Svenja Janina Hartwig & Franziska Schwabe

Teacher attitudes and motivation as mediators between teacher training, collaboration, and differentiated instruction

Abstract

Heterogeneity in achievement characterizes many classrooms. Teachers can adapt to students' varying achievement levels by engaging in differentiated instruction (DI). Applying this strategy adequately is influenced by perceived teacher training quality and collaboration. The current study examined the dimensional structure and predictors of DI as well as a mediation of both teachers' attitudes and motivation. Confirmatory factor analysis confirmed a three-dimensional structure of DI. Teacher training and collaboration were proved to be predictors of DI. Expected success as a measure of motivation was confirmed as a mediator of perceived quality of teacher training on DI, but not the two attitude aspects perceived utility and costs. The relevance of the findings for teacher education and school as a workplace is discussed.

Keywords:

Differentiated instruction; Heterogeneity in achievement; Teacher attitudes; Teacher motivation

Lehrkrafteinstellungen und -motivation als Mediatoren zwischen Ausbildungsqualität, Kooperation und Differenzierung im Unterricht

Zusammenfassung

Leistungsheterogenität findet sich in vielen Schulklassen. Durch Differenzierung (DI) können Lehrkräfte auf die verschiedenen Leistungsniveaus eingehen, wobei der Einsatz dieser Strategie von wahrgenommener Ausbildungsqualität und Kooperation beeinflusst wird. Die vorliegende Studie untersuchte so-

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wohl die Struktur und Prädiktoren von DI als auch Mediationseffekte durch Lehrkrafteinstellungen und -motivation. Konfirmatorische Faktorenanalysen bestätigten eine dreidimensionale Struktur von DI sowie die Ausbildungsqualität und Kooperation als Prädiktoren. Der erwartete Erfolg als ein Maß von Motivation wurde als Mediator zwischen wahrgenommener Ausbildungsqualität und DI von den Daten gestützt, allerdings nicht die Einstellungsaspekte wahrgenommene Nützlichkeit und Kosten. Die Relevanz der Ergebnisse für Lehrkraftausbildung und den Arbeitsplatz Schule wird diskutiert.

Schlagwörter:
Differenzierung; Leistungsheterogenität; Lehrkrafteinstellungen; Lehrkraftmotivation

1. Teacher attitudes and motivation as mediators between teacher training, collaboration, and differentiated instruction

Today's classrooms are heterogeneous in many ways, especially in terms of diverse achievement levels in several groups of learners (Clayton, 2011; Lotan, 2008). Due to students' individual achievement levels, specific educational contents and strategies are not necessarily equally useful for each individual learner (Dixon, Yssel, McConnell, & Hardin, 2014; Pashler, McDaniel, Rohrer, & Bjork, 2008). Although some countries, such as Germany, mostly track students after elementary school by achievement, heterogeneity still exists and needs to be dealt with (cf. Gröhlich, Scharenberg, & Bos, 2009). As a result, there is great interest in teachers' ability to adjust teaching practice to diverse student populations. One expedient instructional behavior for supporting each student adequately is differentiated instruction (DI, see Kyriakides, Creemers, & Antoniou, 2009; Vogt & Rogalla, 2009). In this concept, the teacher tries to meet the educational needs of every student by adapting to her or his individual achievement level (Hall, 2002). DI covers several aspects. In this article, we examined the structure of DI based on Hall (2002) by measuring (a) preparing DI (Lawrence-Brown, 2004; Tricarico & Yendol-Hoppey, 2012), (b) performing DI during classroom lessons (Levy, 2008; Tomlinson & McTighe, 2006), and (c) reflecting on DI (Tomlinson, 2014; Tricarico & Yendol-Hoppey, 2012) in a sample of secondary school teachers working in Germany. For instructional behavior in general, previous research has demonstrated the importance of adequate teacher training (Darling-Hammond, 2000) and collaboration (Rogers, 2015). Whether teachers show high levels of DI may therefore also depend – at least partly – on these aspects. Because of that, the main question addressed in this article is whether teacher training quality and collaboration facilitate teachers' DI. Farther, the article examines teachers' attitudes and motivation as relevant teacher competencies for instructional behavior (see Baumert & Kunter, 2013; Butler &

Shibaz, 2008). Teachers' attitudes and motivation can be connected to their perceived quality of teacher training and collaboration (see Baldwin, Buchanan, & Rudisill, 2007; Hartwig, Schwabe, Gebauer, & McElvany, 2017). Concluding, because teacher training and collaboration might not just influence DI directly, a mediation by teachers' attitudes and motivation toward heterogeneity in achievement is investigated. Such mediation might occur because of the relevance of heterogeneity in achievement as a starting point for DI in classrooms (see Boyd, Goldhaber, Lankford, & Wyckoff, 2007, for the mediating effect of motivation between teacher training and instructional behavior).

1.1 DI in heterogeneous classrooms

Student diversity in achievement exists in most classrooms across educational systems throughout the world (Clayton, 2011; see Bos & Scharenberg, 2010, for Germany). The diverging achievement has been demonstrated empirically within international comparative large-scale studies (Duru-Bellat & Suchaut, 2005; Raitano & Vona, 2013). Heterogeneity in achievement has been shown to be pronounced especially in institutions like integrated schools (Bos & Scharenberg, 2010; Raitano & Vona, 2013). The same may also apply to school systems that do not divide their students into various school types after elementary school (see Green, 2011). Traditionally, heterogeneity within classes has often been assumed to inhibit optimal learning processes – especially for high-achieving students (see Johnson, Johnson, & Johnson Holubec, 1984). However, recent studies have shown that achievement gains depend more on teachers' instructional behavior than on classroom composition (e.g., Rjosk et al. 2014). Thus, instructional behavior plays a key role in exploiting the potential of classrooms that display heterogeneity in achievement. DI can have especially beneficial effects in this context (see Kyriakides et al., 2009). Each student is supported by the teacher considering her or his individual competencies and achievement level (Vogt & Rogalla, 2009). Theoretically, DI is grounded in the theory of aptitude-treatment interaction (Cronbach & Snow, 1977). This theory claims that an optimal result can be attained if teachers' instructional behavior is adapted adequately to each person's individual prerequisites (e.g., students' competencies).

In order to conceptionalize DI, Hall (2002) adapted a model from Oaksford and Jones (2001) (see Coubergs, Struyven, Vanthournout, & Engels, 2017; Smit & Humpert, 2012 for other approaches). Her Learning Cycle model mentions several aspects concerning the conduction of DI in the classroom. As starting points, she names the student on the one side and the curriculum on the other. While considering both of these preconditions, the content, process, and product of education may be differentiated. The process of DI is cyclic and is accompanied by a summative evaluation.

Hence, the extent of DI can be distinguished in terms of activities before, during, and after lessons like Hall (2002) does. One central aspect that also pro-

vides a way to assess teachers' activities in the frame of DI is the time they allocate to it (see Tricarico & Yendol-Hoppey, 2012). High amounts of time spent on DI might also indicate that teachers value this teaching concept. In addition, the time spent on DI can be seen as a precondition for the effectiveness of teaching in heterogeneous learning settings as teachers get better with more experience (see Danielson, 2011; Lawrence-Brown, 2004). In terms of the chronological process in Hall's (2002) Learning Cycle model, the planning of lessons concerning content and instruction means (a) preparing DI (Lawrence-Brown, 2004; Tricarico & Yendol-Hoppey, 2012). The process in Hall's model refers to our scale (b) performing DI during classroom lessons (Levy, 2008; Tomlinson & McTighe, 2006). DI during classroom lessons can be implemented in diverse ways such as assisting predefined groups of students (Levy, 2008) or giving each student in the classroom specific instruction (Bouhuis, 2013). Finally, (c) reflecting on DI (Tomlinson, 2014; Tricarico & Yendol-Hoppey, 2012) belongs to Hall's (2002) concept of assessment of content as she conceptualizes the evaluation at this point. Adjusting teaching toward diverse learners in terms of differentiating instruction is a continuous, complex, and strategic instructional behavior of performing DI, the observation and judgments of the corresponding results, and the subsequent adaption of behavior (see Tomlinson, 2014). Therefore, reflecting on DI may help teachers to exploit the method's full instructional potential (Tomlinson, 2014), because it can be understood as a way to continuous self-improvement. Therefore, reflecting on professional behavior in teaching contexts is a core condition for teaching effectiveness and quality improvement (Cuesta, Azcárate, & Cardeñoso, 2016; Tomlinson, 2014; see Thompson, 2008, for reflective practitioner concept).

The two components preparing DI and reflecting on DI are important for adequate performance of DI. In turn, high-quality DI can be expected to lead to improved learning processes and outcomes. Recent research has demonstrated that students profited immensely from teachers' competence in DI in terms of their achievement, motivation, and well-being (Kyriakides et al., 2009; Tomlinson & Moon, 2013).

Despite the aforementioned positive effects of DI, its implementation may be challenging for teachers, and the quality of DI may vary across teachers due to individual characteristics. Differences in DI have been stated concerning both teachers' age (see Tomlinson, 2014) and gender (Smit & Humpert, 2012) with younger and female teachers practicing more DI. Moreover, the quality of DI might depend on the perceived teacher training quality and on collaboration in school context.

1.2 Relevance of teacher training and collaboration for differentiated instruction

Educational experiences in terms of teacher training are indispensable pre-requisites if teachers are to deliver high instructional behavior, because what teachers learn during their university studies is crucial for their later performance and behavior in the classroom (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2009; Darling-Hammond, 2006). This applies not only to the mere knowledge teachers acquire but also to the specific practical advice they gain from their instructors (Liston, Whitcomb, & Borko, 2006). Furthermore, the perception of quality of teacher training is thought to be connected closely to instructional behavior and efficacy (Knobloch & Whittington, 2002). This behavior could be, for example, dealing with heterogeneity in achievement by performing DI. Teacher training programs differ a lot (Boyd et al., 2008), and how teachers perceive the quality of their training may also vary between different university educational programs (Darling-Hammond, Chung, & Frelow, 2002). In regard to DI, Tomlinson (2014) found that one reason for teachers' difficulties in DI was inappropriate previous teacher training at university. Hence, it can be assumed that training at university is a core requirement for high-quality DI.

Apart from the perceived quality of teacher training, features of everyday work play a meaningful role for instructional behavior (Inan & Lowther, 2010). Among other workplace characteristics, particularly collaboration between teachers has been shown to correlate with instructional behavior and professional development through learning from each other's experience and knowledge (see Ostovar-Nameghi & Sheikhahmadi, 2016). In addition, psychosocial job characteristics such as collaboration may reduce the perceived psychological costs that emerge from challenging job demands like dealing with heterogeneous groups of learners (Bakker, Hakanen, Demerouti, & Xanthopoulou, 2007; see also the Job Demands – Resources Model: Demerouti, Bakker, Nachreiner, & Schaufeli, 2001). Smit and Humpert (2012) showed that collaborations in which educational topics were addressed in team discussions exerted a positive influence on teachers' practice of DI. Moreover, collaboration was assumed to be helpful not only for practicing DI but also for preparing it (Lawrence-Brown, 2004) as well as reflecting on and improving it (Dixon et al., 2014). Dixon et al. (2014) found support for the relevance of combining both teacher training and collaboration for DI in a rather small sample of N = 41 teachers. They reported that teacher training is a meaningful educational condition for DI, and collaboration among teachers can lead to a continuous improvement in practice.

Because of the relevance of heterogeneity in achievement in the context of DI, the use and quality here of can also depend on teachers' attitudes and motivation toward this kind of heterogeneity. The conduction of DI is also related to teachers' mindsets (Gregory & Chapman, 2012). Some teachers may struggle to adapt to each student's background and abilities in an appropriate manner (Dixon et al., 2014; Tomlinson, 2014) or might not even hold positive attitudes toward DI, per-

ceive high costs in terms of the time and energy connected with DI, and not be motivated to adapt their teaching. These individual differences in attitudes and motivation may dissuade teachers from using DI.

1.3 Teacher attitudes and motivation

Apart from the direct relevance of perceived quality of teacher training and collaboration, Boyd et al. (2007) have hypothesized that teacher training might not only lead to better instructional behavior directly, but that this relation is conveyed through other teacher competencies such as motivation. It was stated that attitudes and motivation can influence teaching behavior (Rubie-Davies, Flint, & McDonald, 2012).

Next to behavioral and affective aspects of attitudes, especially cognitive aspects are described (Eagly & Chaiken, 2007). Eagly and Chaiken (1995, p. 414) define cognitive aspects of attitudes as "cognitive content consisting of the perceiver's beliefs about the characteristics of the attitude object". These attitudes may be positive or negative. Specifically, teachers' perceived utility of heterogeneous groups of learners, or perceived costs due to time and effort required for preparing the lessons can be considered as cognitive aspects of attitudes, respectively (also see Wigfield & Eccles, 2000[1]). They depict both positive and negative issues regarding a certain attitude object – in our case, groups of learners with heterogeneity in achievement. The second focal aspect of teacher competencies alongside attitudes is motivation. This can be measured by expected success (see Wigfield & Eccles, 2000). Wigfield and Eccles (2002, p. 119) provided a definition of expected success: "individual's beliefs about how well they will do on upcoming tasks, either in the immediate or longer-term future". The task to be fulfilled in our study is teaching groups of learners that display heterogeneity in achievement.

Teachers' attitudes and motivation are important competencies for dealing with many situations in the everyday school context and especially for dealing with instructional behavior (Baumert & Kunter, 2013; Butler & Shibaz, 2008; Gebauer & McElvany, 2017). The importance of teacher motivation for instructional behavior has also been highlighted empirically (Praetorius et al., 2017; Wozney, Venkatesh, & Abrami, 2006) and may therefore also be important for DI. Given this context, we assume that attitudes and motivation are crucial for dealing with different kinds of heterogeneity – especially given different levels of student achievement (Milner, 2010).

Teachers' attitudes and motivation have been shown to differ by their age (Kooij, de Lange, Jansen, Dikkers, 2008) and gender (Hartwig et al., 2017; Romi & Leyser, 2006). Older teachers showed less work related motivation, female

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1   The items of the scales utility and costs that we used were not worded with a personal connection (see Table 1). Therefore, they do not fit completely in Wigfield and Eccles' (2000) expectancy-value model, but are conceptionalized as aspects of attitudes instead of motivation.

teachers tended to show higher motivation than their male peers. Moreover, attitudes and motivation may be affected through teacher training (see Baldwin et al., 2007; Hartwig et al., 2017). Because of the underlying relevance of heterogeneity in achievement for DI and because of the empirical findings, it can be hypothesized that teachers' attitudes and motivation toward heterogeneity in achievement intercede the influence of perceived quality of teacher training and collaboration on their DI practice in heterogeneous classrooms.

1.4 The current study

As a widespread characteristic of classrooms, heterogeneity in achievement is a phenomenon that teachers need to deal with competently. DI may help to achieve the goal of supporting each student in a way adapted to her or his individual achievement. The present study aimed to investigate how teachers' perceived quality of teacher training and collaboration relate to their practice of DI. It also aimed to analyze if cognitive teacher attitudes (see Eagly & Chaiken, 2007) and motivation (see Wigfield & Eccles, 2000) mediate between these aspects and the practice of DI. Based on the aforementioned research, we investigated the following research questions:

- Can the three theoretically derived DI aspects of (a) preparing DI, (b) performing DI during classroom lessons, and (c) reflecting on DI be confirmed empirically as separate but correlated factors?

We expected to find that the different aspects of DI would be separate factors. Moreover, we hypothesized correlations between the aspects because they are all part of the same multifaceted teaching method (Hypothesis 1).

- Do perceived quality of teacher training and collaboration predict teachers' practice of DI in terms of preparing DI, performing DI during classroom lessons, and reflecting on DI after controlling for the individual characteristics age and gender?

Because of the great relevance of the perceived quality of teacher training (Darling-Hammond, 2006) and collaboration (Cuesta et al., 2016) for different measures of instructional behavior, we hypothesized that both the perceived quality of teacher training and the collaboration between teachers would be associated positively with measures of DI while controlling for age and gender (Hypothesis 2).

- Do the perceived utility and costs of heterogeneity in achievement as well as the expected success of dealing with heterogeneity in achievement mediate how the perceived quality of teacher training and collaboration relate to the practice of DI?

We expected that utility, costs, and expected success would partially, but because of the high relevance of the predictors not totally, mediate the effects of perceived quality of training and collaboration on their DI practice (Hypothesis 3).

2. Method

2.1 Participants

The sample consisted of N = 250 teachers working in 12 secondary schools in Germany. All schools were obliged by the Ministry of Education to take part in a research project investigating the implementation of a specific school type comparable to integrated schools in the German state of North Rhine-Westphalia. The individual teachers' participation in the form of filling out questionnaires was voluntary. On average, teachers were M = 39.32 years old (SD = 9.62 years) and 68.4 % were female. Their mean teaching experience was M = 9.31 years (SD = 8.71 years). Teaching qualifications varied concerning type of school and school subjects. All information was assessed in May 2014 using a standardized questionnaire with self-report measures.

2.2 Materials and procedure

The teachers answered questions on their own DI behavior in class, the perceived quality of their teacher training, their collaboration, and their attitudes and motivation toward heterogeneity in achievement. Demographic variables were also recorded. Examples of items in all scales as well as descriptives and reliabilities are reported in Table 1. For analysis, all metric items were z-standardized.

2.2.1 Preparing DI, performing DI during classroom lessons, and reflecting on DI

All DI scales had been used previously in other studies (*Studie zur Entwicklung von Ganztagsschulen* [StEG], adapted from Frey, Taskinen, Schütte, & Deutschland, 2009; *Entwicklung und Überprüfung von Kompetenzmodellen zur integrativen Verarbeitung von Texten und Bildern* [BiTe]). However, we adapted the wording slightly and dropped a few items due to content considerations that were supported by statistical coefficients. Preparing DI was measured by four items, performing DI during classroom lessons by six items[2], and reflecting on DI was measured with four items (see Table 1).

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2   Three out of nine items were omitted because they did not match the construct quite well in terms of the Learning Cycle model (Hall, 2002), which was supported by inadequate factor loadings in exploratory factor analysis. An example for an excluded item is "I make sure that all students understood the topic before beginning a new issue."

Table 1: *Scales, Examples of Items (Translated from German by the Authors), Descriptive Statistics, Reliabilities, Missing Values, and ICCs.*

Scale	Item examples	M (SD)	α	Miss. (%)	ICC
Preparing DI[A]	While preparing my lessons, I think about how different students will cope with certain material and methods. I think about how well different students' prerequisites are marked for dealing with certain material and methods.	4.84 (0.68)	.85	0.0 − 0.4	.03
Performing DI during classroom lessons[B]	I let the students work in groups or alone on exercises with divergent complexity. In my lessons, I give weaker students additional support.	4.60 (0.79)	.80	1.2 − 2.8	.06
Reflecting on DI[C]	I reflect on whether the materials and methods have been adequate for different groups of students. I reflect critically whether I estimated correctly in advance how well the students would get along with the material and methods.	3.27 (0.51)	.83	0.0 − 0.4	.07
Perceived quality of teacher training[D]	How well trained do you feel when it comes to your knowledge about heterogeneity in achievement? How well trained do you feel when it comes to practically handling heterogeneity in achievement?	4.27 (1.26)	.90	0.4	.02
Teacher collaboration[E]	How often do you collaborate with other teachers when preparing single lessons? How often do you collaborate with other teachers in terms of conducting lessons together?	3.21 (0.73)	.78	0.4 − 2.8	.04
Utility[F]	Regarding their educational learning, students profit from lessons with groups of learners with heterogeneity in achievement. Regarding their development of interests, students profit from lessons with groups of learners with heterogeneity in achievement.	3.05 (0.57)	.86	0.8 − 1.2	.05
Costs[F]	Teachers have to invest more effort in groups of learners with heterogeneity in achievement. In groups of learners with heterogeneity in achievement, it is harder to reach the goal of ideal support for the students.	2.77 (0.66)	.81	0.4 − 1.2	.04
Expected success[F]	I know that I am able to impart the expected subjects to groups of learners with heterogeneity in achievement. I am sure that I am able to adapt to students' individual problems in groups of learners with heterogeneity in achievement.	3.02 (0.49)	.84	1.2 − 5.6	.03

Note. N = 250.
Answering options: [A] 1 = *never* to 6 = *very often*; [B] 1 = *never* to 6 = *in nearly every lesson*; [C] 1 = *not true at all* to 4 = *totally true;* [D] 1 = *insufficient* to 6 = *very good*; [E] 1 = *never* to 5 = *nearly every day*; [F] 1 = *not true at all* to 4 = *totally true*;
Miss. = Missing values over all items; DI = differentiated instruction; ICC = intraclass correlations.

2.2.2 Perceived quality of teacher training

We assessed the perceived quality of teacher training in relation to heterogeneity in achievement with two items focusing on (a) knowledge and (b) practice (see Table 1; Hartwig et al., 2017). For the analyses, we reversed the polarity of the items, z-standardized them, and subsequently modeled a latent variable.

2.2.3 Collaboration

The extent to which teachers collaborated was investigated using six items that focused on different possibilities to cooperate with other teachers (selected items from Bos, Bonsen, Kummer, Lintorf, & Frey, 2009). Each item had the prompt "How often do you cooperate with other teachers . . . ?" and was followed by common educational situations such as when preparing lessons or planning specific lessons or projects (see Table 1 for a sample item).

2.2.4 Teachers' attitudes and motivation

We assessed attitudes and motivation toward heterogeneity in achievement with three 4-point scales each containing five items. Two out of the three scales focused on attitudes (utility, i.e., cognitive evaluations of the positive aspects of heterogeneity in achievement; and costs, i.e., negative evaluations). The third scale measured expected success as a facet of motivation. The scales were developed by Gebauer und McElvany (see Gebauer, McElvany, & Klukas, 2013). Their reliability, separability, and validity had been established in previous studies (e.g., Gebauer et al., 2013; Hartwig et al., 2017). Sample items and descriptive statistics are summarized in Table 1.

2.3 Data analysis

We analyzed our data with IBM SPSS Statistics 22 and Mplus 7 (Muthén & Muthén, 1998–2012). We decided to perform one-level analyses. This decision was supported by our data not being sufficient for multilevel modeling (see Maas & Hox, 2005) because we investigated only $N = 12$ schools. The intraclass correlation coefficients (ICC) of all scales ranged from .03 to .07 implying rather low school-specific variation. The first research question was answered by using confirmatory factor analyses (CFA). A general factor model was tested against a model that considered three scales as separate, but correlated latent factors. The model fits of the competing models were compared using the χ^2-difference test using the Satorra-Bentler scaling correction. To assess the predictability of the practice of DI from teachers' perceived quality of teacher training and collaboration while

controlling for age and gender, we computed a Structural Equation Model (SEM) with the independent latent variables perceived quality of teacher training and collaboration and the manifest individual teacher characteristics age and gender[3]. To answer the last research question, we specified a second SEM with the additional three mediating latent variables utility and costs of heterogeneity in achievement and expected success while dealing with heterogeneity in achievement. Predictors were allowed to correlate in both SEMs, as were the dependent variables. The models were conducted using MLR estimator and missing data were handled using the Full Information Maximum Likelihood estimator (FIML) while permitting one correlation of error values. Standardized estimates were reported. Initial descriptive analysis showed high amounts of DI and positive evaluations of perceived quality of teacher training. Likewise, teachers reported a high perceived utility and expected success for heterogeneity in achievement, but also reported on perceived costs (see Table 1).

3. Results

3.1 Structure of DI

The first research question was whether the three theoretically supposed aspects of DI can be empirically divided. Therefore, in order to identify the factor structure of the construct DI, we conducted two CFAs. The three-factor model (CFI = .96, RMSEA = .05, χ^2 = 112.86, df = 74, p < .05) depicting the separate aspects of DI (preparing DI, performing DI during classroom lesson, reflecting on DI) had a significantly better model fit ($\Delta\chi^2$ = 172.47, Δdf = 3, p < .05) than the one-factor model (CFI = .65, RMSEA = .14, χ^2 = 456.09, df = 77, p < .05) containing all aspects of DI. Likewise, the three-factor model showed smaller values of the Akaike information criterion (AIC = 8527.69) and Bayesian information criterion (BIC = 8686.16) than the one-factor model (AIC = 8928.34, BIC = 9076.24). Therefore, the three-factor model was considered to be more adequate. The three resulting factors correlated with each other from r = .35 to r = .69, and the factor loadings of all items were adequate with ranges from λ = .71 to λ = .83 (preparing DI), from λ = .48 to λ = .74 (performing DI during classroom lesson), and from λ = .57 to λ = .83 (reflecting on DI, see Figure 1). Whereas reflection on and time spent for DI correlated strongly, the weakest relation was found between DI during classroom lessons and reflecting on DI. We concluded that data supported the assumed three-dimensional factor structure of DI.

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3   Bivariate correlation between teacher age and perceived quality of teacher training was small (r = .25**).

Figure 1: Factor structure of differentiated instruction (DI)
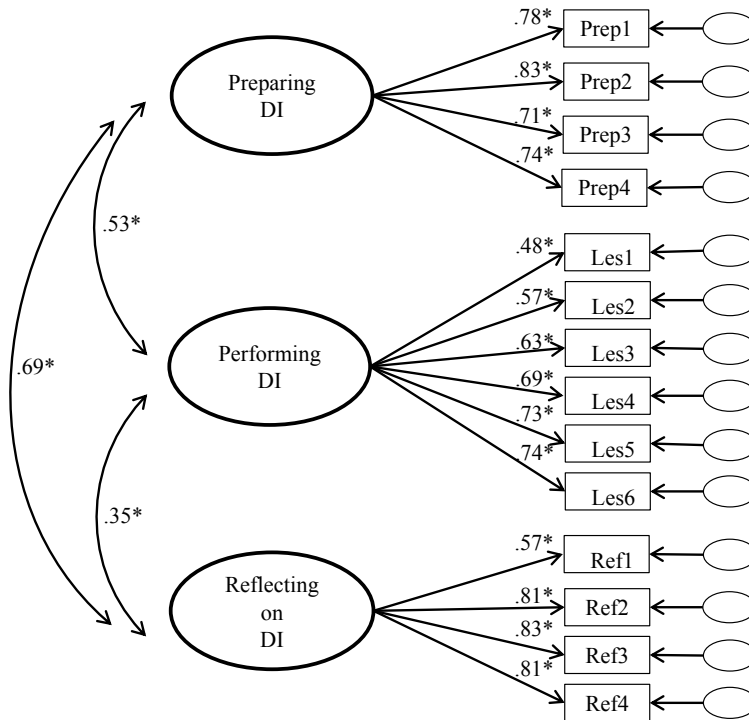
Notes. Model fit: CFI = .96, TLI = .96, SRMR = .05, RMSEA = .05, χ² = 126.50, *df* = 74, *p* < .05.
* *p* < .05.
Prep = items for the scale preparing DI, Les = items for the scale DI during classroom lesson, Ref = items for the scale reflecting on DI.

3.2 Impact of perceived quality of teacher training, collaboration, and demographic variables on DI

The second research question focused on the potential predictors of DI, which were assumed to be the perceived quality of teacher training and collaboration. To ascertain the predictive power of perceived quality of teacher training and collaboration for the previously identified multifaceted aspects of DI, we specified an SEM with a good fit (see Figure 2).[4] As expected, results showed that both the perceived quality of teacher training and collaboration predicted DI during classroom lessons significantly. The same pattern held true for preparing DI, which was additionally predicted by gender with males spending less time on preparation. Finally, reflecting on DI was predicted positively by the perceived quality of teacher training.

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4 The pattern of results did not change substantially when the diverse teaching qualifications for type of school (with vs. without qualification to teach upper secondary) and school subjects (only for language subjects vs. only for MINT subjects) were taken into account.

Figure 2:   Predictors of practice of differentiated instruction (Model 1).
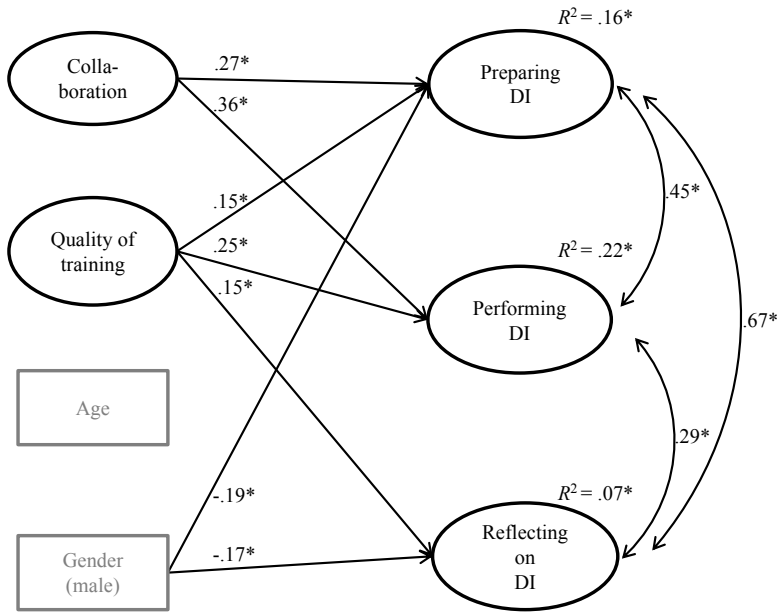
Notes. Model fit: CFI = .94, TLI = .93, SRMR = .05, RMSEA = .04, χ^2 = 343.30, df = 232, p < .05.
* p < .05;
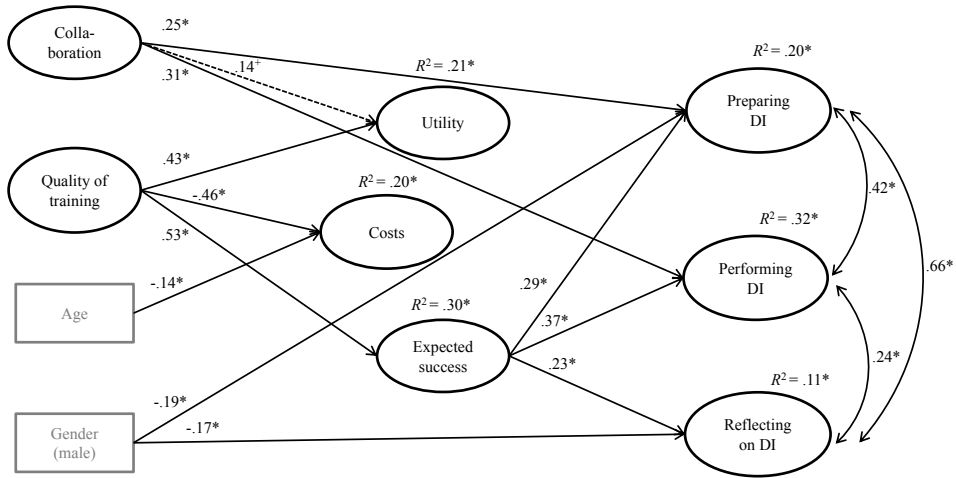age and gender = control variables.

Additionally, male teachers reflected less on DI. The variables concerning DI did not differ significantly by teacher age.[5] The model explained a decent amount of variance (see Cohen, 1992). For two scales, R^2 was moderately high (performing DI during classroom lessons: R^2 = .22, preparing DI: R^2 = .16) and 7.0 % of variance was explained for the scale reflecting on DI.

3.3 Mediating effects of attitudes and motivation

In our last research question, we investigated whether teacher attitudes and motivation toward heterogeneity in achievement were mediators between perceived teacher training quality, collaboration, and DI. The extended SEM had an adequate model fit (see Figure 3), and an SEM that included attitudes and motivation and implied mediation paths explained even more variance (performing DI during classroom lesson: R^2 = .32, preparing DI: R^2 = .20, reflecting on DI: R^2 = .11). Utility perception was predicted marginally positively by collaboration (p < .10). Perceived costs, in turn, were predicted negatively by the perceived quality of teacher training. This means that when the perception of teacher training was more

5   The pattern of results did not change substantially when teacher's age was replaced by teaching experience as a control variable.

Figure 3: Predictors of practice of differentiated instruction with teacher attitudes and motivation as mediating variables (Model 2)

Notes. Model fit: CFI = .93, TLI = .92, SRMR = .05, RMSEA = .04, χ^2 = 924.66, *df* = 656, *p* < .05.
$^+$ = *p* < .10. * = *p* < .05;
age and gender = control variables.
Indirect effects of perceived quality of teacher training on DI with expected success as mediator with 95 % confidence interval: on preparing DI = .15* [.14, .16], on DI during classroom lesson = .20* [.19, .21].

positive, fewer costs of heterogeneity in achievement were reported. Furthermore, we found differences by the individual teacher characteristics age as a control variable, with older teachers perceiving lower costs of heterogeneity in achievement. Expected success as a measure of teacher motivation predicted all three aspects of DI positively. Teacher age did not have any direct connections to on the dependent variables. Considering the relations of the mediators and the other variables, results showed that the attitude of perceived utility and the motivational aspect of expected success were predicted positively by perceived quality of teacher training. The previously identified direct paths between collaboration and performing DI during classroom lessons and preparing DI were still statistically significant. We found statistically significant mediation effects between the perceived quality of teacher training and preparing DI as well as performing DI during classroom lessons with expected success as a mediator. The corresponding indirect effects were significant (*p* < .05) with β = .15 and β = .20. The direct paths remained, but the corresponding coefficients were smaller, indicating a partial mediation. Utility and costs did not mediate relations between teacher perceived teacher training quality, collaboration and DI[6].

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6 The pattern of results did not change substantially when three separate models with only one mediator each were conducted.

4. Discussion

In light of the relevance of heterogeneity in achievement within most classrooms around the world, we examined the structure and possible predictors of teachers' instructional behavior in relation to DI. As hypothesized, we identified three separate, but correlated aspects of DI (preparing DI, performing DI during classroom lesson, and reflecting on DI). Concerning the prediction of DI by perceived quality of teacher training and collaboration, it was particularly the perceived quality of teacher training that related positively to all three aspects of DI. This finding was in line with previous research outlining the importance of perceived quality of teacher training for teacher attitudes and motivation toward heterogeneity in achievement (Hartwig et al., 2017; see also Knobloch & Whittington, 2002). Teachers who felt that they had been given the opportunity to learn adequately about dealing with heterogeneity in achievement at university not only reported conducting DI more often in their lessons but also showed higher rates of preparation in advance and reflection on DI afterwards. Furthermore, collaboration predicted teachers' performing DI during classroom lessons and preparing DI, but did not impact on reflection about DI. This pattern might have arisen due to the fact that reflection on one's behavior can also be done alone. The predictive power of collaboration has also been reported before (e.g., Smit & Humpert, 2012). In addition, current research showed that collaboration on the school level had a significant positive influence on student performance (Rubinstein & McCarthy, 2016), thereby underlining the importance of positive and constructive social relations at the workplace.

We investigated the mediating functions of (a) utility, (b) costs (see also Ajzen, 2005), and (c) expected success. In our data, a higher amount of collaboration did not have the effect of reducing perceived costs as predicted by the Job Demands–Resources Model (Demerouti et al., 2001). Whereas, contradictory to our assumptions, the perceived utility and costs did not mediate the effects of perceived quality of teacher training and collaboration on DI practice, expected success was a significant mediator for preparing DI and performing DI during classroom lessons. One interpretation for this finding is that attitudes are not as important for the relation between perceived quality of teacher training and DI as the motivational aspect of expected success. This pattern may have arisen because the attitudes surveyed here are rather cognitive aspects of teachers' appraisals (Eagly & Chaiken, 2007), whereas expected success as a measure of motivation might relate more closely to actual behavior (see Bandura's self-efficacy theory, 1977; Wigfield & Eccles, 2000). Consistent with this assumption, a recent study by Praetorius et al. (2017) found significant relations between teacher motivation and instructional behavior. The prediction of DI by collaboration was not mediated by attitudes or motivation – perhaps because this teacher characteristic was acquired rather recently. In contrast, educational experiences and the perceived quality of teacher training may be consolidated already in a better way and therefore have stronger effects on motivation and behavior. To sum up, the data partly supported our hypothe-

sis that teacher attitudes and motivation influenced DI and were influenced by the perceived quality of teacher training and collaboration themselves.

It can be weighed whether to use another conceptualization of DI in following studies. Here, we used a three-dimensional model that holds the advantage of simplicity as well as the depiction of three stages of DI – before, during, and after lessons. Hall (2002) suggests in her Learning Cycle model more components that allow a broader inclusion of educational context factors, but does not depict explicit scales. Moreover, she focuses mostly on the aspects that can be differentiated and accompanying guidelines. In Smit and Humpert's study (2012), they adapted Hall's model (2002) and used six extensive scales for assessing DI, which was not economical enough for us. Similarly, Coubergs et al., (2017) use five factors in their model. Unlike our instrument, they focus more on teachers' philosophy and actual methods than the several chronological components of DI.

Although other possible conceptualizations of DI exist, the explained variance was moderate to high in our conducted models. Nevertheless, there was still some variance we were unable to explain through the predictors perceived quality of teacher training for heterogeneity in achievement and collaboration.

4.1 Limitations

A limitation of the study is that the teachers' practice of DI was assessed by self-report. In order to eliminate possible bias (Donaldson & Grant-Vallone, 2002), future research should gather data on the DI actually displayed in lessons. This could be realized by using videography or lesson observation by trained testers (Borko, Jacobs, Eiteljorg, & Pittman, 2008). Nevertheless, earlier research has reported that when anonymity is secured and communicated to participants, statements are quite valid (see Lance & Vandenberg, 2010). In our investigation we told the teachers that the participation is voluntary and anonymous. Because of the sample's selectiveness, the results are limited in terms of generalizability. The items of the collaboration scale and the DI scale did not have specific cues to heterogeneity in achievement, which might be a reason not all paths in our models were significant. Nevertheless, except two items of the scale DI during classroom lessons, all items included hints towards heterogeneity like "different students", "different groups of students", or "weaker/stronger students". Moreover, because our study was cross-sectional, we cannot draw conclusions about the direction of the connections between attitudes and motivation and teaching practice. Longitudinal designs could investigate the direction of the effects found in the present study. Lastly, we conducted one-level analysis, so that the error estimates might be overestimated, however the small ICCs did not indicate such effects.

4.2 Future directions

We were able to show the relevance of the perceived quality of teacher training on how to deal with heterogeneity in achievement for the practice of DI. Enhanced teacher training should focus not only on DI but also on the theory and practice of dealing with heterogeneity. The same holds for promoting pre-service teachers' motivation, especially because expected success while dealing with heterogeneity in achievement proved to be an important aspect in our study. One possibility to improve motivational orientations such as expected success could be workshops that focus on heterogeneity and on how to effectively conduct lessons in this context. A current study showed the positive connection of attendance of specific trainings for teaching heterogeneous groups of learner in the field of inclusion and expected success regarding this (McElvany, Schwabe, Hartwig, & Igler, accepted). Moreover, previous research has also shown that collaboration can be improved by trainings (Tzivinikou, 2015). In addition, collaboration could be strengthened by team activities of the teaching staff and should all in all be communicated as an opportunity for professional development.

Future research should focus on the relevance of other psychosocial aspects available to teachers that may influence their use of DI. In addition to collaboration in school, research could focus on commitment to the workplace. As well as confirming the relevance of expected success while dealing with heterogeneity in achievement as a mediator between perceived quality of teacher training and DI, research could also examine what may contributes to developing a more favorable expectation of success. Furthermore, future studies should investigate other kinds of heterogeneity in school. Especially the heterogeneity emerging from inclusion is recently an important issue (Gräsel, Decristan, & König, 2017; McElvany et al., accepted). Finally, future research should also address the effects of DI on student achievement. In addition to existing studies (e.g., Decristan, Fauth, Kunter, Büttner, & Klieme, 2017; Kyriakides et al., 2009), according to our results, it is advantageous to use several scales for depicting the whole process from preparing DI and performing DI during classroom lessons to reflecting it (see Hall, 2002).

4.3 Conclusions

To sum up, the present study contributed substantially to research on DI and the meaning of perceived quality of teacher training and collaboration for conducting it. It has shown that especially the perceived quality of teacher training and collaboration are important for DI in heterogeneous classrooms. Furthermore, the mediating role of teacher motivation toward heterogeneous groups of learners is a focal addition to existing research. Our findings indicate the need to investigate training at university more closely in the area of instruction with diverse groups of learners. We were able to point out the importance of training for the actual performance of DI after graduating from university. This indicates the need for adequate

teacher training on how to deal with learning groups with heterogeneity in achievement and how to provide the best possible learning opportunities for students on all achievement levels.

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