Teachers and differentiated instruction: exploring differentiation practices to address student diversity

Marcela Pozas, Verena Letzel and Christoph Schneider
University of Trier, Germany

Key words: Student diversity, differentiated instruction, teacher constructivist beliefs, large-scale data.

Introduction

Even though school systems worldwide have responded to student diversity by establishing classrooms with different levels of student ability (tracking or streaming) (Dupriez, Dumay, and Vause, 2008), large-scale data (e.g. PISA) clearly indicate that the diversity of the student population is substantial and continuously increasing (Dixon, Yssel, McConnel, et al., 2014). Students differ greatly in terms of performance, cultural background, language competence, gender-based learning preferences, learning styles, motivation, interest, self-regulatory competencies and other factors (Dijkstra, Walraven, Mooij, et al., 2016; Tomlinson, Brighton, Hertberg, et al., 2003; Wenning, 2007). As used herein, dealing with student diversity encompasses the requirements associated with inclusive education. In this line, in order to address students’ various learning needs, teachers must be able to adequately differentiate their instruction.

Differentiated instruction (DI) is a well-known and practice-proven approach that responds effectively to the diverse students’ needs (Coffey, 2011; Coubergs, Struyven, Vanthournout, et al., 2017; Hall, 2002; Landrum and McDuffie, 2010; Lawrence-Brown, 2004; Santangelo and Tomlinson, 2009; Smit and Humbert, 2012; Tomlinson, 2014; Wischer and Trautmann, 2012). Within DI research, there is evidence that supports this claim. Valiandes (2015), for example found that students in classrooms where teachers implemented DI performed better compared to those students who did not receive DI. Similarly, Reis, McCoach, Little, et al. (2011), as well as Baumgartner, Lipowski and Rush (2003) reported positive effects of DI on students’ achievement, specifically on their reading fluency and comprehension.

As the successful and effective implementation of DI relies mainly on teachers, research has focused on examining how and how frequently teachers differentiate their day-to-day instruction. Empirical research has yielded, however, mixed evidence on teachers’ reported use of DI. For instance, Moon, Callahan, Tomlinson, et al. (2002) reported that teachers rarely use DI practices in their everyday teaching. Similarly, Smit and Humbert (2012) indicated that teachers occasionally make use of DI practices. Moreover, their findings also indicate that teachers show rather low variance in their use of DI practices as they substantially differentiate by tiering activities or implementing flexible grouping. In contrast, Roy, Guay and Valois (2013) reported a moderate usage of DI practices, whereas Prast, van de Weijer-Bergsma, Kroesbergen, et al. (2015) indicated a higher implementation rate.

Given the mixed state of evidence, there is still a clear need to explore in detail how teachers differentiate their instruction, particularly from large-scale studies on DI (Graham, Morphy, Harris, et al., 2008; Prast, van de Weijer-Bergsma, Kroesbergen, et al., 2018; Ritzema, Deunk, and Bosker, 2016). In addition, research must take into account the potential effects of context factors (e.g. school subject) on teachers’ DI application (see Prast, van de Weijer-Bergsma, Kroesbergen, et al., 2015; Ritzema,
Therefore, this study aims to explore secondary school teachers’ implementation of DI practices using large-scale data from the National Educational Panel Study (NEPS). The NEPS is a longitudinal study on education conducted nationally in Germany that follows a multi-cohort sequence design with the aim to examine educational processes and outcomes in different developmental stages of life (Blossfeld, Roßbach, and von Maurice, 2011). Specifically, this study examines secondary teachers’ use of distinct DI practices in German (as native language) and Mathematics lessons across school tracks, and further explores whether the implementation of these practices are influenced by teachers’ constructivist beliefs.

For the purpose of this study, DI is conceptualised as a toolbox of instructional practices, which enables teachers to appropriately cater to students’ specific learning requirements and ensure successful learning for all students within a diverse and inclusive classroom. The following section will briefly discuss the current state of literature on DI in order to clarify the conceptualisation chosen for this study. Afterwards, it will elaborate on the taxonomy of DI practices (Pozas and Schneider, 2019) that guides this paper.

A taxonomy of DI practices

Worldwide, literature and research has acknowledged DI as a set of effective instructional practice (Chamberlin and Powers, 2010; Lawrence-Brown, 2004; Tomlinson, Brighton, Hertberg, et al., 2003). Given the importance of DI, a number of well-established models have been proposed (e.g. Hall, 2002; Lawrence-Brown, 2004; Tomlinson, 2014) varying in terms of their structure, elements and preconditions for differentiation (for a comprehensive discussion of these models please refer to Pozas and Schneider (2019). In spite of the extensive literature and models on the topic, however, there is still no theoretical agreement on the conceptualisation of DI (Jennek, Gronostaj, and Vock, 2019; Roy, Guay and Valosi, 2013). In return, the term DI has been used as a one-dimensional construct of single practices such as learning centres, small-group interaction and tiered activities (e.g. Coffey, 2011; Latz and Adams, 2011; Levy, 2008; McTighe and Brown, 2005; Santangelo and Tomlinson, 2009). Consequently, this one-dimensional approach hinders the possibility of testing the effectiveness of unique DI practices for addressing in-classroom student heterogeneity (Valiandes and Koutselini, 2009).

Additionally, within the literature on DI, there is a large variety of instructional practices that teachers can make use of in order to address diversity within a classroom. However, teachers’ implementation of DI in their daily teaching practice remains critical (Suprayogi, Valcke, and Godwin, 2017). It seems that many teachers either feel overwhelmed by the vast amount of possible practices at hand (Reis, McCoach, Little, et al., 2011), report feeling unprepared by their teacher training to effectively use DI (Idol, 2006), or simply have a lack of understanding of DI (Whipple, 2012). As a result, it is likely that teachers end up selecting single practices on an arbitrary basis without critical reflection of its practical implications and, thus, with suboptimal outcomes.

These barriers inherently limit the effective implementation of DI and call for a systematisation of the DI construct and a categorisation of the possible instructional practices applied to address the broad array of student differences. To this aim, and in order to facilitate secondary school education teachers’ instructional decisions, Pozas and Schneider (2019) propose a taxonomy of DI practices attempting to bridge the gap between educational theory and everyday instructional practice. The taxonomy is framed within the current DI literature and research and builds on existing literature by providing teachers with practical and concrete advice on how to design and differentiate their instruction to successfully address classroom diversity. The taxonomy of DI practices is divided into six categories:

1. Tiered assignments: qualitative and/or quantitative variation of materials and tasks according to challenge level, complexity, outcome, process, product, and/or resources.
2. Intentional composition of student working groups: establishing decidedly homogeneous or heterogeneous subgroups based on performance, readiness, interests, etc.
3. Tutoring systems within the learning group: high ability students take up the role of teacher assistants and tutor low ability students. These roles may persist for a long term.
4. Staggered non-verbal learning aids: carefully and purposely designed series of learning aids that range in complexity level. The learning aids must only contain the minimal information necessary for a student to overcome an obstacle in the learning process. If they still are unable to deal with the task, a second aid with additional information and guidance is provided, and so on.
5. Mastery learning: all instructional practices which ensure that all students achieve at least minimum standards (in combination with higher standards for the more advanced students). This involves close monitoring of students’ learning progress.
6. Open education/granting autonomy to students: students are responsible for their own learning process and may autonomously decide on materials to work upon. Examples of such practices include: student choice of tasks, station work, project-based learning, portfolios, etc.

Despite being distinct instructional methods, the different practices categorised within the taxonomy are not necessarily conceptualised to be implemented uniquely. Some
practices may only be effective when used in a meaningful combination. For instance homogeneous within-class grouping demands implementing adapted assignments or materials (Lou, Abrami, and Spence, 2000), and heterogeneous within-class grouping suggests setting up peer tutoring systems (Slavin, 1987). In other situations, however, the different DI practices might limit each other’s practical use: mastery learning implies teachers’ thorough monitoring of students’ learning progress, whereas open education/granting autonomy suggests quite the opposite.

Therefore, none of these practices can be identified as ‘the most appropriate’, given the fact that each practice may have its advantages and disadvantages. In addition, as empirically proven, their effective implementation will depend on learner’s characteristics, such as student’s age and specific learning prerequisites, or teacher’s characteristics, such as growth mindset and constructivist beliefs (Coubergs, Struyven, Vanhournout, et al., 2017; Dijkstra, Walraven, Mooij, et al., 2016; Dweck, 2010). Likewise, context factors such as school subject (Prast, van de Weijer-Bergsma, Kroesbergen, et al. 2015; Ritzema, Deunk, and Bosker, 2016) and school track (Jennek, Gronostaj, and Vock, 2019) can also influence teachers’ implementation of DI practices.

Context factors

School subject

A context factor that may essentially influence teachers’ use of DI practices is the school subject. Wiley, Good and McCaslin (2008) found that Mathematics lessons have the tendency to be more structured than reading lessons. The nature of a subject-domain may inherently guide how teachers implement DI practices (Prast, van de Weijer-Bergsma, Kroesbergen, et al., 2015). A study by Nummi, Viljaranta, Tolvanen, et al. (2012) examined how Finnish teachers adapted their instruction according to their students’ performance level in the subjects of Reading and Mathematics. Even though teachers tailored instruction according to students’ achievement level, the teaching practices varied considerably across domains. In contrast to Wiley et al.’s research (2008), in this study, Finnish reading lessons tend to be far more structured and teacher-directed in comparison to (Finnish) Mathematics, where lessons are far less structured and teachers have more freedom to vary their instructional practices.

In a recent study by Ritzema, Deunk, and Bosker (2016) where Dutch second- and third-grade teachers’ DI practices in Reading and Mathematics were explored, important variations among the subject-domains were also observed. More specifically, results show that teachers included more content in their reading lessons, as well as implemented more whole-class instruction, whereas Mathematics teachers relied on more organisational discourse, extended instruction and seatwork. Overall, Ritzema, Deunk, and Bosker (2016) reported that Mathematics teachers implement DI practices more often.

In order to investigate the use of DI practices in Germany, Westphal, Gronostaj, Vock, et al. (2016) compared teachers’ use of DI in the subjects of Mathematics and German. Their findings indicated significant variations between the subjects, it appears that Mathematics teachers differentiate their instruction more often than German teachers. In detail, the study revealed that tiered assignments ranging in difficulty levels are far more implemented by Mathematics teachers than German teachers.

School track

School track is another important contextual factor that seems to play a crucial role when implementing DI. According to Gamoran (1992), it appears that tracked schools with a certain degree of flexibility (i.e. having tracked courses, such as specialised advanced courses) implement more DI practices in comparison to highly selective school systems or forms of organisation which inherently build on ability tracking. Germany1 implements a formalised tracking system in which students are assigned to a secondary school based on academic ability (Grade 5) at an early age. As the German federal states (Länder) are primarily responsible for the education system, tracking systems slightly vary across the country. However, the Standing Conference of the Ministers of Education and Culture (Kultusministerkonferenz, KMK) that is in charge of the coordination and development of education in the country, establishes the following main secondary school tracks (KMK, 2017):

1. General secondary school (Hauptschule): type of school that provides basic general education, usually preparing students for vocational studies.
2. School with different courses of education (Schule mit mehreren Bildungsgängen): type of school which groups together both general and intermediate secondary school programmes under one educational and organisational body.
3. Intermediate secondary school (Realschule): type of school that provides more broad education allowing students the opportunity to continue on to courses that lead to vocational education or higher education entrance qualifications.
4. Comprehensive school (Integrierte Gesamtschule): type of school that contains the three courses of education (general, intermediate and advanced secondary school) under one educational and organisational body.
5. Advanced secondary school (Gymnasium): type of school that provides diligent general education qualifying students for entrance to higher education.

1For the purpose of this paper, this section presents a summary of Germany’s secondary school tracking system. For full information on Germany’s legislation and education system please refer to coordinating body: the Standing Conference of the Ministers of Education and Culture (Kultusministerkonferenz) (KMK, 2015).

© 2019 The Authors. Journal of Research in Special Educational Needs published by John Wiley & Sons Ltd on behalf of National Association for Special Educational Needs
Since in Germany ability tracking is the standard in secondary education, variations of teachers’ use of DI practices within tracks have been reported. Evidence from PISA 2009 (Hertel, Hochweber, Steinert, et al., 2010) for the subject of German reveals that comprehensive school teachers implement the most DI practices and are followed by general secondary school and school with different courses of education teachers. In contrast, teachers in advanced secondary schools (the most highly selective school track in Germany) reported a rare implementation of DI practices (Hertel, Hochweber, Steinert, et al., 2010; Letzel and Otto, in press).

A recent study by Jennek, Gronostaj, and Vock (2019) indicated that, on average, the overall use of DI does not differ significantly between school tracks. Even when looking deeper into the specific single implemented DI practices, such as tiered assignments or learning aids, the authors found no clear differences among the school tracks.

In sum, the implementation of DI could be influenced by the subject-domain and school track. Therefore, such contextual factors must not be neglected when examining teachers’ use of DI.

Teacher characteristics: teacher beliefs
Scientific literature and theoretical models have stated that teachers’ beliefs are important variables influencing teachers’ response to their learners’ needs (e.g. Mansour, 2009; Smit and Humpert, 2012; Tomlinson, 2003). Even though there is no universal definition, it is commonly known that beliefs are non-scientific notions referring to psychological understandings, premises or propositions that are felt to be true (Richardson, 1996). Pajares (1992) stated the need to differentiate knowledge from beliefs: ‘Belief is based on evaluation and judgement; knowledge is based on objective fact’ (p. 313). Teacher beliefs can be linked to, for example their view on the way students learn, as well as on which teaching practices are effective or the role of learners’ activity, and are therefore highly connected to teachers’ activities in the classroom (Hancock and Gallard, 2004; Oser and Blömeke, 2012). Moreover, they are seen as one of the most important determinants of professional behaviour (Schneider, Pakzad and Schlüter, 2013) and can be understood as the convictions, philosophy, tenets, or opinions about teaching and learning (Milner, Sonderegger, Demir, et al., 2012). Therefore teachers’ beliefs refer to views on specific teaching practices, teaching approaches such as direct-transmissive or constructivist, and views concerning student diversity, learning and ability (Fives and Buehl, 2012). Literature distinguishes two types of beliefs: direct-transmissive and constructivist beliefs (e.g. Baumert and Kunter, 2006; Peterson, Fennema, Carpenter, et al., 1989; Staub and Stern, 2002). Teachers holding direct-transmissive beliefs rather tend to structure their contents and to see the learning process as the transfer of knowledge from teacher to student (Sfard, 1998). In contrast, teachers understanding learning as an active process rooting in the students themselves and focusing on their previous knowledge as well as their interests rather hold constructivist beliefs (e.g. Bereiter, 1994).

Both literature and research have continuously suggested the positive influence of teachers’ constructivist beliefs on their use of DI (Dijkstra, Walraven, Mooij, et al., 2016; Tomlinson, Brighton, Hertberg, et al., 2003). Smit and Humpert (2012), for example indicated that teachers holding constructivist beliefs tend to make a frequent use of a greater variety of DI. The same was found by Tomlinson (2003): DI was linked to constructivist instructional approaches, student collaboration, individual differences, personal meaning development, etc. This study recognises the theoretical and empirical significance of teachers’ constructivist beliefs, and therefore, they are considered within this investigation.

Purpose and research questions
Despite the importance of DI for successful learning, research into how teachers implement DI is still scarce (Graham, Morphy, Harris, et al., 2008; Prast, van de Weijer-Bergsma, Krosbergen, et al., 2018) and the small amount of research available has yielded heterogeneous results. Therefore, the aim of this study was to use nationally representative large-scale data from the NEPS in Germany in order to explore how distinct DI practices are applied in classroom teaching taking into account contextual factors such as school subject and school track. Additionally, teachers’ constructivist beliefs were included as covariates. The research question guiding this study was: Which DI practices do teachers apply in their classroom teaching and how often?

To explore this research question, two sub-questions were formulated:

- Does the implementation of DI practices vary across school tracks and school subjects?
- To which extent is the implementation of DI practices related to teachers’ constructivist beliefs?

Based on existing DI research, it was hypothesised that tiered assignments and intentional composition of student working groups would be the most frequently implemented DI practices (Smit and Humpert, 2012). Furthermore, it is assumed that significant differences among the use of DI practices between the subjects of German and Mathematics, as well as variations amongst school tracks are to be found: specifically, it was expected that less selective school types (such as general secondary school or comprehensive schools) encourage the most frequent use of single DI practices. Finally, it is hypothesised that teachers’ constructivist beliefs are positively associated to teachers’ implementation of DI practices.
Method

Sampling and sample

The analysis of this study was conducted using the nationally representative data from the NEPS in Germany. The NEPS provides Scientific Use Files (SUF) for registered users that include separate data files corresponding to student, teacher and parent questionnaires. For the purpose of this study, the starting cohort three which assesses students entering Grade 5, was selected. The first wave of data collection began in 2010 (fifth grade), and up to now there are data obtained from seven measurement points (sample entering the tenth grade).

The analyses were conducted with data from the measurement points in sixth and ninth grade taken place during 2011 and 2014. The total sample consisted of 1164 sixth grade students (N6 = 475) and ninth grade (N9 = 689) teachers (65% female). NEPS provides five age categories in their SUF, see Table 1 for details. The sample is divided correspondingly into the school subjects of German and Mathematics and was stratified according to school track within the German school system: general secondary school (NG = 98/NM = 113), school with different courses of education (NG = 66/NM = 80), intermediate secondary school (NG = 121/NM = 133), comprehensive school (NG = 47/NM = 56) and advanced secondary school (NG = 215/NM = 235). Teachers from special education schools were excluded from this study, as well as teachers with missing data.

Instruments

NEPS uses three different types of self-report questionnaires for teachers: (1) the general questionnaire for all teachers, (2) the class teacher questionnaire and (3) the subject-specific (Math and German) teacher questionnaire. The subject-specific teacher questionnaire includes items that collect information on the quality of teaching as well as how they organise their instruction and learning.

DI practices. For the purpose of our study, the subject-specific (Math and German) teacher questionnaire that contains items that correspond to how (and with which frequency) teachers conduct, plan and organise their lessons were selected (see Table 2 for descriptive statistics). The items were identified and labelled according to the Taxonomy of DI practices (Pozas and Schneider, 2019):

1. ‘To what extent do the following statements apply to your German/Mathematics lessons in this class’? The DI items were measured on a 5-point Likert-scale range from 1 = does not apply to 5 = applies completely.
   a. Category I. Tiered Assignments: ‘I allow students who work faster to move on to the next assignment while I am still practicing or reviewing things’. (slow/fast students)
   b. Category I. Tiered Assignments: ‘If students have difficulties in understanding, I give them additional assignments’. (additional assignments)
   c. Category I. Tiered Assignments: ‘I give more capable students extra assignments that are really challenging for them’. (extra assignments)
   d. Category II. Intentional composition of student working groups: ‘I form groups of students with similar capabilities’. (homogeneous ability grouping)
   e. Category II. Intentional composition of student working groups: ‘I form groups of students with different capabilities’. (heterogeneous ability grouping)

2. ‘How often do you use the following social methods of learning in this German/Math class’? The DI items were measured on a 6-point Likert-scale range from 1 = never to 6 = (almost) every lesson.
   a. Category III. Tutoring systems within the learning group: ‘Student acting as tutors (‘Learning by Teaching’, peer tutoring’). (tutoring)
   b. Category VI. Open education/ granting autonomy to students: ‘Project-based learning: the students work in groups on a certain topic and then present the results of their work’. (project-based learning)

| Categories          | Frequency | Percentage |
|---------------------|-----------|------------|
| Born before 1950    | 17        | 2          |
| 1950–1959           | 350       | 38         |
| 1960–1969           | 243       | 22         |
| 1970–1979           | 226       | 21         |
| After 1979          | 264       | 24         |

Table 2: Descriptive statistics for the dependent variables and covariate

| Item                   | Range | M  | SD  |
|------------------------|-------|----|-----|
| Tiered assignments     | 1–5   | 3.54 | 0.56 |
| Homogeneous ability grouping | 1–5   | 2.37 | 0.92 |
| Heterogeneous ability grouping | 1–5   | 3.57 | 0.90 |
| Tutoring               | 1–5   | 2.57 | 1.22 |
| Project-based learning | 1–5   | 2.23 | 0.82 |
| Constructivist beliefs (covariate) | 1–4   | 3.35 | 0.40 |

Notes: DI items measured on a 5-point Likert-scale range from 1 = does not apply to 5 = applies completely. Teachers’ constructivist beliefs items measured on a 4-point Likert-scale range from 1 = completely disagree to 4 = completely agree.

---

2Special education schools (Förderschule) in Germany are established for those students, who due to a disability, cannot be adequately supported at mainstream schools (KMK, 2017, 2015).
NEPS does not include items pertaining to the categories of Category 4. Staggered non-verbal learning aids and Category 5. Mastery learning. For this reason, they cannot be included in the analysis.

**Teacher beliefs.** To measure teachers’ constructivist beliefs, NEPS uses a scale stemming from the Organisation for Economic Co-operation and Development (OECD) Teaching and Learning International Survey from 2008 (2010). The scale consists of four items based on a 4-point scale (1 = completely disagree to 4 = completely agree) (i.e. ‘My role as a teacher is to make it easier for the students to investigate and explore things’.) (α = 0.61).

**Analyses**
In order to answer the research question and sub-questions, a mixed analysis of covariance was used. In line with the DI taxonomy guiding this study (Pozas and Schneider, 2019), all items pertaining to DI practices were submitted to a mixed ANCOVA as dependent variables, while school track and subject school were included as independent variables. Teachers’ constructivist beliefs were used as a covariate.

To reduce complexity and provide comparability, items pertaining to Category I. tiered assignments (slow/fast students, additional assignments and extra assignments) were combined into a mean score. This mean score served as a within-subject factor. Additionally, the DI items of tutoring and project-based learning were originally measured with a 6-point Likert-scale. Consequently, it was necessary to adjust them to a 5-point Likert-scale range in order to include them in the analysis.

With regard to assumption considerations, it is important to note that the sphericity assumption was violated and the Greenhouse-Geiser ε exceeded 0.75, thus, the Huyhn-Feldt corrected test statistic is reported for the within-subjects factor and the interaction.

**Results**
The mixed ANCOVA indicates that the contextual factors have an influencing role on teachers’ use of DI practices. Specifically, the tests of between-subject effects of the mixed ANCOVA results reported a significant main effect of school track, $F(4, 828) = 5.99$, $P < 0.001$, partial $\eta^2 = 0.03$. Overall it appears that advanced secondary school German and Mathematics teachers implement DI practices less often in comparison to their counterparts in other school tracks, thus, they show to have a smaller repertoire of DI practices. In addition, the covariate of teachers’ constructivist beliefs were significantly positive related to teachers’ implementation of DI practices, $F(1, 828) = 26.87$, $P < 0.001$, partial $\eta^2 = 0.03$.

The tests of within-subject effects showed significant variations within the single use of DI practices, $F(3.61, 2991.80) = 6.12$, $P < 0.001$, partial $\eta^2 = 0.01$. In detail, teachers tend to differentiate their instruction predominately using tiered assignments and building heterogeneous (ability-level) groups, while they seldom differentiate by carrying out project-based learning and building homogeneous groups (Figure 1). The implementation of tutoring systems, in contrast, appears as well to be seemingly practiced, yet far less than tiered assignments or heterogeneous groups. Furthermore, a significant interaction effect between the DI practices and school subject ($F(3.61, 2991.80) = 23.59$, $P < 0.001$, partial $\eta^2 = 0.03$) (Figure 2), as well as a significant interaction effect between the DI practices and school track ($F(14.45, 2991.80) = 4.37$, $P < 0.001$, partial $\eta^2 = 0.02$) (Figure 3) were found, indicating that these pattern of effects concerning the differences within the use of DI practices appear to be consistent across both subjects and school tracks. Finally, a significant interaction effect among DI practices, school subject and school track was revealed ($F(14.45, 2991.80) = 1.70$, $P < 0.05$, partial $\eta^2 = 0.01$). These findings indicate important significant differences, particularly, for the use of tutoring and project-based learning. It appears that Mathematics teachers across all school tracks tend to implement tutoring systems far more often than project-based learning. In contrast, German teachers tend to rather implement project-based learning than tutoring systems across all school tracks (Figure 4a and b).

Overall, the results clearly indicate that, (1) in general, teachers indeed apply DI practices in their in-class instruction, however, the frequency in which they implement such practices is less than recommended for successfully dealing with heterogeneity (Moon, Callahan, Tomlinson, et al., 2002) and (2) when they actually do implement DI, they mostly adhere to tiered assignments and heterogeneous ability groups which clearly indicates that teachers hold a rather low variance of DI practices.

**Discussion**
While it is widely acknowledged that teachers must differentiate their instruction to address the diverse students’ needs, little research has been conducted across large-scale data to empirically explore how teachers implement specific DI practices. This study tackles the current gaps in DI empirical research and seeks to further contribute by taking into account contextual factors and teacher characteristics that may influence teachers’ use of DI practices. The aim of this study was to explore in detail how and with which frequency sixth- and ninth-grade German and Mathematics teachers across different school tracks in Germany apply DI practices in their in-classroom teaching.

Concerning the general research question, teachers do in fact make use of DI practices, nonetheless, in a very low frequency. This result is in line with previous international research that has also found that teachers have, without a doubt, a considerable room for improvement...
Additionally, the findings indicate visible differences within the distinct DI practices. First, tiered assignments are, by far, the most applied DI practice. This result is not surprising, as previous research has shown that teachers commonly address student needs by tiered assignments (Smit and Humpert, 2012). Second, consistent with previous research, intentional composition of student groups was also reported as a frequently used DI practice (Tieso, 2005). It appears that the implementation of intentional composition of student groups is commonly regarded by teachers, as a simpler practice to prepare and carry out (Chiner and Cardona, 2013). In detail, results indicate that both German and Mathematics teachers across school tracks tend to build heterogeneous ability groups in order to support low, medium and high achievers (Lou, Abrami, Spence, et al., 1996). However, no concrete information on whether teachers have built such heterogeneous groups intentionally or rather spontaneously, as well as whether these groups are formed for a short or long amount of time. Moreover, NEPS does not provide information on whether teachers form groups based on alternative grouping formats, such as grouping according to students’ academic self-concept, interest, motivation and other characteristics (Nielsen and Yezierski, 2016; Tomlinson, 2001).

Third, the least frequently reported DI practices were tutoring systems and project-based learning. In the case of tutoring systems, this result is quite unfortunate. According to Hattie (2009), peer tutoring has a large significant positive effect on student achievement ($d = 0.55$), and furthermore, fosters positive interactions between students (Wentzel, 2000). Likewise, project-based learning appears to be rarely used by teachers. This DI practice is a variant of open education, yet, this item alone is not broad enough to comprise the complete category of open education. It could possibly be that other variants such as portfolios, station work, interest-based centres (Tomlinson, 2001, 2017) are more commonly employed.

Taken all together, the significant differences within DI practices seem to follow findings from previous DI research (Graham, Morphy, Harris, et al., 2008; Jennek, Gronostaj, and Vock, 2019; Schumm and Vaughn, 1991): teachers appear to implement more frequently those single
DI practices that require less preparation. A first possible explanation could be related to the high workload that teachers face worldwide (OECD, 2014), and therefore, lack the time to plan and prepare for DI, as well as design the appropriate differentiated materials and tasks (Chiner and Cardona, 2013). On the other hand, previous research has reported that teachers express feeling unprepared to differentiate classroom instruction as a mean to appropriately address student diversity (Avramidis, Bayliss, and Burden, 2000; Dee, 2011; Gaitas and Martins, 2016; Hamre and Oyler, 2004; Tomlinson, Moon, and Callahan, 1998). Without the proper training, teachers are inherently unable to provide meaningful and successful instruction for all students, as they do not count with the knowledge on DI, and in the case of beginning teachers, the experience to teach diverse learners. It is then necessary and urgent that DI receives sufficient attention in pre-service education and further in-service teacher trainings.

Regarding the first sub-question, findings indicate a very similar overall response pattern for both, German and Mathematics teachers across school tracks. Evidently, teachers predominantly implement tiered assignments and heterogeneous ability groups as their main choice for differentiating instruction. Additionally, results also show that teachers in advanced secondary schools implement less of DI practices. Gamoran (1992) discussed that teachers in high-track schools and classes tend to make use of less differentiation mechanisms as there is the belief that in more selective and ‘top’ tracks, DI is not necessary, given that the student body is mostly composed of high ability students.

Moreover, when examining in detail the interaction effect between DI practices, school track and school subject, clear differences arise within the DI practices of tutoring systems and project-based learning. Mathematics teachers indicated a higher use of tutoring systems compared to German teachers, whereas German teachers reported a slightly higher implementation of project-based learning. In particular, this difference across school tracks is mainly observed among German advanced secondary school. These differences could be attributable to the particular setup of the subject-domain that guides teachers’ planning and preparing for DI (Prast, van de Weijer-Bergsma, Kroesbergen, et al. 2015).

Finally, concerning the second sub-question, results show that teachers’ constructivist beliefs are indeed positively influencing teachers’ use of DI practices. This result is
consistent with findings from, for example Smit and Humpert (2012) and Tomlinson (2003), and therefore, it is recommended that teachers’ constructivist beliefs should be integrated in further DI research.

Limitations and further research
This study was focused on German and Mathematics teachers’ implementation of DI practices across different school tracks, where their responses indicated how frequently they make use of DI practices. Consequently, such data does not provide information concerning the purposes or goals teachers intended to pursue using such practices (i.e. focusing on achievement or promoting social competences), as well as information on whether such practices were actually effective and successful. Further research should focus on exploring teachers’ intentions behind the specific DI practices, and take a longitudinal approach that could shed light into the effects such practices have on student variables, such as achievement, motivation, self-concept, attitudes towards school, and social competencies. Moreover, research should examine the potential aptitude-treatment-interactions each DI practice may have on, for example high-, middle- or low-achievers, in order to ensure that DI is actually beneficial for all students.

A second limitation is that the study uses teachers’ self-reports of DI; such responses can inherently be sensitive to overestimation, underestimation, or socially desired answers. Desimone, Smith and Frisvold (2010), however, found out that teachers’ self-reports regarding their teaching practices are highly correlated to classroom observations. Future research should not only make use of self-reports but integrate classroom observations as well.

Furthermore, when examining teachers’ constructivist beliefs, further research should consider exploring the influence beliefs have on each of the single DI practices applied in order to identify specifically which DI practices are strongly related to constructivist beliefs and which are not. This analysis would support pre-service and in-service teachers to adapt their beliefs to optimal differentiation practices.

Finally, it should be noted that the DI practices of staggered non-verbal learning aids and mastery learning are not included within NEPS teacher questionnaires, and, therefore, could not be entered in the analysis. Further research should incorporate such DI practices into their analyses, as according to Hattie (2009), mastery learning, for example has strong and positive effects on students’ achievement.
Figure 4: Interaction effect DI practices with school track and school subject: results for (a) German and (b) Mathematics
Data availability statement
This paper uses data from the National Educational Panel Study (NEPS): Starting Cohort Grade 5, https://doi.org/10.5157/NEPS:SC3:8.0.0, https://doi.org/10.5157/NEPS:SC3:8.0.1. From 2008 to 2013, NEPS data were collected as part of the Framework Program for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS is carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide Institute for Educational Trajectories (LIfBi) at the German Federal Ministry of Education and Research (BMBF). From 2008 to 2013, NEPS data were collected as part of the Framework Program for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS is carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network.

*Address for correspondence*
Marcela Pozas,
Universität Trier,
Universitätsring 15,
54296 Trier,
Germany.
Email: pozas@uni-trier.de.

References
Avramidis, E., Bayliss, P. & Burden, R. (2000) ‘A survey into mainstream teachers’ attitudes towards the inclusion of children with special educational needs in the ordinary school in one local education authority.’ Educational Psychology, 20 (2), pp. 191–211. https://doi.org/10.1080/0162353214529042.

Baumert, J. & Kunter, M. (2006) ‘Stichwort: Professionelle Kompetenz von Lehrkräften. [Keyword: Professional teachers’ competence].’ Zeitschrift für Erziehungswissenschaft, 9 (4), pp. 469–520. https://doi.org/10.1007/s11618-006-0165-2.

Baumgartner, T., Lipowski, M. B. & Rush, C. (2003) ‘Increasing reading achievement of primary and middle school students through differentiated instruction (Master thesis).’ Chicago, IL: Saint Xavier University & SkyLight.

Bereiter, C. (1994) ‘Constructivism, socioculturalism, and Popper’s World 3.’ Educational Researcher, 23 (7), pp. 13–20.

Blossfeld, H., Roßbach, H. G. & von Maurice, J. (eds) (2011) ‘Education as a Lifelong Process: The German National Educational Panel Study (NEPS).’ Zeitschrift für Erziehungswissenschaft: Sonderheft 14. Wiesbaden: VS Verlag für Sozialwissenschaften.

Chamberlin, M. & Powers, R. (2010) ‘The promise of differentiated instruction for enhancing the mathematical understandings of college students.’ Teaching Mathematics and its Applications, 29 (3), pp. 113–39. https://doi.org/10.1093/teamat/hrq006.

Chiner, E. & Cardona, M. (2013) ‘Inclusive education in Spain: how do skills, resources, and supports affect regular education teachers’ perceptions of inclusion?’ International Journal of Inclusive Education, 17 (5), pp. 526–41. https://doi.org/10.1080/13603116.2012.689864.

Coffey, S. (eds) (2011) ‘Differentiation in theory and practice.’ In S. Coffey, J. Dillon & M. Maguire (eds), Becoming a Teacher: Issues in Secondary Education, pp. 197–209. New York: Open University Press.

Coubergs, C., Struyven, K., Vanthournout, G. & Engels, N. (2017) ‘Measuring teachers’ perceptions about differentiated instruction: the DI-Quest instrument and model.’ Studies in Educational Evaluation, 53, pp. 41–54. https://doi.org/10.1016/j.stueduc.2017.02.004.

Dee, A. L. (2011) ‘Preservice teacher application of differentiated instruction.’ The Teacher Educator, 46 (1), pp. 53–70. https://doi.org/10.1080/03055698.2016.1195719.

Desimone, L., Smith, T. & Frisvold, D. (2010) ‘Survey measures of classroom instruction: comparing student and teacher reports.’ Educational Policy, 24, pp. 267–329.

DijkstRA, E. M., Walraven, A., Mooij, T. & Kirschner, P. A. (2016) ‘Improving kindergarten teachers’ differentiation practices to better anticipate student differences.’ Educational Studies, 42 (4), pp. 357–77. https://doi.org/10.1080/03055698.2016.1195719.

Dixon, F. A., Yssel, N., McConnell, J. M. & Hardin, T. (2014) ‘Differentiated instruction, professional development, and teacher efficacy.’ Journal for the Education of the Gifted, 37 (2), pp. 111–27. https://doi.org/10.1177/0162353214529042.

Dupriez, V., Dumay, X. & Vause, A. (2008) ‘How do school systems manage pupils’ heterogeneity?’ Comparative Education Review, 52 (2), pp. 245–73.

Dweck, C. S. (2010) ‘Mindsets and equitable education.’ Principal Leadership, 10 (5), pp. 26–9.

Fives, H. & Buehl, M. M. (eds) (2012) ‘Spring cleaning for the “messy” construct of teachers’ beliefs: what are they? Which have been examined? What can they tell us?’ In K. R. Harris, S. Graham, T. Urdan, S. Graham, M. Royer & M. Zeidner (eds), APA Educational Psychology Handbook, Vol 2: Individual Differences and Cultural and Contextual Factors, pp. 471–99. Washington: American Psychological Association.

Gaitas, S. & Martins, M. (2016) ‘Teacher perceived difficulty in implementing differentiated instructional strategies in primary school.’ International Journal of Inclusive Education, 21 (5), pp. 544–56. https://doi.org/10.1080/13603116.2016.1223180.

Gamoran, A. (1992) ‘The variable effects of high school tracking.’ American Sociological Review, 57 (6), pp. 812–28.

Graham, S., Morphy, P., Harris, K. R., Fink-Chorzempa, B., Saddler, B., Moran, S. & Mason, L. (2008) ‘Teaching spelling in the primary grades: a national survey of instructional practices and adaptations.’ American Educational Research Journal, 45 (3), pp. 796–825. https://doi.org/10.3102/002031208319722.
Hall, T. (2002) ‘Differentiated Instruction.’ Wakefield, MA: National Center on Accessing the General Curriculum. <http://www.cast.org/publications/nccac/diffinstruc.html> (accessed 15 July 2018).

Hamre, B. & Oyler, C. (2004) ‘Preparing teachers for inclusive classrooms: learning from a collaborative inquiry group.’ Journal of Teacher Education, 55, pp. 154–63. https://doi.org/10.1177/0022067003261588.

Hancock, E. & Gallard, A. (2004) ‘Preservice science teachers’ beliefs about teaching and learning. The influence of K – 12 field experiences.’ Journal of Science Teacher Education, 15 (4), pp. 281–291.

Hattie, J. (2009) Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement. London, New York: Routledge.

Hertel, S., Hochweber, J., Steinert, B. & Klieme, E. (eds) (2010) ‘Schulische Rahmenbedingungen und Lerngelegenheiten im Deutschunterricht [Academic requirements in german lessons].’ In E. Klieme, C. Artelt, J. Hartig, N. Dude, O. Köller, M. Prenzel, W. Schneider & P. Stanat (eds), PISA 2009: Bilanz nach einem Jahrzehnt, pp. 113–51. Münster, New York, München, Berlin: Waxmann.

Idol, L. (2006) ‘Toward inclusion of special education students in general education.’ Remedial and Special Education, 27 (2), pp. 77–94.

Jennek, J., Gronostaj, A. & Vock, M. (2019) ‘Wie Lehrkräfte im Englischunterricht differenzieren: Eine Re-Analyse der DESI-Videos [how do english teachers differentiate their instruction: a reanalysis of the DESI-Videos].’ Unterrichtswissenschaft, 47 (1), pp. 99–116. https://doi.org/10.1007/s42010-018-0027-7.

KMK (Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany). (2017) ‘Basic structure of the education system in the Federal Republic of Germany’. <https://www.kmk.org/fileadmin/Dateien/pdf/Dokumentation/en_2017.pdf> (accessed 25 April 2019).

KMK (Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany). (2015) The Education System in the Federal Republic of Germany 2013/2014: A Description of the Responsibilities, Structures and Developments in Education Policy for the Exchange of Information in Europe. <https://www.kmk.org/fileadmin/Dateien/pdf/Eurydice/Bildungswesenengl-pdf/s/dossier_en_ebook.pdf> (accessed 25 April 2019).

Landrum, T. J. & McDuffie, K. A. (2010) ‘Learning styles in the age of differentiated instruction.’ Exceptionality, 18 (1), pp. 6–17. https://doi.org/10.1080/09362830903462441.

Latz, A. O. & Adams, C. M. (2011) ‘Critical differentiation and the twice oppressed.’ Journal for the Education of the Gifted, 34 (5), pp. 773–89. https://doi.org/10.1177/0162353211417339.

Lawrence-Brown, D. (2004) ‘Differentiated instruction: Inclusive strategies for standard-based learning that benefit the whole class.’ American Secondary Education, 3, pp. 34–64.

Letzel, V. & Otto, J. (in press) Binnendifferenzierung und Deren Konkrete Umsetzung in der Schulpraxis – Eine Qualitative Studie [Differentiated Instruction and Its Implementation in Everyday Teaching – A Qualitative study]. Manuscript accepted by the Zeitschrift für Bildungsforschung.

Levy, H. (2008) ‘Meeting the needs of all students through differentiated instruction: helping every child reach and exceed standards.’ The Clearing House: A Journal of Educational Strategies, Issues, and Ideas, 81 (4), pp. 161–4.

Lou, Y., Abrami, P., Spence, J., Poulsen, C., Chambers, B. & d’Apollonia, S. (1996) ‘Within-class grouping: a meta-analysis.’ Review of Educational Research, 66 (4), pp. 423–58.

Lou, Y., Abrami, P. C. & Spence, J. C. (2000) ‘Effects of within-class grouping on student achievement: an exploratory model.’ The Journal of Educational Research, 94 (2), pp. 101–12. https://doi.org/10.1080/0020670009598748.

Mansour, N. (2009) ‘Science teachers’ beliefs and practices: issues, implications and research agenda.’ International Journal of Environmental and Science Education, 4, pp. 25–48.

McTighe, J. & Brown, J. (2005) ‘Differentiated instruction and educational standards: is détente possible?’ Theory Into Practice, 44 (3), pp. 234–44.

Milner, A. R., Sondergeld, T. A., Demir, A., Johnson, C. C. & Czerniak, C. M. (2012) ‘Elementary teachers’ beliefs about teaching science and classroom practice: an examination of pre/post NCLB testing in science.’ Journal of Science Teacher Education, 23, pp. 111–32.

Moon, T., Callahan, C., Tomlinson, C. A. & Miller, E. (2002). ‘Middle School Classrooms: Teachers’ reported practices and student perceptions.’ Storrs, CT: The National Research Center on the Gifted and Talented. <https://eric.ed.gov/?xml:id=ED505452> (accessed 18 February 2019).

Nielsen, S. & Yezierski, E. (2016) ‘Beyond academic tracking: using cluster analysis and self-organizing maps to investigate secondary students’ chemistry self-concept.’ Chemistry Education Research and Practice, 17 (4), pp. 711–22. https://doi.org/10.1039/c6rp00058d.

Nurmi, J., Viljaranta, J., Tolvanen, A. & Aunola, K. (2012) ‘Teachers adapt their instruction according to students’ academic performance.’ Educational Psychology, 32 (5), pp. 571–88. https://doi.org/10.1080/01443410.2012.675645.

Organisation for Economic Co-operation and Development (OECD). (2014) “Indicator D4: how much time do teachers spend teaching?”, in education at a glance 2014: OECD indicators.’ OECD Publishing. https://doi.org/10.1787/888933120005.
Organisation for Economic Co-operation and Development (OECD). (2010) ‘Teaching and Learning International Survey: TALIS 2008 technical report.’ <http://www.oecd.org/publishing/corrigenda> (accessed 20 March 2019).

Oser, F. & Blömeke, S. (2012) ‘Überzeugungen von Lehrpersonen. Einführung in den Themen Teil [teacher beliefs. Introduction].’ Zeitschrift für Pädagogik, 58, pp. 415–21.

Pajares, M. F. (1992) ‘Teachers’ beliefs and educational research: cleaning up a messy construct.’ Review of Educational Research, 62 (3), pp. 307–32. https://doi.org/10.3102/00346543062003307.

Peterson, P. L., Fennema, E., Carpenter, T. P. & Loef, M. (1989) ‘Teacher’s pedagogical content beliefs in mathematics.’ Cognition and Instruction, 6 (1), pp. 1–40.

Prast, E. J., van de Weijer-Bergsma, E., Kroesbergen, E. H. & van Luit, J. (2015) ‘Readiness-based differentiation in primary school mathematics: expert recommendations and teacher self-assessment.’ Frontline Learning Research, 3 (2), pp. 90–116. https://doi.org/10.14786/fhr.v3i2.163.

Prast, E. J., van de Weijer-Bergsma, E., Kroesbergen, E. H. & van Luit, J. (2018) ‘Differentiated instruction in primary mathematics: effects of teacher professional development on student achievement.’ Learning and Instruction, 54, pp. 22–34. https://doi.org/10.1016/j.learninstrucc.2018.01.009.

Reis, S. M., McCoach, D. B., Little, C. A., Muller, L. M. & Kaniskan, R. B. (2011) ‘The effects of differentiated instruction and enrichment pedagogy on reading achievement in five elementary schools.’ American Educational Research Journal, 48 (2), pp. 462–501. https://doi.org/10.3102/0002831210382891.

Richardson, V. (eds) (1996) ‘The role of attitudes and beliefs in learning to teach.’ In V. Richardson & J. Sikula (eds), Handbook of Research on Teacher Education, pp. 102–19. New York, NY: Simon and Schuster Macmillan.

Ritzema, E. S., Deunck, M. I. & Bosker, R. J. (2016) ‘Differentiation practices in grade 2 and 3: variations in teacher behavior in mathematics and reading comprehension lessons.’ Journal of Classroom Interaction, 51 (2), pp. 49–71.

Roy, A., Guay, F. & Valois, P. (2013) ‘Teaching to address diverse learning needs: development and validation of a differentiated instruction scale.’ International Journal of Inclusive Education, 17 (11), pp. 1186–204. https://doi.org/10.1080/13603116.2012.743604.

Santangelo, T. & Tomlinson, C. A. (2009) ‘The application of differentiated instruction in postsecondary environments: benefits, challenges, and future directions.’ International Journal of Teaching and Learning in Higher Education, 20 (3), pp. 307–23.

Schneider, C., Pakzad, U. & Schlüter, K. (2013) ‘The influence of personal school experience in biology classes on the beliefs of students in university teacher education.’ Journal of Education and Training Studies, 1(2), 197–210. https://doi.org/10.1111/jets.v12.146.

Schunk, J. & Vaughn, S. (1991) ‘Making adaptations for mainstreamed students: general classroom teachers’ perspectives.’ Remedial and Special Education, 12 (4), pp. 18–27. https://doi.org/10.1177/0741923X01201040.

Frd, A. (1998) ‘On two metaphors for learning and the dangers of choosing just one.’ Educational Researcher, 27 (2), pp. 4–13. https://doi.org/10.3102/0013189X027002004.

Slavin, R. E. (1987) ‘Ability grouping and student achievement in elementary schools: a best-evidence synthesis.’ Review of Educational Research, 57 (3), pp. 293–336. https://doi.org/10.2307/170460.

Smit, R. & Humpert, W. (2012) ‘Differentiated instruction in small schools.’ Teaching and Teacher Education, 28 (8), pp. 1152–62. https://doi.org/10.1016/j.tate.2012.07.003.

Staub, F. C. & Stern, E. (2002) ‘The nature of teachers’ pedagogical content beliefs matters for students’ achievement gains: Quasi-experimental evidence from elementary mathematics.’ Journal of Educational Psychology, 94 (2), pp. 344–55. https://doi.org/10.1037/0022-0663.94.2.344.

Suprayogi, M. N., Valcke, M. & Godwin, R. (2017) ‘Teachers and their implementation of differentiated instruction in the classroom.’ Teaching and Teacher Education, 67, pp. 291–301. https://doi.org/10.1016/j.tate.2017.06.020.

Tieso, C. (2005) ‘The effects of grouping practices and curricular adjustments on achievement.’ Journal for the Education of the Gifted, 29 (1), pp. 60–89.

Tomlinson, C. A. (2001) ‘How to Differentiate Instruction in Mixed-Ability Classrooms.’ (2nd edn). Alexandria, VA: ASCD.

Tomlinson, C. A. (2003) ‘Fulfilling the Promise of the Differentiated Classroom: Strategies and Tools for Responsive Teaching.’ Alexandria, VA: Association for Supervision and Curriculum Development.

Tomlinson, C. A. (2014) ‘The Differentiated Classroom: Responding to the Needs of all learners.’ (2nd edn). Alexandria, VA: ASCD.

Tomlinson, C. A. (2017) ‘How to Differentiate Instruction in Academically Diverse Classrooms.’ (3rd edn). Alexandria, VA: ASCD.

Tomlinson, C. A., Moon, T. & Callahan, C. (1998) ‘How well are we addressing academic diversity in the middle school?’ Middle School Journal, 29 (3), pp. 3–11.
Tomlinson, C. A., Brighton, C., Hertberg, H., Callahan, C. M., Moon, T. R., Brimijoin, K., Conover, L. A. & Reynolds, T. (2003) ‘Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms: a review of literature.’ *Journal for the Education of the Gifted*, 27 (23), pp. 119–45. https://doi.org/10.1177/016235320302700203.

Valiandes, S. (2015) ‘Evaluating the impact of differentiated instruction on literacy and reading in mixed ability classrooms: quality and equity dimensions of education effectiveness.’ *Studies in Educational Evaluation*, 45, pp. 17–26. https://doi.org/10.1016/j.stueduc.2015.02.005.

Valiandes, S. & Koutselini, M. (2009) ‘Application and evaluation of differentiation instruction in mixed ability classrooms’. 4th Hellenic Observatory PhD Symposium.

Wenning, N. (ed.) (2007) ‘Heterogenität als Dilemma für Bildungseinrichtungen [Heterogeneity as Dilemma in Education]’ In S. Boller, E. Rosowski & T. Stroot (eds), *Heterogenität in Schule und Unterricht: Handlungsansätze zum pädagogischen Umgang mit Vielfalt [Heterogeneity in School: Practices to Deal With Student Diversity]*. (1st edn), pp. 21–31. Weinheim: Beltz.

Wentzel, K. (2000) ‘What is it that I’m trying to achieve? Classroom goals from a content perspective.’ *Contemporary Educational Psychology*, 25, pp. 105–15. https://doi.org/10.1006/ceps.1999.1021.

Westphal, A., Gronostaj, A., Vock, M., Rico, E. & Harych, P. (2016) ‘Differenzierung im gymnasialen Mathematik und Deutschunterricht – vor allem bei guten Diagnostiker/innen und in heterogenen Klassen [differentiated instructional practices in advanced secondary mathematics and German classrooms: the importance of good diagnostics in heterogeneous classrooms].’ *Zeitschrift für Pädagogik*, 62, pp. 131–48.

Whipple, K. A. (2012) ‘Differentiated instruction: a survey study of teacher understanding and implementation in a southeast Massachusetts school district’. (Doctoral dissertation), Northeastern University. <https://repository.library.northeastern.edu/files/neu:1180/fulltext.pdf> (accessed 17 February 2019).

Wiley, C., Good, T. & McCaslin, M. (2008) ‘Comprehensive school reform instructional practices throughout a school year: the role of subject matter, grade level, and time of year.’ *Teachers College Record*, 110, pp. 2361–88.

Wischer, B. & Trautmann, M. (eds) (2012) ‘Innere Differenzierung als reformerischer Hoffnungsträger: Eine einführende Problemskizze zu Leerstellen und ungelösten Fragen [differentiated instruction as a reform hope: A detailed description for gaps and open questions].’ In T. Bohl, M. Bönsch, M. Trautmann & B. Wischer (eds), *Binnendifferenzierung: Teil 1: Didaktische Grundlagen und Forschungsergebnisse zur Binnendifferenzierung im Unterricht*, vol 1, pp. 24–39. Immenhausen bei Kassel: Prolog-Verl.