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Published in:
Teaching and Teacher Education

DOI:
[10.1016/j.tate.2016.07.003](https://doi.org/10.1016/j.tate.2016.07.003)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2016

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Van den Hurk, H. T. G., Houtveen, A. A. M., & Van de Grift, W. J. C. M. (2016). Fostering effective teaching behavior through the use of data-feedback. *Teaching and Teacher Education*, 60, 444-451.
<https://doi.org/10.1016/j.tate.2016.07.003>

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Fostering effective teaching behavior through the use of data-feedback

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HIGHLIGHTS

- We studied the development of effective teaching behavior.
- Connecting theory and professional practice accelerates professional development.
- A standardized observational instrument was used to assess teaching behavior.
- Teachers were professionalized in a cyclic model of data-driven teaching.
- Data-feedback proves to be a lever of change in teachers' professional development.

ARTICLE INFO

Article history:

Received 11 March 2016

Received in revised form

20 June 2016

Accepted 5 July 2016

Available online 21 July 2016

Keywords:

Data feedback

Professional learning and development

Effective teaching behavior

Classroom observation

Primary education

ABSTRACT

In this study data-feedback in a cyclic model of data-driven teaching was used to enhance the teaching behavior of students registered in a master course for teachers. Differences between pre- and post-test measures in a simple one-group pre-test post-tests design proved to be significant with effect sizes ranging from $d = 0.29$ to $d = 0.76$. Improving teaching behavior in a time span of only six weeks on average is remarkable since earlier studies indicated that it takes over 15 years to master complex teaching skills with a 'natural development' of teaching skills of about 25% of a standard deviation.

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1. Introduction

At the start of their professional career in primary education all teachers in the Netherlands are by statutory requirement, qualified and competent to perform their job (Min. OC&W, 2004). At the same time, research has shown that it usually takes teachers a lot of time to master the more complex teaching skills. Cross-sectional studies in several European countries, for instance, revealed that teachers roughly need 15–20 years of teaching experience to develop the most difficult teaching skills like adapting instruction and classroom assignments to the relevant differences between pupils or teaching the use of learning strategies (Van de Grift, 2007, 2014; Van de Grift, Van der Wal, & Torenbeek, 2011). To date this is an important issue in the Netherlands since many teachers are set

to retire from education as the population continues to age in the years to come, as a result of which a large number of novice teachers will enter education (Min. OC&W, 2013). These novice teachers start working in an educational environment which is becoming increasingly more complex. Due to recent changes in legislation, schools for primary education in the Netherlands have moved towards a more inclusive learning environments in which a growing number of children with special educational needs will attend mainstream schools. At the same time the Netherlands, like all other European countries, is confronted with growing numbers of refugees and asylum seekers whose children, at some point, will enter the educational system. These recent developments bring about that novice teachers are confronted with a strongly diverging population of pupils. This makes it extremely important that teachers accelerate their professional development and master difficult teaching skills like, for instance, adapting teaching to the diverse needs of their pupils as soon as possible.

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The aim of this study is to investigate whether the development of effective teaching behavior can be accelerated in one of the modules of a master course in education. In this particular part of the master course, the teacher behavior of the participating teachers is observed with a standardized observational instrument. The development of effective teacher behavior is accelerated through the use of data-feedback in a cyclic model of data-driven teaching. The assumption behind the application of this model is that it enables students to make informed decisions regarding the improvement of their teaching behavior. An earlier study on the application of this model yielded positive results with regard to the teaching of beginning reading (Van den Hurk, Houtveen & Van de Grift, 2014). In the current study we investigate whether it is possible to accelerate the development of effective teacher behavior in general. More specifically we are interested in the possibility to accelerate the more difficult and complex teacher behavior.

2. Theoretical and empirical framework

In this section we will briefly discuss the knowledge base of effective teaching that led to the construction of the observation instrument that was used in the current study (2.1). Furthermore we will elaborate on the use of data-feedback in the cyclic model of data-driven teaching that was used (2.2).

2.1. Effective teacher behavior

After more than five decades of teacher effectiveness research, scholars generally agree that effective teacher behavior is one of the important factors that eventually will lead to students' learning gains (for reviews see: Cotton, 1995; Creemers, 1994; Ellis & Worthington, 1994; Hattie, 2009; Levine & Lezotte, 1990, 1995; Marzano, 2003; Purkey & Smith, 1983; Sammons, Hillman, & Mortimore, 1995; Scheerens, 1992; Scheerens & Bosker, 1997; Walberg & Haertel, 1992). In this study we are specifically interested in the effective behavior that teachers display in their educational practice, that is teacher behavior that can be observed in everyday lessons. Based on the above mentioned research six categories of effective teacher behavior were distinguished, namely: Creating a safe and stimulating learning climate, Efficient classroom management, Clear instruction, Activating learning, Adaptation of Teaching and Teaching learning strategies (Van de Grift & Lam, 1998; Van de Grift, 2007; Van de Grift, Van den Hurk, & Houtveen, 2016; Van de Grift et al., 2011). In this section we will elaborate on the empirical evidence for the effectiveness of these categories of teacher behavior.

2.1.1. Creating a safe and stimulating learning climate

Research shows that at least part of the differences in student achievement are accounted for by factors concerning the learning climate (Cohen, McCabe, Michelli & Pickeral, 2009; Thapa, Cohen, Guffey, & Higgins-D'Alessandro, 2013). Thapa et al. (2013) distinguished three essential factors in school climate, applicable to the within-class situation: Safety, Relations and Learning and Teaching. The subject of 'safety' concerns the basic social safety in the classroom. The importance of this subject is illustrated in the results of a large scale survey on several thousands of schools in the US, which show that students consistently rate school bullying as a severe problem (Ateah & Cohen, 2009). Clarity on rules and regulations is conditional but even more important is that teachers maintain these rules and regulations and are living up to them on a day to day basis (Evertson & Weinstein, 2013). The second factor deals with the teacher-student relation which is of importance for the motivation for learning (Davis, 2003; Osterman, 2000; Perry &

Weinstein, 1998). Next to that, positive mutual relations between students can endorse cooperative learning and mutual trust and respect (Ghaith, 2003). Research in the field of the third distinguished factor of school climate, the factor of learning and teaching, shows that teachers' expectations are of major importance for student achievement (Dusek & Joseph, 1983; Harris & Rosenthal, 1985). Furthermore it becomes clear that students' self-efficacy is strongly correlated with learning motivation and student achievement (Bandura, 1997). Teachers can enhance students self-efficacy by expressing high expectations about student achievement (Teddle, Falkowski, Stringfield, Desselles & Gervue, 1984) and by setting high but attainable learning goals (Latham & Locke, 1991).

2.1.2. Efficient classroom management

Generally accepted in education is the fact that all students can learn. The way in which they learn and the amount of time they need to do so, differs from student to student. Teachers have the important task to organize their lessons efficiently and to limit the time loss during lesson transitions, on classroom management and on maintaining order. Minimal time loss ensures optimal opportunities to learn (Creemers & Reezigt, 1996; Scheerens & Bosker, 1997). Following Carroll (1963) we differentiate between allocated time, engaged time and time on task. Although the amount of time that has to be spent on different academic subjects is formally specified (Marzano, 2007), huge differences between schools can occur in the way this allocated time is used (e.g. Houtveen & Van der Velde, 2010). The engaged time is the net amount of time used for instructional purposes. Positive correlations have been found between the amount of engaged time and student achievement (see further: Marzano, 2003; Scheerens & Bosker, 1997). Research shows that efficient teachers lose 15% less time than their less efficient colleagues. Furthermore they spend 50% more time on considering topic related interactions (Houtveen & Van de Grift, 2007). Time on task, sometimes indicated as 'perseverance', is the amount of time that students are actively engaged in learning tasks. Teachers are challenged to keep their students' attention focused on the learning tasks at hand.

2.1.3. Clear instruction

A clear instruction ensures that students understand the subject that is being taught and are able to combine new content with earlier acquired knowledge (Creemers, 1994; Muijs & Reynolds, 2010; Scheerens, 1992). Communicating a limited set of clearly defined lesson objectives with the students proves to be of importance (Hattie & Clinton, 2008; Smith, Baker, Hattie & Bond, 2008), as well as defining and communicating a limited set of core concepts that can work as stepping stones or advances organizers in structuring the lesson topic (Kameenui & Carnine, 1998; Lohman, 1986; Nunes & Bryant, 1996; Pearson & Fielding, 1991; Pearson & Gallagher, 1983; Pressley et al., 1992; Rosenshine & Meister, 1997). During instruction the teacher has to make sure that the students understand the subject and execute the lesson assignments as planned (Hattie & Clinton, 2008; Kameenui & Carnine, 1998; Lohman, 1986; Pearson & Fielding, 1991; Pearson & Gallagher, 1983; Rosenshine & Meister, 1997; Smith et al., 2008).

2.1.4. Activating learning

Research conducted from the sixties of the last century onwards made clear that the extent of student involvement is positively correlated with learning outcomes (Anderson, Evertson, & Brophy, 1979; Denham & Lieberman, 1980; Evertson, Anderson, Anderson, & Brophy, 1980; Fischer et al., 1980). Teachers can enhance student involvement and activate student learning by intensifying their instructions. This can be done by avoiding excessive seatwork

(Hampton & Reiser, 2004; Lang & Kersting, 2007), by posing higher order questions that promote comprehension (Craig, Sullins, Witherspoon, & Gholson, 2006; Mantione & Smead, 2003), and by replacing one-sided, teacher led communication by forms of cooperative learning (Meeuwisse, Severiens, & Born, 2010).

2.1.5. Adaptation of teaching

As 'teaching to the middle' can't meet the diverse needs of all the pupils in a classroom (Haager & Klingner, 2005), teachers should adapt the instruction and the classroom assignments to the relevant differences between their pupils. Adaptation of teaching means that teachers have to find ways to tailor their instruction to accommodate all learners. Research indicates that placing students into mixed-ability groups is more likely to lead to better results for almost all students (Walmsley & Allington, 1995; Houtveen, Booij, De Jong, & Van de Grift, 1999; Slavin, 1996), and will definitely contribute to higher self-esteem and a better motivation for learning (Bennett, 1986; Slavin & Braddock, 1993; Houtveen, 2007; Houtveen & Van de Grift, 2001). Finding ways of extending the amount of instruction time, e.g. by means of pre-teaching and re-teaching, is found to be successful when tailoring the instruction to the students' learning needs (Kidron & Lindsay, 2014).

2.1.6. Teaching learning strategies

Students use cognitive and meta-cognitive strategies to solve problems and to memorize and integrate newly acquired knowledge (Muijs & Reynolds, 2010). The use of these strategies is proven to be helpful because it ensures a reduction of the cognitive load in pupils (Shah & Oppenheimer, 2008). Teachers can help their students in acquiring these strategies and in successfully using them whenever needed. Several ways of supporting students in the acquisition and use of learning strategies have proven to be successful. Teachers can explicitly model the targeted behavior, for instance by using a think aloud method while deriving meaning from a text. Furthermore teachers can provide support through the use of scaffolds and provide corrective feedback (Carnine, Dixon, & Silbert, 1998; Dixon, Carnine, Lee & Wallin, 1998; Brophy & Good, 1986; Hattie & Clinton, 2008; Houtveen & Van de Grift, 2007; Rosenshine & Stevens, 1986; Slavin, 1996; Smith et al., 2008).

The results of earlier studies confirm the assumption that these different categories of teacher behavior can be arranged in an ascending sequence according to their level of difficulty. Put in other words, there is a specific sequence in which teachers will master these subsequent categories of teacher behavior. The first three categories, including the more elementary teaching behavior which is relatively easy to master, are: Creating a safe and stimulating learning climate (1), Efficient classroom management (2) and Clear instruction (3). The subsequent three categories comprise relatively more complex and difficult teacher behavior. These categories are: Activating learning (4), Adaptation of Teaching (5) and Teaching learning strategies (6) (Van de Grift & Lam, 1998; Van de Grift, 2007; Van de Grift et al., 2011).

2.2. Data-feedback in a cyclic model of data-driven teaching

The results of earlier research showed that the close connection between theory and professional practice is an important condition for professional learning and development (Timperley, Wilson, Barrar, & Fung, 2008; Wayman & Jimerson, 2014). A synthesis of research on teacher professional learning demonstrated that teachers who gather data about their own teaching practices and use these data to improve the effectiveness of their teaching behavior, will eventually improve their students' learning and achievement (Timperley et al., 2008). The ability to make use of different kinds of data to determine appropriate adjustments in

teaching behavior is often referred to as data literacy (Gummer & Mandinach, 2015).

In an earlier study we found that the process of collecting, analyzing and examining data on their instructional behavior enabled teachers to make informed decisions about adjustments in their instructional behavior during following lessons. In this small scale study 70 first year student teachers were involved. Close connections were sought between the knowledgebase on interactive storybook reading, taught at the teacher training college, and student teachers' experiences in providing storybook reading sessions at schools for workplace learning. These connections were established by the alternation of theory and practice in a model of data driven teaching. Firstly the theory of interactive storybook reading was dealt with in lessons at the teacher training college. Subsequently student teachers carried out interactive book reading sessions and, while doing so, were observed by their mentors who used standardized observational instruments. A digital interface provided immediate feedback of the observational results, which made it possible to discuss these results in the following lessons at the teacher college. In these lessons the student teachers formulated specific points of improvement for their next interactive storybook reading lesson in workplace learning. This second lesson was processed in exactly the same way as the first one was. The results of all the steps that were taken in this procedure, were recorded in a reflection report that all students had to write as a final assignment. The results indicated that the use of data-feedback in a cyclic model of data-driven teaching enabled student teachers in initial teacher training to significantly improve the quality of their reading lessons over a relatively short period of time (Van den Hurk, Houtveen, Van de Grift, & Cras, 2014).

In the present study we again used the procedure of data-feedback in a cyclic model for data-driven teaching that was originally adapted from Marsh (2012, p.53). The model, depicted in Fig. 1, emphasizes the connection between teachers' professional practice and the theory that is being discussed during the training in the master course. In this model the observational data, gathered in the teachers' professional practice are revalued into useful information and eventually into knowledge that can be acted upon in professional practice (see further: Marsh, 2012; Van den Hurk et al., 2014). The theory concerns the knowledge base of effective teaching that is discussed in Section 2.1. The professional practice of the participating teachers is video recorded and observed by peer-students using a standardized observational instrument (see further: Section 3.4). The connection between theory and professional practice is ensured through the use of (data-) feedback. In this process of discussing the available data all students work closely together in learning teams supervised by lecturers in the master course. The participating teachers are enabled to exchange ideas and insights in close collaboration with their peers.

Fig. 1. Model for data-driven decision making (Adapted from Marsh, 2012, p.53, p.53).

Participation in such a professional community with colleagues is seen as an integral part of professional learning that eventually has a positive impact on students (Timperley et al., 2008, p. 19). This process of discussing the available data leads to the formulation and registration of specific points of improvement of teacher behavior, to be applied in the following lessons. The tight connection between theory and professional practice ensures that the participating students are able to practice newly acquired knowledge in their everyday professional practice. Since research indicates that teachers are inclined to maintain changes in their professional practice once they have experienced the positive results (Fullan, 2007; Guskey & Yoon, 2009; Guskey, 2002), this is an important factor in sustaining the newly acquired teacher behavior.

3. Method

In this section we will start with a short description of the research design we applied (3.1). Subsequently we will describe the sample of participating teachers (3.2), the treatment (3.3), the variables that were used (3.4) and the data-analyses that were performed (3.5).

3.1. Design

The study involved a group of teachers, all registered as students in a Master Course for teachers at the Utrecht University of Applied Sciences in the schoolyear 2015–2016. Since the observations were part of the regular curriculum, all of the participating students were assigned to the treatment condition and a simple one-group pre-test-post-test design was used (Shadish, Cook, & Campbell, 2002). The application of this design asks for some prudence in the interpretation of the results. Since we are not able to use a control condition we can't be sure that possible effects are solely caused by the independent variable (i.e. the treatment).

3.2. Sample

This study involved 110 teachers, the majority of which was female (96%). The participating teachers on average had worked 9.14 (SD = 7.55) years in primary education. Slightly over 40% of the group had up to five years of experience in teaching primary education. The major part of the participating teachers was teaching pupils aged 8 through 12 (57%) while 18% was teaching pupils aged 6 and 7 and the remaining 25% of the respondents worked with pupils in the age group of 4 and 5. All of the students were certified teachers from a University of Applied Sciences (PABO), which is a form of higher professional education. In the Netherlands the teacher training programs in higher professional education are more practical orientated than the teacher training programs at a research oriented university, with a primary objective of 'the transfer of theoretical knowledge and the development of skills that are closely linked to professional practice' (EP-Nuffic, 2015). After having finished their four year bachelor's program (240 ECTS) the majority of these teachers typically start working in education. At some point in their professional career some of the teachers enroll in a master's program (60 ECTS) that either can be attended full-time (1 year) or part-time (2 year). The 110 teachers participating in this study were all enrolled as a student in such a master course.

3.3. Treatment

Prior to the start of the first module of the master course all students were assigned to make a video- or a digital recording of one of their lessons. During the first lesson of the module all

recorded lessons were independently observed by two peer students. Immediately after the observations the observers discussed the observational data in order to reach agreement on the scores. The agreed upon scores were then entered in a digital version of the observation instrument. This digital interface ensured the recording of the results and, at the same time, provided feedback reports. In this feedback report mean scores on the different scales of the observation instrument were returned to both the observed students and their lecturers. This procedure made it possible that all students had access to the observation results while the first lesson of the module was still in progress.

The next three lessons of the module are organized in a standard pattern. About half of every three hour session is spent on theory where the lecturers provide the students with theoretical and empirical background information on a specific subject matter from the knowledge base of teacher effectiveness. The second half of each session is allocated for activities in learning teams of three or four students. These learning team activities typically begin with a 10–15 min discussion about a given proposition from the specific subject matter. An example of one of the propositions regarding the subject of 'adaptation of teaching' is: "Ability grouping doesn't improve pupil achievement and is specifically harmful for pupils at risk. Why do you, or don't you agree with this proposition? Do you think that 'Round Robin Reading' will improve the reading achievement of students at risk? Why do you, or don't you think so?"

The initial discussion in the learning team is immediately followed by a closer look at the 'real-life' data obtained in the students' own professional environment. After having examined the observation results of their own lesson, every student selects at least one area of teaching behavior they see fit for improvement. Some guidelines for the interpretations of the observations are provided in the basic assumption that scale scores exceeding 2.00 can be seen as a sufficiently satisfying result. Scale scores ranging from 1.00 up to 2.00 on the other hand, can be interpreted as an indication that this specific category of teacher behavior is open to improvement.

In their learning teams all students relate the observation results and their own teaching behavior displayed in the recorded lessons with the background information that was provided by their lecturers. Learning team members question each other and suggest alternatives for the displayed teaching behavior. The discussions in these learning teams are focused on the formulation of points of improvement with regard to the students' instructional behavior in their next lessons. Although these learning team activities are basically student-led, the lecturers are permanently available if any additional support is required.

Before the fifth lesson of the module, a second lesson is video recorded. In this fifth and last lesson of the module these recordings are processed in exactly the same way as the first lesson was. The students use the feedback on both observations to write their final assignment that is assessed by their lecturers.

3.4. Training in the use of the observation instrument

Prior to the start of this module all of the participating teachers attended a three hour training session where information was provided on the theoretical background and the composition of the observation instrument. The mandatory training sessions were led by trained researchers who were experienced in the use of the observation instrument. During the training all participating teachers watched and scored a video recorded lesson. The results of these observation were discussed with the intention to find agreement between observers. Subsequently a second video recorded lesson was processed in exactly the same way. At the end

of the training sessions the mutual consensus between observers was 0.70 and all scores showed an acceptable agreement with the norm with differences of less than 0.20 of a standard deviation.

3.5. Variables

The empirical evidence from almost five decades of teacher effectiveness research was used in the construction of the ICALT (International Comparative Analysis of Learning and Teaching) observation instrument that was used in several national and international studies (Van de Grift & Lam, 1998; Van de Grift, 2007; Van de Grift et al., 2011). The 32 items of this standardized observation instrument, all referring to effective teacher behavior, are divided into six categories: Creating a safe and stimulating learning climate (4 items), Efficient classroom management (4 items), Clear instruction (7 items), Activating learning (7 items), Adaptation of Teaching (4 items) and Teaching learning strategies (6 items). The items can be scored on a 4-point scale: predominantly weak (0), more weaknesses than strengths (1), more strengths than weaknesses (2) and predominantly strong (3). In the hard-copy version of the observation instrument, every single item is illustrated with examples of 'good practice', added to focus the observers' attention and to facilitate the scoring procedure. For instance, one of the items from the category 'Efficient classroom management' is 'the teacher uses learning time efficiently'. This item is illustrated by three examples of good practice, namely: 'there is no loss of time at the start, during or at the end of the lesson', 'there are no dead moments' and 'the children are not left waiting'.

3.6. Data analyses

In order to be sure that the construct of effective teaching behavior could reliably be measured by the ICALT observation instrument, the internal consistency of the different scales again was measured using Cronbach's Alpha (Cronbach, 1951). As shown in Table 1, all of the scales proved to be consistent. The results on pre-test and post-test measures, gathered with the ICALT observation instrument, were compared by using repeated measures *t*-tests for comparing means. In order to interpret the differences that were found, effect sizes were calculated. According to Cohen (1988), effect sizes up to 0.19 SD are interpreted as negligible effects, effect

sizes from 0.20 up to 0.49 SD can be seen as small effects, effect sizes from 0.50 up to 0.79 SD are judged as medium effects and effect sizes from 0.80 and above can be considered large effects.

4. Results

In the present study we tried to answer the research question whether it would be possible to accelerate the development of effective teacher behavior through the use of data-feedback in a cyclic model of data-driven teaching. We were specifically interested in the possibility to accelerate the more difficult and complex teacher behavior. In order to answer our research question, we conducted repeated measures *t*-tests to evaluate the difference between pre-test and post-test measures on the ICALT observation scales. On average the time span between pre-test and post-test was 43 days, just over six weeks. The results of the analyses are displayed in Table 2. On the pre-test observations the average scores on Creating a safe and stimulating learning climate ($M = 2.45$, $SD = 0.56$), Efficient classroom management ($M = 2.22$, $SD = 0.57$) and Clear instruction ($M = 2.03$, $SD = 0.56$) reached values between 2.00 and 3.00, indicating that, although an adequate level of performance was already observed, these categories of teacher behavior were still open for improvement. The average scores in the categories of Activating learning ($M = 1.74$, $SD = 0.61$), Adaptation of teaching ($M = 1.43$, $SD = 0.96$) and Teaching learning strategies ($M = 1.25$, $SD = 0.74$) reached values between 1.00 and 2.00. The scores in this range indicate that an improvement of teacher behavior in these specific categories is required to sufficiently meet the needs of all the pupils in the classroom.

On the post-test observations, we found a significant increase on the average scores on all of the ICALT scales, with effect sizes ranging from 0.29 to 0.76. On the post-test observations the average scores of the participating teachers on Activating learning, one of the three categories in which an improvement was required, indicated that an adequate level of performance was reached ($M = 2.18$, $SD = 0.55$). At the same time the standard deviations of the first four categories indicate that some of the participating teachers fall short in these relatively easy to master categories of teacher behavior. The standard deviations of the last two categories of teacher behavior show an even larger spread in scores, indicating that a fair part of the participating students still score well below mastery level.

Although an increase of the mean scores on all of the assessed categories of effective teacher behavior was found on the post-test measurements, the trend in the mutual proportions of the scores on the different categories roughly stayed the same over the two measurements (Fig. 2).

5. Conclusion and discussion

Recent developments in the Netherlands have led to an educational environment which is becoming increasingly more complex.

Table 1
Reliability of the ICALT observation scales ($n = 110$).

	Cronbach's alpha	
	Pre-test	Post-test
1 Creating a safe and stimulating learning climate (4)	0.79	0.79
2 Efficient classroom management (4)	0.70	0.69
3 Clear instruction (7)	0.77	0.77
4 Activating learning (7)	0.73	0.77
5 Adaptation of teaching (4)	0.82	0.73
6 Teaching learning strategies (6)	0.81	0.84

Table 2
Results on the ICALT observation scales ($n = 110$).

	Pre-test	Post-test	Difference	
	M (SD)	M (SD)	Sign.	ES
1 Creating a safe and stimulating learning climate (4)	2.45 (0.56)	2.60 (0.48)	0.01	0.29
2 Efficient classroom management (4)	2.22 (0.57)	2.42 (0.52)	0.01	0.37
3 Clear instruction (7)	2.03 (0.56)	2.35 (0.47)	0.01	0.62
4 Activating learning (7)	1.74 (0.61)	2.18 (0.55)	0.01	0.76
5 Adaptation of teaching (4)	1.43 (0.96)	1.89 (0.84)	0.01	0.51
6 Teaching learning strategies (6)	1.25 (0.74)	1.78 (0.75)	0.01	0.71

Fig. 2. Results on the ICALT observation scales ($n = 110$).

At the same time many experienced teachers are set to retire from education in the years to come, as a result of which a large number of less experienced and less skillful novice teachers will enter education. This makes it worthwhile to find out whether teachers' professional development can be accelerated in order to maintain the high quality educational system that we strive for. Furthermore we take into account that data-driven teaching is an important lever of change in the process of teachers' professional learning and development. In this study we answered the research question it would be possible to accelerate the development of effective teacher behavior through the use of data-feedback in a cyclic model of data-driven teaching. The quality of teacher behavior was observed with the ICALT observation instrument, containing 32 items divided into six scales: Creating a safe and stimulating learning climate, Efficient classroom management, Clear instruction, Activating learning, Adaptation of Teaching and Teaching learning strategies (Van de Grift & Lam, 1998; Van de Grift, 2007; Van de Grift et al., 2011).

The results of the current study showed a sufficient internal consistency of the different scales of the ICALT observation instrument. The analyses of pre-test and post-test observation results proved that the participating students on average succeeded in significantly improving their scores on all of the assessed categories of effective teaching behavior. The effect sizes of the gains on the post-test observations ranged from $d = 0.29$ to $d = 0.76$. The results were obtained after an intervention at a master course for teachers where a model of data-driven decision making was used with a strong emphasis on the connection between the participating teachers' professional practice and the theory of effective teacher behavior. The participating teachers succeeded in improving their teaching behavior in a relatively short time span of 43 day on average which is a time span just slightly over six weeks. These results are in line with the results of our previous work, where we found that student teachers in initial teacher training were able to significantly improve the quality of their interactive storybook reading lessons over a relatively short period of time (Van den Hurk et al., 2014). We have to bear in mind that this is the first time that participating teachers are confronted with the processing of data-feedback on their own instructional behavior. In one of the following modules the same procedure is repeated when the students again are challenged to improve their instructional behavior, this time in literacy lessons. It is fair to state that by the end of the master course they have the skills to execute the routines and they have gained some valuable experiences in doing so. Completing the procedure of data-feedback in a cyclic model of data-driven teaching two times in this master course however, does not ensure that teachers will make use of the procedure in the context of their own professional practice.

The results of earlier studies have indicated that the quality of teacher behavior grows over time as teaching experience increases (Shagrir, 2012; Van de Grift et al., 2011). At the same time we know, from the results of cross sectional studies in several European countries, that it roughly takes 15–20 years of experience to develop the most difficult teaching skills (Van de Grift, 2007; Van de Grift et al., 2011). Furthermore a recent study in secondary education proved that the 'natural development' of teaching skills is about 25% of a standard deviation (Maulana, Helms-Lorenz, & van de Grift, 2015). The results of the current study indicate that the natural development of teaching skills can be accelerated. This is an extremely important finding given the fact that novice teachers have to cope with an educational environment which is becoming increasingly more complex. Speeding up the professional development of these staff members is essential in maintaining and improving the quality of the educational system. Furthermore, the results of this study indicate that this accelerated development seems to be caused by the application of the treatment in which data-feedback was placed in a cyclic model of data driven teaching. As earlier research has indicated, teachers who gather data about their own teaching practices and use these data to improve the effectiveness of their teaching behavior, will eventually improve their students' learning and achievement (Timperley et al., 2008). The application of the model for data-feedback ensured the connection of 'real-life' data obtained in the students' own professional environment with evidence from research on teacher effectiveness. The participating students were able to actively apply and practice newly acquired knowledge and skills in their everyday professional practice. This is a very important aspect, since earlier research has shown that a close connection between theory and professional practice is an important condition for professional learning (Timperley et al., 2008; Wayman & Jimerson, 2014). Another interesting finding in the current study is that the trend in the mutual proportions of the scores on the different categories of effective teacher behavior roughly stayed the same over the two measurements. This finding also seems to be in line with the results of earlier research where was found that the different categories of teacher behavior can be arranged in an ascending sequence according to their level of difficulty. Put in other words, there is a specific sequence in which teachers will master these subsequent categories of teacher behavior (Van de Grift et al., 2011).

Some limitations of the study should be discussed. Although we are convinced of the benefits of the application of the model of data-based decision making in our master course, the application of a simple one group pre-test post-test design calls for some consideration. Due to the absence of a control condition, we can't be sure that the discovered effects are caused by the independent variable in this study. In their final assignments however, the students reflected on what they saw as probable causes for the obtained results. A large part of the participating students mentioned the fact that they were explicitly challenged to formulate alternative teaching behavior, as an important lever of change. Another important reason was found in the opportunities the students were given to employ the alternative teacher behavior in their own professional practice. It goes without saying that in future studies, whenever possible, the application of an experimental design should be considered. A second point of concern is the fact that the recorded lessons are observed and judged by fellow students. As stated in 3.4 a lot of time and effort was spent in a training of the use of the ICALT observation instrument. The acceptable interrater reliability that was reached in these training sessions does not assure that all the other results of the observed lessons are completely without bias.

However important this average acceleration of teacher development may be, it is important to keep in mind that there is a large

spread in individual scores in the different categories. This means that a considerable group of teachers still scores well below target, specifically in the more difficult categories of teaching behavior. Further research is needed to find out whether or not for these teachers an extended intervention could be successful. Furthermore we are very curious whether the obtained results are sustainable over time. This means that in a future study we could use a third, and possibly even a fourth observation moment, scheduled some time after the participating students have finished the master course. In addition it is interesting to find out whether or not there is a transfer of skills to the participating teachers own professional context. In other words do the participating teachers still make use of some sort of data-feedback procedures concerning their own, or their colleagues', instructional behavior.

The results of this study lead to the conclusion that it is possible to significantly improve relevant teacher behavior through the use of data-feedback in a cyclic procedure of data-driven teaching. It is striking that these improvements occur over a relatively short period of time. In the meantime course evaluations have indicated that both lecturers and participating students experience positive developments in students' knowledge and skills. Therefore we will continue to use the procedure in our master course for teachers. At the same time we are convinced that novice teachers could capitalize on the advantages of the implementation of this procedure in their current professional practice. Therefore it could be worthwhile to incorporate a procedure of data-feedback in a cyclic model of data driven teaching in novice teacher coaching programs or in teacher induction projects.

References

- Anderson, L. M., Evertson, C. M., & Brophy, J. E. (1979). An experimental study of effective teaching in first-grade reading groups. *The Elementary School Journal*, 79(4), 193–223.
- Ateah, C., & Cohen, I. (2009). School victimization and bullying experiences: Cross-national comparisons between Canada and the United States. *Currents: Scholarship in the Human Services*, 8(1), 1–22.
- Bandura, A. (1997). *Self-efficacy: The exercise of self-control*. New York: Freeman.
- Bennett, C. I. (1986). *Comprehensive multicultural education: Theory and practice*. Boston: Allyn and Bacon.
- Brophy, J., & Good, T. L. (1986). Teacher behavior and student achievement. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (pp. 328–375). New York: Macmillan.
- Carnine, D., Dixon, R., & Silbert, J. (1998). Effective strategies for teaching mathematics. In E. Kameenui, & D. Carnine (Eds.), *Effective teaching strategies that accommodate diverse learners* (pp. 93–112). Columbus, OH: Merrill.
- Carroll, J. (1963). A model of school learning. *The Teachers College Record*, 64(8), 723–723.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Cohen, J., McCabe, L., Michelli, N. M., & Pickeral, T. (2009). School climate: Research, policy, practice, and teacher education. *The Teachers College Record*, 111(1), 180–213.
- Cotton, K. (1995). *Effective schooling practices: A research synthesis, 1995 update*. Portland, OR: Northwest Regional Educational Laboratory.
- Craig, S. D., Sullins, J., Witherspoon, A., & Gholson, B. (2006). The deep-level-reasoning-question effect: The role of dialogue and deep-level-reasoning questions during vicarious learning. *Cognition and Instruction*, 24(4), 565–591.
- Creemers, B. P. (1994). *The effective classroom*. London: Cassell.
- Creemers, B. P., & Reezigt, G. J. (1996). School level conditions affecting the effectiveness of instruction. *School Effectiveness and School Improvement*, 7(3), 197–228.
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3), 297–334.
- Davis, H. A. (2003). Conceptualizing the role and influence of student-teacher relationships on children's social and cognitive development. *Educational Psychologist*, 38(4), 207–234.
- Denham, C., & Lieberman, A. (1980). *Time to learn. A review of the beginning teacher evaluation study*. Washington, DC: National Institute of Education.
- Dixon, R., Carnine, D., Lee, D., Wallin, J., & Chard, D. (1998). *Review of high quality experimental mathematics research: Report to the California state board of education*. Eugene, OR: National Center to Improve the Tools of Educators.
- Dusek, J. B., & Joseph, G. (1983). The bases of teacher expectancies: A meta-analysis. *Journal of Educational Psychology*, 75(3), 327–346.
- Ellis, E. S., & Worthington, L. A. (1994). *Research synthesis on effective teaching principles and the design of quality tools for educators*. Eugene, OR: University of Oregon.
- EP-Nuffic. (2015). *Education system the Netherlands*. Retrieved from <https://www.epnuffic.nl/en/publications/find-a-publication/education-system-the-netherlands.pdf>.
- Evertson, C. M., Anderson, C. W., Anderson, L. M., & Brophy, J. E. (1980). Relationships between classroom behaviors and student outcomes in junior high mathematics and English classes. *American Educational Research Journal*, 17(1), 43–60.
- Evertson, C. M., & Weinstein, C. S. (2013). *Handbook of classroom management: Research, practice, and contemporary issues*. Mahwah, NJ: Laurence Erlbaum Associates.
- Fischer, C., Berliner, D., Filby, N., Marliave, R., Cahen, L. S., & Dishaw, M. M. (1980). Teaching behaviors, academic learning time, and student achievement: An overview. In C. Denham, & A. Lieberman (Eds.), *Time to learn* (pp. 7–32). Washington DC: Department of Education and the National Institute of Education.
- Fullan, M. (2007). Change the terms for teacher learning. *Journal of Staff Development*, 28(3), 35–36.
- Ghaith, G. (2003). The relationship between forms of instruction, achievement and perceptions of classroom climate. *Educational Research*, 45(1), 83–93.
- Gummer, E. S., & Mandinach, E. B. (2015). Building a conceptual framework for data literacy. *Teachers College Record*, 117(4), 1–12.
- Guskey, T. R. (2002). Professional development and teacher change. *Teachers and Teaching: Theory and Practice*, 8(3), 381–391.
- Guskey, T. R., & Yoon, K. S. (2009). What works in professional development. *Phi Delta Kappan*, 90(7), 495–500.
- Haager, D., & Klingner, J. K. (2005). *Differentiating instruction in inclusive classrooms: The special educator's guide*. Columbus, OH: Merrill.
- Hampton, S. E., & Reiser, R. A. (2004). Effects of a theory-based feedback and consultation process on instruction and learning in college classrooms. *Research in Higher Education*, 45(5), 497–527.
- Harris, M. J., & Rosenthal, R. (1985). Mediation of interpersonal expectancy effects: 31 meta-analyses. *Psychological Bulletin*, 97(3), 363.
- Hattie, J. (2009). *Visible learning: A synthesis of 800 meta-analyses on achievement*. London: Routledge.
- Hattie, J., & Clinton, J. (2008). Identifying accomplished teachers: A validation study. In L. C. Ingvarson, & J. Hattie (Eds.), *Assessing teachers for professional certification: The first decade of the National Board for Professional Teaching Standards* (Vol. 11, pp. 313–344). Amsterdam: Elsevier Press.
- Houtveen, A. (2007). *Leren lezen is te leren*. In *Reading can be learned*. Utrecht: Kenniscentrum Educatie.
- Houtveen, A., Booij, N., De Jong, R., & Van de Grift, W. (1999). Adaptive instruction and pupil achievement. *School Effectiveness and School Improvement*, 10(2), 172–192.
- Houtveen, T., & Van de Grift, W. (2001). Inclusion and adaptive instruction in elementary education. *Journal of Education for Students Placed at Risk*, 6(4), 389–409.
- Houtveen, A., & Van de Grift, W. (2007). Effects of metacognitive strategy instruction and instruction time on reading comprehension. *School Effectiveness and School Improvement*, 18(2), 173–190.
- Houtveen, A., & Van der Velde, V. (2010). *Rapportage Pilots Taalbeleid onderwijs-sachterstanden over de schooljaren 2007-2008 en 2008-2009*. Utrecht: Kenniscentrum Educatie.
- Kameenui, E. J., & Carnine, D. (Eds.). (1998). *Effective teaching strategies that accommodate diverse learners*. Upper Saddle River, NJ: Prentice Hall.
- Kidron, Y., & Lindsay, J. (2014). *The effects of increased learning time on student academic and nonacademic outcomes: Findings from a meta-analytic review (REL 2014-015)*. Washington DC: Regional Educational Laboratory Appalachia.
- Lang, J. W., & Kersting, M. (2007). Regular feedback from student ratings of instruction: Do college teachers improve their ratings in the long run? *Instructional Science*, 35(3), 187–205.
- Latham, G. P., & Locke, E. A. (1991). Self-regulation through goal setting. *Organizational Behavior and Human Decision Processes*, 50(2), 212–247.
- Levine, D. U., & Lezotte, L. W. (1990). *Unusually effective schools: A review and analysis of research and practice*. Madison, WI: National Centre for Effective School Research and Development.
- Levine, D. U., & Lezotte, L. W. (1995). Effective schools research. In J. A. Banks, & C. A. M. Banks (Eds.), *Handbook of research on multicultural education* (pp. 525–547). New York: Macmillan.
- Lohman, D. (1986). Predicting mathematanic effects in the teaching of higher-order thinking skills. *Educational Psychologist*, 21, 191–208.
- Mantione, R. D., & Smead, S. (2003). *Weaving through words: Using the arts to teach reading comprehension strategies*. Newark, DE: International Reading Association.
- Marsh, J. (2012). Interventions promoting educators' use of data: Research insights & gaps. *Teachers College Record*, 114(11), 1–48.
- Marzano, R. J. (2003). *What works in schools: Translating research into action*. Alexandria, VA: ASCD.
- Marzano, R. J. (2007). *The art and science of teaching: A comprehensive framework for effective instruction*. Alexandria, VA: ASCD.
- Maulana, R., Helms-Lorenz, M., & van de Grift, W. (2015). Development and evaluation of a questionnaire measuring pre-service teachers' teaching behaviour: A rasch modelling approach. *School Effectiveness and School Improvement*, 26(2), 169–194.

- Meeuwisse, M., Severiens, S. E., & Born, M. P. (2010). Learning environment, interaction, sense of belonging and study success in ethnically diverse student groups. *Research in Higher Education*, 51(6), 528–545.
- Min. OC&W. (2004). *Wet op de beroepen in het onderwijs* [Professions in Education Act]. Zoetermeer: Ministerie van OC&W.
- Min. OC&W. (2013). *Lerarenagenda 2012–2020. De leraar maakt het verschil* [Teachers Calendar 2013–2020. The teacher makes the difference]. Zoetermeer: Ministerie van OC&W.
- Muijs, D., & Reynolds, D. (2010). *Effective teaching: Evidence and practice*. London: Sage.
- Nunes, T., & Bryant, P. (1996). *Children doing mathematics*. Oxford: Wiley-Blackwell.
- Osterman, K. F. (2000). Students' need for belonging in the school community. *Review of Educational Research*, 70(3), 323–367.
- Pearson, P. D., & Fielding, L. (1991). Comprehension instruction. In *Handbook of reading research* (Vol. 2, pp. 815–860).
- Pearson, P. D., & Gallagher, M. C. (1983). The instruction of reading comprehension. *Contemporary Educational Psychology*, 8(3), 317–344.
- Perry, K. E., & Weinstein, R. S. (1998). The social context of early schooling and children's school adjustment. *Educational Psychologist*, 33(4), 177–194.
- Pressley, M., Wood, E., Woloshyn, V. E., Martin, V., King, A., & Menke, D. (1992). Encouraging mindful use of prior knowledge: Attempting to construct explanatory answers facilitates learning. *Educational Psychologist*, 27(1), 91–109.
- Purkey, S. C., & Smith, M. S. (1983). Effective schools: A review. *The Elementary School Journal*, 83(4), 427–452.
- Rosenshine, B. V., & Meister, C. (1997). Cognitive strategy instruction in reading. In S. A. Stahl, & D. A. Hayes (Eds.), *Instructional models in reading* (pp. 85–107). Hillsdale, NJ: Lawrence Erlbaum.
- Rosenshine, B., & Stevens, R. (1986). Teaching functions. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 376–391). New York: Macmillan.
- Sammons, P., Hillman, J., & Mortimore, P. (1995). *Key characteristics of effective schools. A review of school effectiveness research*. London: OFSTED.
- Scheerens, J. (1992). *Effective schooling: Research, theory and practice*. London: Cassell.
- Scheerens, J., & Bosker, R. J. (1997). *The foundations of educational effectiveness*. Oxford: Pergamon.
- Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston, MA: Houghton Mifflin.
- Shagrir, L. (2012). How evaluation processes affect the professional development of five teachers in higher education. *Journal of the Scholarship of Teaching and Learning*, 12(1), 23–35.
- Shah, A. K., & Oppenheimer, D. M. (2008). Heuristics made easy: An effort-reduction framework. *Psychological Bulletin*, 134(2), 2007–2022.
- Slavin, R. E. (1996). *Education for all*. Lisse, the Netherlands: Swets & Zeitlinger.
- Slavin, R. E., & Braddock, J. H. L., II (1993). Ability grouping: On the wrong track. *College Board Review*, 168, 11–17.
- Smith, T., Baker, W., Hattie, J., & Bond, L. (2008). A validity study of the certification system of the national board for professional teaching standards. In L. C. Ingvarson, & J. Hattie (Eds.), *Assessing Teachers for Professional Certification: The First Decade of the National Board for Professional Teaching Standards* (Vol. 11, pp. 345–380). Amsterdam: Elsevier Press.
- Teddlie, C., Falkowski, C., Stringfield, S., Desselle, S., & Garvue, R. (1984). *The Louisiana school effectiveness Study: Phase two, 1982–84*. Baton Rouge LO: State Department of Education.
- Thapa, A., Cohen, J., Guffey, S., & Higgins-D'Alessandro, A. (2013). A review of school climate research. *Review of Educational Research*, 83(3), 357–385.
- Timperley, H., Wilson, A., Barrar, H., & Fung, I. (2008). *Teacher professional learning and development*. Wellington, New Zealand: Ministry of Education. Available from: <http://www.minedu.govt.nz/goto/bestevidencesynthesis>.
- Van de Grift, W. J. C. M. (2007). Quality of teaching in four European countries: A review of the literature and application of an assessment instrument. *Educational Research*, 49(2), 127–152.
- Van de Grift, W. J. C. M. (2014). Measuring teaching quality in several European countries. *School Effectiveness and School Improvement*, 25(3), 295–311.
- Van de Grift, W., & Lam, J. (1998). Het didactisch handelen in het basisonderwijs [Instruction in primary education]. *Tijdschrift Voor Onderwijsresearch*, 23(3), 224–241.
- Van de Grift, W. J. C. M., Van den Hurk, H. T. G., & Houtveen, A. A. M. (2016). *Effective Teaching. Empirical evidence for the construction of the ICALT observation instrument* (Manuscript in preparation).
- Van de Grift, W., Van der Wal, M., & Torenbeek, M. (2011). Ontwikkeling in de pedagogisch didactische vaardigheid van leraren in het basisonderwijs [Development of teacher skills in primary education]. *Pedagogische Studiën*, 88, 416–432.
- Van den Hurk, H. T. G., Houtveen, A. A. M., Van de Grift, W. J. C. M., & Cras, D. W. P. (2014). Data-feedback in teacher training: using observational data to improve student teachers' reading instruction. *Studies in Educational Evaluation*, 42, 191–206.
- Walberg, H. J., & Haertel, G. D. (1992). Educational psychology's first century. *Journal of Educational Psychology*, 84(1), 6–19.
- Walmsley, S. A., & Allington, R. L. (1995). Redefining and reforming instructional support programs for at-risk students. In R. L. Allington, & S. A. Walmsley (Eds.), *No quick fix: Rethinking literacy programs in America's elementary schools* (pp. 19–44). Newark, DE: International Reading Association.
- Wayman, J. C., & Jimerson, J. B. (2014). Teacher needs for data-related professional learning. *Studies in Educational Evaluation*, 42, 25–34.