions, variation was observed in the learner-centeredness of the interactive cognitions. At the level of the subcategories identified in the types of teacher-student interactions, we found variation in: (a) the aim of the interaction (teachers wanted to meet the students' needs as and when they arise or they also wanted to anticipate and meet future needs); and (b) who the interactive cognitions during the interactions were directed at (class, groups, individual students). It also emerged from the interactive cognitions that teachers rarely if ever saw it as their role to challenge their students or get them to exceed themselves. The teachers' interactive cognitions relating to DI in this study revealed mainly convergent DI (Bosker & Doolaard, 2009). However, the aim of GUTS was that the teachers would help students to develop their talents further. In other words, the aim was for them to use divergent DI to enable each student to reach his/her zone of proximal development (ZPD) (Subban, 2006). The teachers were given freedom in the design of their GUTS lessons to subsequently give the students more autonomy. The fact that we mainly found convergent DI in this study could reflect the fact that divergent DI is more complex than convergent differentiation (Bosker & Doolaard, 2009).

Differences in interactive cognitions were also found between the categories of teacher-student interactions. In *context/goal setting* and *student assessment*, *readiness* of the students was the most frequent characteristic found in the interactive cognitions. On the other hand, the interactive cognitions during *attention for the individual* were mainly directed at the students' *interest*, whether or not in combination with *readiness* or *learning profile*. In the case of the interaction types

instruction and classroom routine and *positive, supportive learning environment*, in virtually all the interactive cognitions *readiness* in combination with *interest* or *learning profile* was considered. One finding that was common to all of the categories was that *learning profile* occurred least often of all the student characteristics in the interactive cognitions. These results are similar to those of previous studies into the effects of DI (e.g. Graham et al., 2008), which found that when teachers successfully implemented DI into their day-to-day teaching, this was often directed at students' *readiness*. In this study *learning profile* was the student characteristic considered the least by the teachers, probably because it requires that the teachers know their students and details of their backgrounds well. Another explanation could lie in the nature of the student characteristic *learning profile*. The students' learning profile is actually a category of student characteristics, of which the students' cultural background is one. Appropriately incorporating culture requires an additional approach to DI, for example teaching for equity or culturally responsive teaching (Cohen & Lotan, 1995; Santamaria, 2009; Severiens, 2014).

Based on interviews with a small number of teachers, we found great variation in teachers' interactive cognitions in relation to taking differences between students into account in different types of lesson situations. This finding ties in with studies which concluded that teachers' practical knowledge is dependent of the context, situation, and individual (Gholami & Husu, 2010; Meijer, 1999; Verloop et al., 2001). Teachers may start from the same knowledge base but, depending, for instance, on the specific moment in the lesson or the students in their class, different teachers may have different interactive cognitions during the same type of interaction. As far as the provision of further support for teachers is concerned, this dependency on context, situation and individual means that a 'uniform' approach to the implementation of DI is neither desirable nor even possible for teachers.

In order to value the conclusions from this study, we should remark that in this study we focused on a part of Tomlinson et al.'s (2003) definition of DI by operationalizing DI as how teachers took student characteristics into account during teacher-student interactions. Teachers' use of proactive DI was, for example, not studied, given the methods and aim of the study. Therefore, it is possible that we mainly captured how teachers differentiate in the process of their teaching, rather than also the adjustments teachers make in the content and/or product, which seem to be more planned adjustments (Tomlinson et al., 2003).

It is important that we make clear that the results and conclusions in our study cannot be generalized unconditionally. After all, the research was conducted with only four teachers and in a specific context (GUTS). The teachers were expected to develop projects that met four criteria: (1) enrichment; (2) autonomy; (3) higher order thinking skills, according to Bloom's taxonomy; and (4) differentiated instruction. Despite its limited scope, a large variety of interactive cognitions were found, showing that the teachers used reactive DI in different ways.

4.5.2 Recommendations and practical implications

In the theoretical framework of this chapter, we argued that to support teachers to develop their actions with respect to DI, it is important to know what interactive cognitions underlie their actions. The results of this study indicate that teachers do usually take differences between students into account in their interactive cognitions during lessons. The variety in interactive cognitions that we found leads us to make two recommendations for the further implementation of DI.

Based on the finding that teachers' interactive cognitions, although mainly geared to students' *readiness*, are dependent on the context, situation, and person, means that it is necessary to provide teachers with as much differentiated support as possible. Supporting

teachers close to their practice, for example by means of SRIs, allows existing interactive cognitions to be explored (further) and then compared with other options in order to differentiate between different types of teacher-student interactions.

Second, this study provides evidence that DI is often practiced in schools already. This DI seems to be mainly convergent DI. Not all situations require convergent DI and so it may be worthwhile to help teachers to become more familiar with divergent DI, which they could then use to facilitate students to exceed their own expectations. To do this it is important to support teachers by offering them methods they can use to help their students to reach their own ZPD (Subban, 2006).

The method we chose, SRIs with video clips, turned out to be suitable for exploring the variety of teachers' interactive cognitions (McAlpine et al., 2006; Meijer et al., 2002). The method could also serve as a training instrument for supporting teachers as they implement DI. A coach or trainer could, for instance, use SRIs to help teachers who want to implement DI to explicate their interactive cognitions relating to DI, as described by Van Veen and Janssen (2016). It makes teachers more aware of what is going on in their heads while they are teaching and on that basis, they become able to formulate new learning objectives for themselves. Teachers can also learn from each other by exchanging and discussing their own interactive cognitions during teaching.

The way we used SRIs in our research, by selecting clips beforehand, does mean, however, that the interpretation of the action based on the interactive cognition remains the job of the observer. The teacher does not literally link the action that takes place to the reason for that action (Janssen, Westbroek, & van Driel, 2013; Van Veen & Janssen, 2016). One way to take this interpretation out of the hands of the observer is to adopt the method of using SRIs used in much research into practical knowledge (McAlpine et al., 2006; Meijer, 1999; Verloop, 1989). In these studies, the teachers were shown a recording

of the whole lesson, as explained above in the Method section. The teachers had to pause the video when they recalled an interactive cognition. The disadvantage of this method, for our research, was that it reduced the chance of interactive cognitions emerging that were specifically related to DI. Another possible method for studying teachers' interactive cognitions linked to specific actions could be a laddering interview. In this type of interview, a teacher discusses with the interviewer the goals (s)he is pursuing in a representative lesson and what actions (s)he took during the lesson to achieve those goals (Janssen, Westbroek, & van Driel, 2013). This allows goal-means hierarchies to be identified and it also produces an overview of the interactive cognitions underlying teachers' actions.

A laddering interview in combination with SRIs could be used in a professional development program. A coach or trainer could adapt the professional development to the goal-means relationships identified in the laddering interview and then support the teachers by allowing them to make situation-specific interactive cognitions explicit using SRIs (Janssen, Westbroek, & Van Driel, 2013; Janssen, Westbroek, Doyle et al., 2013; Van Veen & Janssen, 2016). This study provides evidence that teachers need differentiated support in order to further develop their use of DI. Hopefully, by working with professional development plans that are tailored to the individual and the specific situation, a contribution can be made to the effective implementation of DI.

Chapter 5

Teachers' sense-making processes during two years of an innovation aimed to differentiate instruction