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Teachers' learning and sense-making processes in the context of an innovation: a two year follow-up study

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ABSTRACT

To better align teacher learning with teachers' learning needs, teachers' sense-making of an innovation during which teachers experimented with differentiated instruction was studied during two school years. Using answers to a questionnaire, 15 teachers' sense-making processes were characterised by three types of search for meaning: assimilation, adaptation, and toleration. We further specified the teachers' sense-making through their experienced sources of ambiguity and uncertainty (limited resources and conflicting goals) and a detailed description of their personal frames of reference. We concluded that the teachers varied in their types of search for meaning during both school years, though most teachers were found to use assimilation in the second school year. Their experienced sources of ambiguity and uncertainty and their personal frames of reference, though becoming more similar to each other, still differed after two school years. A possible reason for the variety in teachers' sense-making is the freedom they had in the implementation of differentiated instruction: several teachers were positive about this from the start, others needed more support and guidance. This study hereby provides additional insight into the advantages of freedom in the implementation of an innovation, but also show the importance of proper support and guidance to ensure effective implementation.

Introduction

Teacher professional learning in the context of an innovation is influenced by its objectives and the context in which it is to be implemented (the innovation's situational demands) as well as by 'the dynamic process by which individuals and groups [of teachers] make meaning from the environments in which they operate' (März and Kelchtermans 2013, p. 15). Luttenberg, Van Veen *et al.* (2013) argue that this sense-making is an interaction between teachers' perceptions of the situational demands and their personal frames of reference. Teachers' sense-making of innovations can be seen as a process, as noted by März and Kelchtermans (2013), for teachers dynamically try to find coherence between their own personal frame of reference and the contextual factors during the course of the innovation.

This study aims to provide a better understanding of teachers' sense-making processes and how such information can be used in supporting teachers in their professional learning processes when

enacting on educational innovations. To that end, we explore the dynamic process of sense-making in the context of the innovation GUTS (an acronym for the Dutch translation of *Differentiated Challenging of Talent in School*). In GUTS, teachers of the lower grades of one secondary school were required to teach GUTS lessons that did not have to fit within the regular curriculum. Only having to adhere to several criteria, for example, planning for differentiated instruction (DI), the teachers in these lessons might perceive that they have agency to innovate and take risks (Allen and Penuel 2015). Research on DI has shown that it is an educational approach that teachers have difficulties implementing (Tomlinson *et al.* 2003, Janssen *et al.* 2016). Teachers thus have to learn how to differentiate their instruction. Especially in the case of teacher learning to differentiate instruction, it appears to be important that teachers perceive to have agency to try out different educational approaches (De Neve *et al.* 2015). On the other hand, an innovation with space to innovate and take risks can be interpreted as having too little structure, causing teachers to be confused and experience ambiguity (Schmidt and Datnow 2005). In sum, teacher learning and implementation of DI differs per teacher, since each teacher experiences and acts upon innovations (to implement DI) differently (Author *et al.* 2017). This is especially the case in a loosely structured innovation like GUTS (Schmidt and Datnow 2005, Tricarico and Yendol-Hoppey 2012, Luttenberg, Van Veen *et al.* 2013). It is therefore interesting to study teachers' sense-making processes in such a context. To characterise teachers' sense-making, we use Luttenberg, Van Veen *et al.*'s (2013) types of search for meaning combined with a typification of the sources of ambiguity and uncertainty the participating teachers experienced throughout the innovation (Allen and Penuel 2015). We aim to get a comprehensive understanding of the dynamic process of teachers' sense-making and thus study the teachers at two points in time, each one year apart (März and Kelchtermans 2013). This leads to the following research questions: *How can teachers' sense-making of an innovation to differentiate instruction be typified in terms of type of search for meaning and sources of ambiguity and uncertainty? How does this sense-making change over two school years?* These insights can contribute to a more aligned professional development program for teachers.

Theoretical framework

Educational innovations and teacher professional learning

In most studies on DI, its implementation is dealt with as an educational innovation (e.g. Smit and Humpert 2012, Puzio *et al.* 2015). Previous studies on educational innovations have shown that their implementation does not come easily. Often the implemented innovation is not exactly as it was intended to be (Author *et al.* 2010, März and Kelchtermans 2013). Most of these educational innovations were designed with the goal of increasing student achievement, motivation or other learning outcomes, but lacked an explicit and elaborated theory of improvement (Wayne *et al.* 2008, Author *et al.* 2010).

Teachers are at the centre of educational change (Schmidt and Datnow 2005). In many cases of educational innovation, teachers are expected to take innovations as these are offered by the school or government and implement them as intended (Luttenberg, Van Veen *et al.* 2013). However, when teachers are confronted with an innovation requiring them to change their practices, a learning process is set in motion (Vandenberghe 1984, Shirrell *et al.* 2019). Since teachers differ, their learning will, too (Clarke and Hollingsworth 2002, März and Kelchtermans 2013, Luttenberg, Imants *et al.* 2013, Author *et al.* 2017): the schools in which they work have an influence, as does their prior knowledge which in turn influences how they perceive their environment (school) and interpret innovations (Spillane *et al.* 2002, Allen and Penuel 2015). Teachers' emotions play a role in the learning process, especially when it comes to teachers' own classroom practices (Schmidt and Datnow 2005, Van Veen and Lasky 2005, Ketelaar *et al.* 2012). Also, their beliefs form the foundations of their interpretations of good teaching, how to achieve it and of a professional development program or educational innovation (Clarke and Hollingsworth 2002, Brighton 2003,

Turner *et al.* 2009, Shirrell *et al.* 2019). It is therefore that in educational innovations, the influence of the teacher on how the innovation is enacted and how the teacher learns cannot be separated from each other (Author *et al.* 2017). Consequentially, innovations often turn out differently than intended by the developers of the innovations (Author *et al.* 2010). Especially when innovation designs are less structured and specific, implementation is diverse (Schmidt and Datnow 2005). In other words, there is an interaction between the situational demands of the innovation (characteristics of context in combination with characteristics of the innovation) on the one hand, and teachers' dynamic processes of sense-making of the innovation, on the other hand (März and Kelchtermans 2013, Luttenberg, Van Veen *et al.* 2013). In turn, this interaction influences teachers' professional learning and therefore has consequences how best to support these learning processes.

Teachers' sense-making

In this study, teachers' sense-making is defined as the interaction between teachers' personal frames of reference and their perceptions of the situational demands (Spillane *et al.* 2002, Ketelaar *et al.* 2012, Luttenberg, Van Veen *et al.* 2013). The teachers' personal frames of reference consist of current practices, prior knowledge, beliefs, and other characteristics that influence how they perceive and interpret the world around them (Spillane *et al.* 2002, Allen and Penuel 2015). For example, teachers' beliefs about how students should be taught or their ideas on how to practice DI influence how they will perceive an innovation that is aimed at stimulating student talent development through DI. The situational demands are the external expectations that are placed on teachers coming from policy, school, an innovation, etcetera (März and Kelchtermans 2013). Although these demands can be considered objective, teachers will perceive them in their own way. Consequently, when studying sense-making, both the objective situational demands and the teachers' *perceptions* of these demands are important elements for understanding teachers' sense-making processes.

Studies on sense-making describe and classify in different ways the processes teachers go through when they are confronted with (new) situational demands in a structural manner. Luttenberg, Van Veen *et al.* (2013) describe the sense-making process as different types of search for meaning: (a) *assimilation*, there is a match between the personal frame of reference and the perceptions of the situational demands, and the teacher fits the innovation within the personal frame of reference; (b) *accommodation*, there is a match between the personal frame of reference and the perceptions of the situational demands, and the teacher fits the personal frame of reference within the innovation; (c) *toleration*, there is a mismatch between the personal frame of reference and the situational demands, but the teacher acts towards the innovation while maintaining the personal frame of reference; or (d) *distantiation*, there is a mismatch between the personal frame of reference and the situational demands, but the teacher acts towards the personal frame of reference and discards the innovation.

In their study, Allen and Penuel (2015) analysed teachers' interviews for the sources of ambiguity and uncertainty they experienced in order to describe the sense-making processes they went through. This method stems from the idea that sense-making occurs when teachers go through 'crises' because they experience ambiguity and uncertainty (Weick *et al.* 2005, Allen and Penuel 2015). Sense-making is then a way to resolve or deal with these ambiguities and uncertainties (Weick *et al.* 2005). Sources of this ambiguity and uncertainty can include conflicting goals, limited resources, and role ambivalence (Allen and Penuel 2015).

The dynamic process of sense-making in a professional learning process

Teachers' sense-making processes can have a large influence on the implementation of innovations. For example, when a teacher experiences limited access to resources, and searches for meaning through assimilation, an adjustment of the teaching practices might occur in terms of minor variations to what the teacher already knows and does, rather than a significantly different way of teaching (Spillane *et al.* 2002). The innovation thus will be implemented in an adapted

form, or the school (or other stakeholders) will decide to adapt the innovation because of the outcomes of teachers' sense-making processes. These processes will then be influenced by new innovations or by colleagues adapting the innovation differently (Spillane *et al.* 2002, Ketelaar *et al.* 2012, März and Kelchtermans 2013). From a professional learning perspective, this requires that teachers should be provided with relevant and high-quality resources to assist them in enacting on their agency and innovating their teaching practices (Author *et al.*). These recurrent effects of the sense-making process show that teachers' sense-making is not only a complex, but also a dynamic process that should be taken into account when studying teacher learning (Ketelaar *et al.* 2012).

In this study, we focus on the process of sense-making, and particularly on its dynamic element. More specifically, we examine differences in how individual teachers make sense of an innovation at different points in time.

Differentiated instruction

Teachers who differentiate their instruction aim to proactively take their students' individual learning needs into account in the process, product, and content of their teaching (Tomlinson *et al.* 2003, De Neve *et al.* 2015, Deunk *et al.* 2015). Much research has already been done into the effectiveness of DI on student learning (e.g., Deunk *et al.* 2015), teachers' perceptions and practices of DI (e.g., Brighton 2003), and how they can incorporate it into their practice (e.g., Tomlinson *et al.* 2008). DI appears to be beneficial for students' achievement, motivation, and engagement (Graham *et al.* 2008, Deunk *et al.* 2015), but many problems have been described in the literature regarding the incorporation of DI into practice (Tomlinson *et al.* 2003, Hertberg-Davis and Brighton 2006, Smit and Humpert 2012, Janssen *et al.* 2016). Teachers may not view DI as a challenge to innovate their teaching, but rather as a burden (Smit and Humpert 2012). Contextual factors like support during the implementation of DI are of great importance (Hertberg-Davis and Brighton 2006). As a result of the teachers' experienced problems with the implementation of DI, certain DI practices remain an add-on in many cases, instead of a fully implemented pedagogical approach (Smit and Humpert 2012).

Method

Context: the innovation GUTS

This study took place within the second and third year of the innovation GUTS. In GUTS teachers designed and taught GUTS lessons to stimulate differentiated student talent development and thereby increase the students' motivation and achievement. Per semester, each student nominated the subject (s)he preferred to explore further during GUTS. The lessons had to meet four criteria: (1) they had to provide *enrichment* for the students in addition to their regular subject-matter; (2) students should be able to experience *autonomy*; (3) *higher order learning*, with regard to Bloom's taxonomy, had to be stimulated; and (4) the teachers should *differentiate* their instruction and take differences between students into account within the lessons. Apart from these criteria, teachers were free in the specificities of the content and pedagogy of these lessons, they got to design those themselves.

GUTS was implemented in the lower grades of one secondary school in the Netherlands in cooperation between researchers from the university and a group of administrators and teachers in the school. During the whole course of the implementation process – from 2013–2014 to 2015–2016 – both teams met regularly to discuss the innovation and what changes to make for the next year. Table 1 provides an overview of the characteristics of the innovation in each of the three school years.

Table 1. Details of GUTS and its main differences throughout the school years.

School year	Grades involved	Details of GUTS
2013–2014	7	10 GUTS lessons through the year in three subjects (two in subject 1, four in subject 2, four in subject 3). Lessons took place on Wednesday afternoons between November and June at the end of the school day and lasted 100 minutes.
2014–2015	7, 8	8 GUTS lessons per semester, a different subject each semester: thus, more time per subject. Times of the lessons alternated. Several regular lessons had to be cancelled to free up time for the GUTS lessons. Again, lessons lasted 100 minutes. In the second semester, classes combined students from 1st and 2nd grades.
2015–2016	7, 8, 9	GUTS lessons for 7 and 8 as in 2014–2015. The GUTS lessons had their own place in the schedule and regular lessons no longer had to be cancelled. Again, the moment in the day alternated. 9th grade did not follow GUTS lessons, but carried out a personal project.

The personal project of the 9th grade is not explained in detail, as this and teachers' participation in that was beyond the scope of this study.

Participants

In this study, 15 teachers (seven males) from the cooperating school participated voluntarily. All teachers from the lower grades of the school who took part in the educational innovation received the questionnaire. The teachers were free to decide whether they would fill out the questionnaire; no consequences were attached for not completing the questionnaire.

Teaching experience among these teachers ranged from two to 28 years. Table 2 provides an overview of the different teachers (names are pseudonyms) and their subjects.

Instruments

In most of the studies focused on sense-making, retrospective interviews were carried out, in which teachers were requested to explicate their sense-making (Weick *et al.* 2005, Luttenberg, Van Veen *et al.* 2013). In this study, to make sure all teachers were asked the same questions and to decrease the chances of getting socially desirable answers, a questionnaire was developed (Ballou 2008). At first, we developed a questionnaire in a closed question format (multiple choice) in combination with boxes where the teachers were invited to explain their choice, to investigate teachers' DI and general teaching beliefs. This questionnaire was piloted amongst the participating teachers. When reviewing the data we collected in this pilot, it appeared especially from the extra boxes for further explanation that the teachers often did not understand the closed questions as intended. We used this information to develop a new, more open questionnaire. This second questionnaire is the one used in this study. In this questionnaire, the teachers had to respond to five open-ended questions (see Table 3). We used a direct approach asking teachers how they understood differentiated student talent development, and what they thought of GUTS as an innovation to this. Questions on differentiated instruction were designed based on the review article by Tomlinson *et al.* (2003).

Table 2. Descriptives of the participating teachers.

Subject	Teacher (sex)
English language	Sarah (f), Helga (f), Gideon (m)
Dutch language	Rita (f), Frank (m)
Chinese language	Nicole (f)
German language	Quint (m)
Spanish language	Julia (f)
French language, Drama	Irma (f)
Art & Design, Art History	Paula (f), Mark (m)
PE	Leon (m)
Mathematics	Alex (m)
Biology	Kate (f)
History	Otto (m)

Table 3. Concepts, variables and questions in the questionnaire.

Concept	Variable	Questions
Perception of situational demands	Attitude to GUTS	What do you think of GUTS until now? Please elaborate in a few sentences.
Personal frame of reference	Perception of differentiated student talent development	What is, according to you, differentiated student talent development?
		As a teacher, how can you stimulate each students' talent development?
	Practice of DI	When planning your lessons, do you plan (how) to differentiate your lessons? If so, could you elaborate to what extent you plan your differentiation?
		What student characteristics do you take into account when differentiating instruction? (for example readiness, interest, learning profile)

The questions were open-ended, to provide teachers an opportunity to elaborate as much as they wanted and in their own words (Roulston 2008). The teachers' attitudes to the innovation were considered to represent their perceptions of the situational demands (Table 3), as these include both teachers' opinions of the innovation and what they perceive the innovation to be. The teachers' perceptions and practices were together considered to be their personal frames of reference, in line with Spillane *et al.*'s (2002) description of the teachers' personal frames of reference.

Procedure

In both school years, the questionnaire was administered digitally and on paper halfway through the first semester, around the same time the first GUTS lesson of the year took place. The teachers first received an invitation to fill in the questionnaire digitally; if they did not respond or if they said they had lost the link to the digital questionnaire, they received the questionnaire on paper.

Data coding

To explore the teachers' sense-making, their perceptions of the situational demands were coded according to how they felt about GUTS and the sources of ambiguity and uncertainty they experienced (Allen and Penuel 2015). These codes were used to compare teachers' perceptions of the situational demands with their personal frames of reference to characterise their types of search for meaning per school year (Luttenberg, Van Veen *et al.* 2013, Allen and Penuel 2015). The teachers' personal frames of reference were also coded to further specify their sense-making.

Teachers' perceptions of the situational demands

Teachers' attitudes to GUTS – a measure of their perceptions of the situational demands – were coded for how they felt about the project (positive, ambivalent, or negative). If teachers felt positive about GUTS, they were considered to experience no sources of ambiguity and uncertainty. However, if they were ambivalent or expressed negative feelings, the explanations for those feelings were labelled as their sources of ambiguity (Allen and Penuel 2015). These explanations were further categorised in *limited resources* and *conflicting goals*. When teachers mentioned having limited access to (proper) resources and time, the source of their ambiguity was *limited resources*. When teachers said they did not think GUTS was executed correctly according to their perceptions of differentiated student talent development, this was typified as a *conflicting goal*.

Teachers' personal frames of reference

The teachers' personal frames of reference were retrieved from their perceptions of differentiated student talent development and their practices of DI. We first coded the answers to both questions

on teachers' perceptions of differentiated student talent development. The answers were coded for mentioning the four criteria of a GUTS lesson (*enrichment, autonomy, higher order learning*, and *differentiated instruction*), and whether the teacher considered talent development as situated *within* a school subject or to occur *regardless of* school subject.

Next, the practices of DI were coded. We considered DI to be the main approach with which differentiated student development could be stimulated, and this was also communicated to the teachers. The answers to the two questions on their practices were coded for *convergent* or *divergent* DI (if we could distinguish one of the two types of DI from their answers). Teachers' practices were coded as *convergent* if they mentioned main lesson goals that all students should accomplish (Bosker and Doolaard 2009). If a teacher mentioned having extra assignments for weak and/or strong students, this was not valued as having students achieve different goals. *Divergent* DI was coded if a teacher mentioned helping every student achieve as much as possible (Bosker and Doolaard 2009).

Data analysis

Types of search for meaning

Teachers' perceptions of situational demands were then compared with their personal frames of reference, and it was determined whether their personal frames of reference or their perceptions of the situational demands of the innovation were more dominant. Table 4 provides explanations of when we thought a teacher's type of search for meaning could be characterised as *assimilation, accommodation*, or *toleration*. In this study, *distantiation* was not considered a type of search for meaning.

Teachers' sense-making processes

After all data for both school years were coded and analysed, both cross- and within-case analyses were made across the school years. The aim of these analyses was to explore whether teachers' sense-making changed between 2014 and 2015 and how this happened for the individual teachers. In addition, we compared the changes in teachers' sense-making with the changes that were made to GUTS.

The quality of the analyses was ensured by inviting an independent coder, a researcher familiar with research into DI, to code five teachers, and afterwards discussing the results. In this discussion, the coding scheme as well as the coding process was discussed and agreement was reached on several minor adjustments of the scheme and process.

Table 4. Types of search for meaning as described by Luttenberg, Van Veen *et al.* (2013) and the applied definitions in this study.

Type of search for meaning	Description
Assimilation	There is a match between teachers' perceptions of GUTS and their personal frames of reference regarding differentiated student talent development. Also, they are positive or ambivalent towards GUTS, but mainly stay true to their own frame of reference. (Most teachers who felt ambivalent and were placed in this category had *limited resources* as source of ambiguity.)
Accommodation	There is a match between teachers' perceptions of GUTS and their personal frames of reference regarding differentiated student talent development. However, they feel somewhat ambivalent or negative towards GUTS and feel they have to adapt their personal frames of reference to the situational demands of GUTS. (Most teachers who felt ambivalent and were placed in this category, had *conflicting goals* as source of ambiguity; teachers who felt negative and were placed in this category, had *limited resources* as source of ambiguity.)
Toleration	Teachers are ambivalent or negative towards GUTS when they have to do something during GUTS that is different from what they want to do (in total or within GUTS). (Teachers who felt ambivalent were positive about the idea behind GUTS, but had *conflicting goals* and *limited resources* as sources of ambiguity; teachers who felt negative and were placed in this category were negative about the idea behind the innovation, and had *conflicting goals* and perhaps 'limited resources' as source(s) of ambiguity.)
Distantiation	Not used in this study. Teachers had to teach GUTS lessons and could not simply give a regular lesson if they distanced themselves from the innovation. In addition, if teachers did decide to organise their GUTS lessons so that they would be very similar to their regular lessons, this would not be clear from the questionnaires.

Results

Teachers' search for meaning and sources of ambiguity

Fall 2014

Table 5 shows the results regarding the teachers' sense-making as typified by their search for meaning, the sources of ambiguity and uncertainty they experienced and personal frames of reference in 2014. The table shows that seven teachers' types of search for meaning could be characterised as *assimilation*. Three of those teachers experienced no sources of uncertainty and ambiguity and three experienced *limited resources*. Only Mark appeared to have *conflicting goals* as a source of ambiguity. Mark was mainly very pleased with GUTS and seemed to be able to do as he liked, but he made the following remark regarding the goals of the intervention: 'I really enjoy doing GUTS, but especially with [pre-university students] or kids that (…) really like my subjects'.

Four teachers were assigned to *accommodation* as type of searching for meaning. These teachers experienced either *conflicting goals* and *limited resources*, or only *conflicting goals* as sources of ambiguity. They thus experienced such differences between their own frame of reference regarding how GUTS should be executed and the situational demands that they adjusted their frame of reference to what was expected of them in GUTS. Irma (*limited resources* and *conflicting goals*) said: '[It is] not clear enough what is expected from us (teachers) and kids. (…) Why [is it] not reward[ed] with a grade? But [it is] also a lot of fun!' Thus, Irma did what was expected of her and enjoyed teaching the GUTS lessons, but she perceived that one of GUTS' goals (transfer of motivation to regular lessons) conflicted with one of her own (reward students with grades). In addition, she experienced to lack the proper resources at her disposal to receive guidance in what was expected of her (and her students).

Finally, the four teachers who could be typified as using *toleration* as type of search for meaning in 2014, had *conflicting goals* as source of ambiguity and uncertainty. They participated within GUTS as was expected of them, but their goals for GUTS differed from the actual goals of GUTS. Quint explained this as follows: 'The development of talent is focused on "school subjects". (…) in my opinion, other factors like getting an idea of your underlying competences, play an important role in developing and using your talent'. Quint participated in GUTS as was expected of him, but appeared to maintain his own personal frame of reference.

Fall 2015

Table 6 provides the results for the teachers' sense-making in 2015. In the school year 2014–2015 GUTS was embedded within the daily schedule replacing regular lessons. In 2015–2016 the school stopped replacing regular lessons with GUTS, thus embedding GUTS lessons within the regular timetable.

What stands out in Table 6 is that in 2015 most teachers (n = 10) could be characterised as using *assimilation* as type of search for meaning in GUTS. Also, within *assimilation*, more teachers (n = 3) experienced *conflicting goals*. These three teachers said they liked the project, but still had some reservations. For example, Sarah stated: 'A nice addition but (…), what I am concerned about most is that I often hear (…) [is that] it is an extra addition to their workload'. Especially interesting in this category are Kate, Quint, and Alex, whose types of search for meaning were labelled with *toleration* the year before. These teachers' changes in type of search for meaning might be related to the changes that were made to GUTS. Those changes were made because the school and team of researchers felt that GUTS needed to fit better within the school.

Three teachers' types of search for meaning within GUTS could be typified as *accommodation*, and they experienced *conflicting goals* as a source of ambiguity and uncertainty. Two of them (Gideon and Nicole) could be characterised with *assimilation* the year before, and either experienced no sources of ambiguity (Gideon) or experienced *limited resources* (Nicole). In 2015, both searched for meaning through *accommodation* and experienced *conflicting goals*. Nicole's response when asked what she thought about GUTS: '(…) I think it would be best if the students do not get extra lessons as an extra challenge, but have to do something outside the classroom'.

Table 5. Teachers' sense-making by type of search for meaning and source of ambiguity in 2014.

2014 Type of search for meaning	Perceptions of the situational demands: Source of ambiguity			
	None	Limited resources	Conflicting goals	Both
Assimilation	Otto – Divergent DI, providing autonomy, and higher order learning regardless of subject Gideon – DI, providing autonomy, and higher order learning within subject Paula – Convergent DI, within subject	Nicole – Convergent DI, and enrichment within subject Sarah – Convergent DI within subject Rita – DI within subject	Mark – Convergent teaching, and enrichment within subject	
Accommodation			Julia – DI, and enrichment within subject Helga – Convergent DI within subject	Irma – Convergent DI
Toleration			Frank – Convergent DI, and providing autonomy within subject Kate – Convergent DI within subject Quint – Convergent DI, and enrichment regardless of subject Alex – Convergent DI regardless of subject	Leon – DI within subject

Table 6. Teachers' sense-making by type of search for meaning and source of ambiguity in 2015.

| 2015 Type of search for meaning | Perceptions of the situational demands: Source of ambiguity | | |
	None	Limited resources	Conflicting goals	Both
Assimilation	**Otto** – Divergent DI, providing autonomy, and higher order learning regardless of subject *Mark – DI, and providing autonomy within subject*	**Rita** – DI, and providing autonomy within subject *Paula – DI, and providing autonomy within subject* Leon –DI within subject *Helga – Convergent DI, and providing autonomy within subject* Kate – DI within subject	*Sarah – Convergent DI, and providing autonomy within subject* Quint – Convergent DI, and enrichment regardless of subject **Alex** – Convergent DI within subject	
Accommodation			*Nicole –Convergent DI within subject* *Gideon –Divergent DI, providing autonomy, and higher order learning within subject* Irma – Divergent DI	
Toleration			**Frank** – Convergent DI within subject	*Julia –Divergent DI, providing autonomy and enrichment, regardless of subject*

Italics indicate differences in the teachers' source of ambiguity between 2014 and 2015; Underlines indicate differences in the teachers' type of search for meaning between 2014 and 2015.

The number of teachers assigned to *toleration* as type of search for meaning fell from four in 2014 to two in 2015. Only Frank was assigned to *toleration* in both years. His sense-making remained largely the same. He continued to believe that the goals he held for differentiated student development conflicted with the goals of GUTS: 'I don't think GUTS makes students get better grades. Many students see GUTS as something [obligatory] …' Julia, the other teacher assigned to *toleration* in 2015, not only experienced *conflicting goals*, but also *limited resources*:

> "I think (…) the real challenge is not there, because GUTS is mandatory for everyone. (…)Secondly, the way it is going now, students get sorted into subjects of their second or even their third choice. This is not stimulating, nor motivating. (…)."

Teachers' sense-making

We aimed initially to characterise teachers' sense-making through their types of search for meaning and their experienced sources of uncertainty and ambiguity (see: *Introduction*). However, when reviewing the teachers' personal frames of reference in more detail, we noticed that teachers with identical types of search for meaning (and experienced sources of ambiguity) still differed from each other. During the analysis of teachers' perceptions of the situational demands (i.e., related to the question 'What do you think of GUTS until now?'), we noticed that their responses also held information about what they thought the innovation, or differentiated student talent development, *should* be. The question 'What is, according to you, differentiated student talent development?', was initially aimed at measuring teachers' perceptions of differentiated student talent development. In addition, the answers to this latter question were not always consistent with the answers to the first question. In other words, for some of the teachers their thoughts about what differentiated student development *should* be did not coincide with their perceptions of differentiated student talent development. Julia, for example, explained differentiated student talent development to be exactly what is aimed for in GUTS: 'Providing students with a talent for a specific subject an opportunity to further develop their talent, knowledge and practices for that subject further. Students should largely be responsible for the design of their learning process and determining their goals'. However, as can also be seen at the end of the previous section, she perceives that participating in GUTS should be a reward for performing well in the subject, rather than a place to follow your interest.

Thus, when analysing the teachers' types of search for meaning, we tried to take teachers' perceptions of differentiated student talent development as well as what they perceived that differentiated student talent development *should* be into account. Teachers' personal frames of reference were used to understand their sense making into further detail, as depicted in Tables 5 and 6. This analysis showed that even teachers with identical types of search for meaning and who experienced the same sources of ambiguity and uncertainty, differed in their sense-making.

A first glance at Tables 5 and 6, shows that all teachers, except Mark in 2014 (his personal frame of reference holds *convergent teaching* and *enrichment*), saw DI as an important way of stimulating differentiated student talent development. Furthermore, all teachers' personal frameworks held some connection to the criteria for GUTS (*autonomy, higher-order learning, enrichment*, and *DI*). However, very few teachers formulated their perception of differentiated student talent development as holding all four criteria for GUTS. In 2014, the two teachers' personal frames of reference that held the most GUTS criteria (three out of four) were Otto's and Gideon's, who were both assigned to *assimilation* as type of search for meaning, without sources of uncertainty and ambiguity. However, in 2015, this similarity with the criteria appeared to be irrelevant to how Gideon made sense of GUTS: he had *accommodation* as type of search for meaning and experienced *conflicting goals*.

Table 5 also shows that three teachers viewed differentiated student talent development as something that should focus first and foremost on the student. These teachers explained that as a teacher you should first look at where the student's talents lie and then at how you (the teacher) can adapt your teaching of the subject matter to that talent. This is opposed to the views of most teachers who believe that talent development is situated *within* the subject: thus, that as a teacher

you should figure out what the student's talents within the subject are and aim to develop those further. These three teachers can be found in *assimilation-none* (Otto) and *toleration-conflicting goals* (Quint and Alex). This perception in theory conflicts with one of the criteria for GUTS and how GUTS is set up, as it is situated *within* subjects. Otto did not see this as a problem, apparently: 'I totally love it. I have seen faces light up when I explain that (…) they can take the lead in direction, purpose, enjoyment and presentation'. In 2015 Quint and Alex moved to searching for meaning through *assimilation-conflicting goals*. For Quint, it seems that although he fitted best in *assimilation* in 2015, he apparently still held perceptions that were somewhat similar to those he held in 2014 regarding GUTS: '(…) Every round, GUTS is getting closer to its goal. It provides us space to experiment with other pedagogical approaches'.

Comparing Table 6 with Table 5, teachers still seem to be scattered across types of search for meaning and sources of uncertainty and ambiguity. Teachers with similar frames of reference made sense of GUTS in different ways, through different types of search for meaning and with different sources of ambiguity. However, in 2015 many teachers (n = 5) appear to have added *providing autonomy* to their perceptions of differentiated student talent development. This broadening of their personal frames of reference seems to have occurred especially among teachers who used *assimilation* as type of search for meaning. All these teachers, except Helga, also used *assimilation* as type of search for meaning in the previous year. Julia also added *providing autonomy* to her personal frame of reference and changed in her type of search for meaning; however, this change was from *accommodation* to *toleration*. Another change in Julia's personal frame of reference could be found in her point of view regarding stimulating differentiated student talent development. Although in 2014 Julia thought that differentiated student talent development was situated *within* subjects, in 2015 she perceived it to be a development that should be *regardless of* subject.

In sum, it is clear that teachers with similar personal frames of reference make sense of GUTS in different ways: for example, some through *assimilation* with no sources of ambiguity, others through *accommodation* with *limited resources* and *conflicting goals* as sources of ambiguity. In 2015 most teachers seemed to have changed in their process of sense-making. Most teachers used *assimilation* as type of search for meaning, though their sources of ambiguity still differed.

Conclusion and discussion

In this study, we aimed to answer the following questions: *How do teachers make sense of an innovation to differentiate instruction in terms of type of search for meaning and sources of ambiguity and uncertainty? How does this sense-making process change over two school years?* After exploring 15 teachers' personal frames of reference and their attitudes towards the innovation GUTS in two school years, we found that teachers make sense of this minimally structured innovation in very different ways. This is in line with previous studies on teacher sense-making, educational innovations, and teacher professional learning (Author *et al.* 2010, 2017, Ketelaar *et al.* 2012, Luttenberg, Van Veen *et al.* 2013, Kennedy 2019). Schmidt and Datnow (2005) concluded that teachers' sense-making shows greater diversity in less structured reforms than in more structured reforms. Literature on educational innovations and professional development has found that educational innovations often have a variety of outcomes when a clear theory of improvement is lacking (Wayne *et al.* 2008, Author *et al.* 2010). GUTS did not have a distinct theory of improvement: several criteria were described which, if implemented by the teachers, were supposed to help students develop their talents, but what specifically had to change in teachers' practice was not made explicit (Wayne *et al.* 2008, Author *et al.* 2010).

Teachers' sense-making in this study was defined using types of search for meaning (Luttenberg, Van Veen *et al.* 2013), which were further specified through the sources of ambiguity and uncertainty (Allen and Penuel 2015) they experienced and their personal frames of reference. In order to come to these classifications, teachers' personal frames of reference with regard to differentiated student talent development (perceptions and self-reported practices) were combined with their perceptions of the situational demands

(attitudes towards GUTS). In this study, like in previous studies, it appeared that teachers' sense-making is a complex process (März and Kelchtermans 2013, Luttenberg, Imants *et al.* 2013). The complexity of this process became especially apparent during the analysis of the teachers' perceptions of the situational demands. These perceptions appeared to also hold perceptions of what the teachers thought differentiated talent development *should* be. For some teachers, these perceptions differed from what we found in their personal frames of reference, when we explicitly asked for their perception of differentiated student talent development. Thus, when we analysed the teachers' types of search for meaning, we found that the teachers' personal frames of reference could be context-dependent: when teachers are explicitly questioned about their personal frames of reference they might answer from their idea of how regular, everyday classroom practice looks, but when they were asked about their experiences with an innovation, they seemed to perceive the concept central to that innovation differently (Spillane *et al.* 2002). We would therefore argue that when exploring the teachers' types of search for meaning it should be taken into account that teachers might hold more than one personal frame of reference at the same time, which might depend on the question asked: what their perceptions are, or what their experiences are.

We therefore conclude that in the context of an innovation that is added to the regular curriculum, teachers' sense-making cannot be defined by merely categorising their types of search for meaning. In this study, we saw that teachers' sense-making could change over time and that a number of variables, like the context from which teachers reasoned, seemed to be involved in influencing their sense-making processes (Spillane *et al.* 2002).

Sense-making as a dynamic process through type of search for meaning

Considering the diversity of teachers' sense-making of GUTS, it appeared in this study that their sense-making became more similar as time passed and the innovation changed. Some changes to the innovation were also made to make sure there was a better fit between GUTS and what the teachers said they would prefer to do in GUTS. This adds to the literature explaining teachers' sense-making as a dynamic process (März and Kelchtermans 2013). Specifically, in the second year of data collection, most teachers were similar in their sense-making, which was typified as *assimilation*. According to Spillane *et al.* (2002) it is possible that this greater similarity in the sense-making of teachers shows an advance in the level of implementation of GUTS. That the number of teachers grouped under *toleration* also decreased seems to be in accordance with Luttenberg, Imants *et al.*'s (2013) conclusion. They stated that coherence between the different aspects of teachers' work is achieved as they participate in the process of an innovation, rather than a given at the start of the innovation. It should be noted, however, that even though more similarity was observed regarding type of search for meaning, the teachers still experienced different sources of ambiguity. Teachers thus made sense of GUTS in their own, unique, ways.

Sense-making through sources of ambiguity

GUTS appeared to be an interesting context for exploring teachers' sense making. In the GUTS lessons teachers had space to take risks to differentiate and innovate in ways they often feel they are not able to, because teaching in the regular curriculum restricts them to certain routines (Allen and Penuel 2015, De Neve *et al.* 2015). But, this freedom in the specific design of a GUTS lesson might have left some teachers confused, because they felt that not enough structure was provided (Schmidt and Datnow 2005). The teachers who experienced *limited resources* as the source of their ambiguity mentioned a high workload, or not being properly equipped. Thus, teachers need additional guidance and support to learn how to participate in such a lightly structured innovation (Schmidt and Datnow 2005). An example of such support is that from a school leader who is supportive of changes towards more DI (Hertberg-Davis and Brighton 2006, Ketelaar *et al.* 2012). The school leader could also support collaboration between teachers, possibly in the form of mentoring, a professional development method that, compared to other more formal, more rigid and high-cost alternatives appears to be very effective (De Neve *et al.* 2015, Papay *et al.* 2016, Kennedy 2019).

Teachers' personal frames of reference

Teachers' need for guidance within GUTS may also explain the discrepancies we found between the teachers' personal frames of reference when we explicitly asked them about their perceptions of differentiated student talent development and their frames of reference we found in their attitudes to GUTS (their context-dependent frames of reference). The teachers' personal frames of reference regarding talent development could be called narrow, as they often contained only two of the four GUTS criteria. This is similar to findings by Mills *et al.* (2014), who found that in their context without specific guidelines on how to implement DI, teachers held *narrow* views of DI. However, their context-dependent frames of reference were defined more broadly. This could mean that the space teachers were given within GUTS could indeed help them to see possibilities to innovate and take risks to differentiate, and think of the best ways to help students develop their individual talents, although guidance is still needed. For that matter, not all teachers in this study considered this space sufficient, especially those with a narrower personal frame of reference. Looking at these subgroups of teachers and their sense-making processes, it appears valid to conclude that other variables apart from the teachers' perceptions, practices, and attitudes, play a role in teachers' sense-making (Spillane *et al.* 2002). We would argue that one of these variables is a teachers' starting point in their sense-making process. One group of teachers (*assimilation-none*) seemed to experience GUTS as an opportunity to innovate and was not bothered by the design criteria. Another group (*toleration-both/conflicting goals*) experienced the few criteria there were as constraining them. It is possible that this subgroup of teachers would have benefitted from more guidance and support to understand and implement this innovation.

Implications for teacher learning with regard to differentiated instruction

Based on the insights this study offered – how teachers' perceptions of a concept central to an innovation can differ across contexts, the way teachers search for meaning during an innovation becomes more similar, and the influence of the starting points of the teachers' sense-making processes – several implications for teachers' professional learning can be drawn.

From this study, we concluded that teachers need space to innovate and take risks in their daily practice, especially in the case of an innovation focused on differentiated talent development (Schmidt and Datnow 2005, Tricarico and Yendol-Hoppey 2012). However, teachers also need structure and support in their innovating endeavours. The on-demand aspect of the structure and support is important, since even in a loosely structured innovation like GUTS, teachers felt constrained by criteria that were set at the start of the innovation.

Individual teachers, similar to students in their learning processes, differ in their needs. It could be argued that differentiated professional development is thus necessary to help teachers incorporate DI in their practices, thus it would help to instruct teachers using the same approach as they are required to use when instructing students. Before starting an innovation, it may be useful to explore the teachers' type of search for meaning and experienced sources of ambiguity. This would help in getting information about whether or not, and to what extent teachers need support. To provide teachers more tailored on-demand structure and support and facilitation of working together with colleagues in, for example, professional learning communities or mentoring programs, might provide a low-cost and effective solution (Ketelaar *et al.* 2012, De Neve *et al.* 2015, Papay *et al.* 2016, Kennedy 2019).

Limitations and future research

In this study, we were not able to identify causes for the discrepancies within the teachers' personal frames of reference, nor was it our intention to do so as we did not expect to find these discrepancies. Neither did we study what this meant for the teachers. This would be an interesting subject for future research. In the literature, teachers' personal frames of reference are made up of many different variables (Spillane *et al.* 2002, Luttenberg, Imants *et al.* 2013). As mentioned above, the starting point of teachers' sense-making processes might be one of those variables that would be interesting to study

further. In addition, it is possibly the interplay of all those different variables that becomes clear when researchers explore a specific concept (differentiated student talent development): teachers may hold one broad frame of reference, but when researchers zoom in they discover other details.

Questionnaires were used to typify teachers' dynamic sense-making processes during GUTS. This method reduced the chances of getting the socially desirable responses teachers might have given in face-to-face interviews (Ballou 2008). However, using semi-structured interviews in addition to the questionnaire (at different points in time) may provide extra information on the influence of the changes made to GUTS over time on the teachers' sense-making. In addition, looking at our results, especially the discrepancies, it may be interesting to further elaborate on this topic using retrospective interviews with teachers in which they are shown their sense-making processes and asked whether they indeed feel that way and to elaborate on that. These interviews would also provide a space for teachers to explain their emotions at different points in time (Schmidt and Datnow 2005), as these also play an important role in teachers' sense-making (Ketelaar *et al.* 2012).

Finally, what we did find is that teachers' sense-making is a complex and dynamic process. This process needs further attention in research, as stated above, but also in the practice of implementing DI. These results show that it is important to give teachers space to innovate and take risks, but also guidance and support in the implementation of DI. Guidance and support needs will not be the same for all teachers, as they all have a unique way of sense making.

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