Hindawi
Education Research International
Volume 2020, Article ID 2471956, 8 pages
https://doi.org/10.1155/2020/2471956

Research Article

Do Teachers Treat Their Students Differently? An Observational Study on Teacher-Student Interactions as a Function of Teacher Expectations and Student Achievement

Eddie Denessen,[1] **Annelies Keller**,[2] **Linda van den Bergh**,[3] **and Paul van den Broek**[2]

[1]*Leiden University, Education and Child Studies, Leiden, Radboud University, Behavioural Science Institute, Nijmegen, Netherlands*
[2]*Leiden University, Education and Child Studies, Leiden, Netherlands*
[3]*Fontys University of Applied Sciences, 's-Hertogenbosch, Netherlands*

Correspondence should be addressed to Eddie Denessen; e.denessen@pwo.ru.nl

Received 14 February 2020; Revised 6 October 2020; Accepted 11 November 2020; Published 29 November 2020

Academic Editor: Paul S. Szalay

Through classroom interactions, teachers provide their students with different opportunities to learn. Some kinds of interactions elicit more learning activities than others. With differential treatment of students, teachers may exacerbate or reduce achievement differences in their classroom. In addition, differential interactions may contribute to teacher expectation effects, with teachers treating their high-expectation students more favourably. This study investigated how differential teacher-student interactions are related to students' mathematics achievement and teachers' expectations. In eight fourth-grade classrooms in the Netherlands, interactions between teachers and students ($N = 152$) were observed in maths lessons. Data regarding teachers' expectations about their students and mathematics achievement tests scores were collected. Analyses indicated that there were relations between teacher expectations and teachers' classroom interactions. Teachers gave more direct turns and more directive feedback to their low-expectation students, who were also the students who performed low in maths. After controlling for actual achievement, it appeared that students for whom the expectations were lower than could be expected based on their performance received more direct turns and directive task-related feedback. These results point to the existence of teacher expectation effects.

1. Introduction

Primary education teachers teach heterogeneous classes in which students differ in numerous aspects, such as their cognitive abilities, their classroom behaviour, and their socioeconomic backgrounds. To ensure that all individual students in these classes can develop according to their potential, teachers should meet the educational needs of each student. One way to do so is to provide adaptive and differentiated teaching. Adaptive and differentiated teaching is meant to be tailored to specific needs of individual or small groups of students [1, 2]. The adaptation of teaching to the needs of students can be planned as part of the preparation of teaching (proactive differentiation), for example, in lesson plans in which teachers plan the instruction and assignments for different students. Adjustments can also be made during lessons (reactive differentiation), by asking questions and providing feedback in response to the observed needs of students during lessons [3, 4]

Although adaptive and differentiated teaching are seen as pedagogies that optimize learning opportunities for all students, they may unintentionally lead to negative effects for some students, especially those students who are underestimated by their teachers [5, 6]. In general, students from lower socioeconomic and minority ethnic backgrounds appear to be at risk for being underestimated by their teacher [7, 8]. Proactive, as well as reactive, differentiation can trigger these negative effects of adaptive teaching for these

groups of students. Proactive differentiation can increase unequal educational opportunities because teachers tend to form higher expectations of students from highly educated ethnic majority backgrounds and treat them accordingly, for example by selecting them for higher ability groups or providing them with more complex assignments [9]. Reactive differentiation may increase inequalities because teachers' intuitive responses to students are likely to be aligned with the expectations they have regarding their students and teachers have interactions of a higher quantity and quality with students of whom they have higher expectations [5, 6].

Thus, adaptive and differentiated teaching may have positive and negative effects on student learning. Although research on teacher expectations has a long history, it is attracting renewed attention because of recent educational policies that stress individualized, differentiated, and adaptive teaching as ways to promote optimal learning opportunities of each individual student [1]. The purpose of this study, therefore, is to clarify the extent to which adaptive and differentiated teacher behaviour is associated with teacher expectations and student achievement.

2. Theoretical Background

2.1. Teacher Expectations. Recent educational policies stress individualized, differentiated, and adaptive teaching as ways to promote the learning opportunities of each individual student [1]. To reach this goal, teaching should be tailored to individual students' needs and teachers need to engage in adaptive interactions with each student. It can be questioned, however, to what extent teachers adapt their interactions with students based on unbiased assessments of students' current level of understanding. Since Rosenthal and Jacobson [9] published their Pygmalion-in-the-classroom study, ample research has shown that teacher expectations are not always consistent with students' actual capacities. Teachers tend to form rather stable expectations about their students at the beginning of a school year, which predict student achievement during that year [7]. These expectations can be based on previous assessments of students, test results, reports provided by colleagues, and their own observations of student performance and behaviour [7, 10]. Although, in general, teacher expectations are in line with student performance and seem to be realistic, for five to ten percent of the students, teacher expectations are not in line with student performance as they are biased by student characteristics, such as their socioeconomic or cultural-ethnic background [7, 11]. When expectations are biased, self-fulfilling prophecy effects may occur: students develop in accordance with incorrect expectations [8, 11]. Students with low socioeconomic backgrounds are vulnerable for negative self-fulfilling prophecy effects [6, 11] because these students are especially at risk to be underestimated [12, 13].

Low expectations are communicated to students in several ways. For example, Howe and Abedin [14] showed in their review that teacher-initiated classroom interactions are not equally spread among all students but correlate with variables that are sources of teacher expectations. Earlier, Babad [5], Jussim and Harber [6], and Rosenthal [4] found that high-expectation students receive more turns and particularly turns of a higher quality (i.e., elaborated feedback and complex questions) than low-expectation students.

2.2. Interaction Patterns in the Classroom. The most commonly used interaction pattern during whole class teaching is the Initiative-Response-Evaluation interaction pattern (IRE [3]) during which the teacher asks a question, a student answers, and the teacher provides feedback regarding the correctness of the provided response. When the answer is (partly) wrong, the student may receive additional feedback or the question is passed on to another student. The IRE interaction pattern gives teachers a high degree of control over the classroom dialogue. They can use answers to increase involvement by checking students' understanding, asking additional questions, or adapting instruction [3, 16].

In empirical research, this IRE interaction pattern has been used to design observations of classroom dialogues. From a teacher expectations perspective, observation schemes have been developed to assess teachers' differential treatment of their students. The most commonly used are the observation schemes developed by Shute [19], in which each teacher-student interaction is observed in terms of quantity and quality of questions (turns), feedback, and follow-up. With this kind of observation scheme, whether high-expectation students engage in more and higher level interactions in classrooms can be studied. According to Flieller et al. [16], it is difficult for teachers to meet the individual needs of all students in classroom dialogue during whole class teaching. They state that this is easier to realise during individual work following whole class teaching. During that phase of the lesson, teacher-student interactions can become more extensive and better adjusted to students' individual needs [16]. Regarding the type of feedback that is provided by the teacher during individual work, recent studies have broadened the scope. Recent research on feedback [18–20] has elaborated the types of feedback that can be provided and the way in which feedback is given by teachers to effectively meet students' needs.

2.3. Effective Feedback. The purpose of feedback is to reduce the gap between present and expected performance in light of the learning goal that should be achieved [18, 19]. Feedback can be the most powerful tool to support students' learning, but effects depend on the quality of the feedback interactions. Effective feedback is goal related, focused on students' metacognition, and contains feed forward [18, 19].

The focus of feedback can lie on the task, the process, the metacognition, or the self [18, 20]. Feedback on the task provides information about whether a given answer is correct or (partly) wrong and about whether a task is performed well. Feedback on the process provides students with information about the way they process the information to understand and perform their task. Feedback on the metacognition informs students about how they plan, monitor, or reflect on their task. Feedback on the self gives students information about themselves as a person [18].

Besides the focus of feedback, feedback can be given either in a directive or facilitative way [19, 20]. When giving directive feedback, teachers tell students how to process information or how to carry out a task or they ask questions for which they expect a certain answer. With the use of facilitative feedback, teachers prompt students to think by asking them open-ended questions or by giving them hints that facilitate learning and help students construct their knowledge [21]. Directive feedback is most effective when a new concept is taught. When students become more experienced with a concept, facilitative feedback is more effective [19]. In general, compared to directive feedback, facilitative feedback is considered to foster higher level learning.

3. Research Question and Hypotheses

Prior research [5, 7, 14, 15] shows that interaction patterns in the classroom are related to teacher expectations, for example, through an uneven distribution of turns among students [14]. Furthermore, teachers provide their high-expectation students with feedback of a higher quality than their low-expectation students (e.g., [4, 7]). Students with disadvantaged backgrounds are especially at risk to be underestimated and, thus, achieve below their abilities [11, 12]. Given the recent educational policies that stress individualized and adaptive teaching as ways to promote the learning opportunities of each individual student, the purpose of this study was to explore how teachers treated students differentially when they had varying levels of expectations and achievement.

We aim to give renewed attention to teachers' differential treatment of students with a specific focus on teachers' feedback interactions with their students. If the quality of feedback is related to student achievement and to teachers' over- or underestimations of their students, then these feedback interactions may contribute to increased unequal educational opportunities.

To gain insight into these mechanisms, our research question was to what extent are differential classroom interactions affected by student achievement and teacher expectations?

We hypothesised classroom interactions to be related to student achievement and teachers' expectations of their students and, more specifically, that high achievement levels and high expectations were associated with more turns and feedback of higher quality.

4. Method

4.1. Participants and Context. To answer our research question, we have conducted our study in primary school classrooms in the Netherlands. Teacher-student interactions were observed in eight fourth-grade classes (9–10 year-old students) in the western part of the Netherlands. In these classes the population consisted mainly of children of Dutch origin (85%).

Teachers (5 female; 3 male) differed with respect to their experience, ranging from less than five years to more than ten years. The number of students per class ranged from 19 to 28 with an average of 24, adding to a total of 189. The students' parents were asked for active consent for their child to participate in this study and for the school to provide data on their child's academic achievement. Parents of 156 students gave active consent. Parents of 10 students withheld their consent, and parents of 23 students did not respond. Students without parental consent were not included in the analyses. From these 156 students, schools did not provide the achievement data from 4 of them, resulting in a final sample of 152 students.

This study has been approved by the Ethics Review Board (ECPW) of the Institute of Educational and Child Studies, Leiden University (file number ECPW2017-159).

4.2. Measures

4.2.1. Teacher Expectations Questionnaire. Teacher expectations were measured with four items per student that asked teachers to rate on a five-point Likert scale (1 *not applicable at all* to 5 *totally applicable*). We used the following items: "<*name*> will be successful in secondary education," "<*name*> will receive high grades for all subjects at secondary education," "<*name*> will not achieve high grades at the end-of-primary-school tests," and "<*name*> will definitely have a successful career" [c.f. 15]. After recoding the scores on the negatively formulated item, the four items assessed teacher expectations with a high level of consistency (Cronbach's $\alpha = .87$).

4.2.2. Academic Achievement. Students' most recent national standardized mathematics test scores were collected as a teacher-independent measure of achievement. These tests from the Dutch National Institute for Educational Measurement (Cito, see cito.nl) are administered to students in the Netherlands each year to monitor student progress. The maths tests start with a maths dictation task, and after that, the students work independently with a test booklet and answer sheet. The maths tests contain different kinds of maths problems, including mental arithmetic and questions about money or time. The scoring was performed according to norm tables provided by Cito and ranged from 1 to 5.

4.2.3. Teacher-Student Interaction Observation Scheme. To observe teacher-student interactions, we used an observation scheme based on the original Brophy and Good [17] observation scheme. Turn categories at students' level were taken from this scheme as presented in Table 1. Feedback categories were taken from recent research about effective feedback [18–20] and coded using a previously designed and validated feedback observation scheme [20]. The provided feedback was scored in terms of focus (task, process, metacognition, or self) and of whether feedback was given in a directive or facilitative way [19, 20] (see Table 1 for examples).

4.3. Procedure. We observed 24 maths lessons (three lessons per teacher) within a period of two months. The average duration of observed lessons was 50 minutes ($SD = 8$, Range

Table 1: Observed turns and feedback categories with examples.

Observed category		Explanation
Turns	Direct	The teacher asks a question directly to a student without the student raising hands. Sometimes this is carried out by random name picking
	Public	The teacher asks a question in public, and students can apply for getting turns by raising hands
	Aloud	Students calling the answer aloud without having got the turn and get response from the teacher
	Student initiative	The student asks and gets a turn to ask a question or asks for help during individual work
Feedback	Task	Information or questions about the task and about whether an answer is correct or incorrect
	Directive	"From 100 to 900, that is how much more?"
	Facilitative	"Try to explain what they mean in the exercise book"
	Process	Information or questions about the learning process or chosen strategy
	Directive	"One is centimeter, the other meter, what will be your first step?"
	Facilitative	"What would be your way of computing?"
	Metacognition	Information or questions about planning of or reflection on work.
	Directive	"What did we practice? When you do not know how to continue, you skip the exercise and pass on to the next one"
	Facilitative	"What difficulties did you come across?"
	Self	Praise or criticize the student as a person (also including encouraging or nonspecific remarks)
		"Perfect, girl"
		"I already thought you could not explain, you are only chatting with your neighbour"

31–64 min.). Observations were all carried out by one observer (the second author). Before the observations, the observer practiced observing and coding Dutch maths lessons with video recordings of mathematics lessons and with live observations in two classes that did not participate in this study. Observations were discussed with the first author. Prior to the observations, teachers were told observations would be carried out on teacher-student interactions and on the way teachers interact with different students. After the observations and completion of the questionnaire, teachers were fully briefed about the purpose of our study. All data were processed anonymously.

The observation scheme was used during whole class teaching and during individual (or small group) work. Each observed interaction started with recording the type of turn and the student who received this turn. In teacher-student interactions, reactions of teachers (either stated as a remark or as a question) on answers or utterances by students (either oral or written on whiteboards or in exercise books) were considered as feedback. Teachers could have multiple feedback interactions with a different focus within one turn. If teachers had multiple feedback interactions with different foci within one turn, they were all categorised separately. Per lesson, we coded on average 53 ($SD = 10$) turns and 69 ($SD = 12$) feedback interactions.

Some teachers first gave whole class instruction, followed by individual (or small group) work, and some teachers switched from whole class teaching to individual work several times within a single lesson. Sometimes, a mix of instruction and individual work was observed, for example, when teachers provided tiered instruction to a small group of struggling students. When teachers taught a smaller group of students with such a loud voice that all students could hear the instruction, the lesson phase was coded as whole class teaching, since the teacher can be heard by all students, giving them the opportunity to learn from it [19]. When teachers gave tiered instruction to small groups, meanwhile monitoring the rest of the classroom working independently, we coded this as individual work. During the observations, teachers used a remote microphone and the observer used a headset to make sure all remarks, also those in a whispering voice, were recorded.

After transcription of the observations, the feedback focus was scored: feedback on the *task*, the *process*, *metacognition*, and the *self*. For feedback on the task, the process, and metacognition, we distinguished whether this was given in a directive or facilitative way, resulting in the variables *directive* and *facilitative*. Nonspecific remarks, such as "well done," without reference to what was done well, were also coded as feedback on the self.

For each student, these variables were coded during whole class teaching and during individual work. For each variable, we computed frequencies per student. One of the students never attended a lesson during whole class teaching; therefore, we had one participant less in our analyses of whole class teaching.

To prevent observations from being influenced by teachers' knowledge about the purpose of this study, teachers filled out the teacher expectations questionnaire after the third observation. Data on students' academic achievement scores also were collected after the third observation.

4.4. Data Analyses. To answer the research questions, we conducted correlational analyses on the relations between teacher expectations and student achievements with classroom interactions during different phases of their lessons. To assess the relations of biased teacher expectations with teacher-student interactions, partial correlations were calculated between teacher expectations and interactions, controlling for student achievement. Since achievement scores and teacher expectations might vary across classrooms and the relations between teacher expectations and

achievement with classroom interactions might be caused by different mean levels of expectations and achievements between classrooms and teachers (see, for example, the differences between high- and low-expectation teachers, as presented by Rubie-Davies [7]), we performed correlational analyses across classrooms and within classrooms. For the calculation of effects within classrooms, we standardized teacher expectations and achievement scores within each classroom.

5. Results

5.1. Descriptive Findings. In Table 2, the means and standard deviations are presented of children's academic achievement and teacher expectations, as well as the lowest (M_{min}) and the highest (M_{max}) mean score of the teachers.

The differences between classrooms or teachers for academic achievements (Kruskall–Wallis = 30.70, df = 7, $p < 0.01$), as well as for teacher expectations (Kruskall–Wallis = 31.70, df = 7, $p < 0.01$), were statistically significant. This means that the performance levels and the levels of teacher expectations were relatively high in some classrooms and low in others. The correlation between achievement and expectations was moderately high ($r = 0.67$, $p < 0.01$). For one teacher, there was no relation between student achievement and teacher expectations ($r = 0.00$), whereas for the other seven teachers, the correlations were substantial (ranging from 0.60 to 0.83). We checked whether the exclusion of this teacher from the analyses would change the results of further analyses. As this was not the case, we decided to not remove this teacher from further analyses.

Tables 3 and 4 report the means and standard deviations of the teacher-student interactions during whole class teaching and individual work, respectively: type of turns, focus of feedback, and way of giving feedback. The total number of interactions per students ranged from 0 to 116. Three students were not observed to have any interaction with their teacher during the observed three lessons. The type of turns students received showed distinct differences for whole class teaching and individual work. In both settings, direct turns were given relatively often, but during whole class teaching, public turns were given more frequently than during individual work. During individual work, in contrast, interactions were initiated more frequently by students themselves than during whole class teaching. Regarding the type and way of feedback, during whole class teaching, as well as during individual work, the focus was mostly on the task and was given predominantly in a directive way.

5.2. Relations of Teacher-Student Interactions with Student Achievement and Teacher Expectations. To analyse how teacher-student interactions were related to student achievement and teacher expectations, we conducted separate correlational analyses for each teacher-student interaction variable during whole class teaching (Table 3) and individual work (Table 4).

Table 2: Descriptive statistics for academic achievement and teacher expectations (range 1–5; $N = 152$).

	M	SD	M_{min}	M_{max}
Academic achievement	2.99	1.38	1.89	4.00
Teacher expectations	3.58	0.91	3.07	4.13

5.2.1. Teacher-Student Interactions during Whole Class Teaching. Table 3 shows the results of the analyses of correlations of teacher-student interactions with student achievement and teacher expectations. It appeared that a few interactions were related to students' level of achievement. Overall, teachers gave differently performing students similar numbers of turns and types of feedback. A statistically significant finding was that low-performing students appeared to receive more self-related feedback than high performers ($r = -0.18$, $p < 0.05$). This correlation was no longer significant when differences between teachers were controlled for. Thus, giving more self-related feedback to students appeared to be more a between-teacher than a within-teacher difference. Controlling for differences between teachers, it appeared that, within classes, teachers gave more direct turns ($r = -0.18$, $p < 0.05$) and task-related ($r = -0.17$, $p < 0.05$) and directive feedback ($r = -0.17$, $p < 0.05$) to low-achieving students.

Teachers had more interactions with their low-expectation students ($r = -0.22$, $p < 0.01$). They gave more direct ($r = -0.23$, $p < 0.01$) and public turns ($r = -0.16$, $p < 0.05$) to students for whom they had low expectations. Low-expectation students also received more task-related ($r = -0.24$, $p < 0.01$) and self-related feedback ($r = -0.16$, $p < 0.05$), and the feedback targeted at these students was more directive ($r = -0.26$, $p < 0.01$) than the feedback that high-expectation students received. These expectation effects could partly be explained by student achievement, since most correlations dropped to levels of nonsignificance when controlling for achievement differences. Moreover, three of the four significant partial correlations were nonsignificant when between-teacher differences were ruled out, indicating that differences between students were between rather than within teachers. These results indicate that, during whole class teaching, teachers with low levels of expectations tend to give their students more public turns and more task-related and directive feedback than teachers with generally higher expectation levels.

5.2.2. Teacher-Student Interactions during Individual Work. Correlational analyses showed several negative correlations of teacher-student interactions during individual work with student achievement and teacher expectations. This means that teachers interacted more with low-performing and low-expectation students. In total, there were more interactions with low-achieving ($r = -0.24$, $p < 0.01$) and low-expectation students ($r = -0.24$, $p < 0.01$). Low-achieving students were given more direct and public turns ($r = -0.19$ $p < 0.05$ and $r = -0.18$, $p < 0.05$, respectively). Low-performing students also gave more responses to questions when they were not explicitly invited by the teachers to do so ($r = -0.22$, $p < 0.01$). This correlation was statistically nonsignificant within

Table 3: Descriptive statistics for teacher-student interactions during whole class teaching and bivariate and partial correlations with academic achievement and teacher expectations, across (A) and within (W) classrooms ($N = 151$).

	Descriptives		Correlations					
	M	SD	Academic achievement		Teacher expectations		Partial (expectations, controlling for achievement)	
			A^1	W^1	A	W	A	W
Type of turns								
Direct	1.56	1.70	−0.13	−0.18*	−0.23**	−0.24**	−0.19*	−0.16*
Public	1.66	1.53	−0.06	−0.13	−0.16	−0.18*	−0.16*	−0.13
Aloud	0.28	0.71	0.02	0.06	0.07	0.13	0.09	0.11
Student initiative	0.15	0.46	−0.02	−0.03	−0.08	−0.09	−0.08	−0.09
Focus of feedback								
Task	2.44	2.20	−0.13	−0.17*	−0.24**	−0.22**	−0.20*	−0.14
Process	1.03	1.32	−0.08	−0.06	−0.13	0.12	−0.10	−0.11
Metacognition	0.15	0.42	0.01	−0.06	0.03	−0.04	0.03	0.01
Self	0.94	1.21	−0.18*	−0.11	−0.16*	−0.16	−0.06	−0.12
Way of feedback								
Directive	3.10	2.91	−0.16	−0.17*	−0.26**	−0.22**	−0.21**	−0.14
Facilitative	0.52	0.95	0.07	0.03	0.09	−0.01	0.06	−0.04
Total[2]	8.21	6.72	−0.13	−0.16	−0.22**	−0.22**	−0.18*	−0.15

* $p < 0.05$, ** $p < 0.01$. Notes: (1) A = across classrooms, W = within classrooms; (2) total number of interactions is the sum of turns and feedback interactions (focus).

Table 4: Descriptive statistics for teacher-student interactions during individual work and bivariate and partial correlations with academic achievement and teacher expectations, across (A) and within (W) classrooms ($N = 152$).

	Descriptives		Correlations					
	M	SD	Academic achievement		Teacher expectations		Partial (expectations, controlling for achievement)	
			A^1	W^1	A	W	A	W
Type of turns								
Direct	1.29	1.82	−0.19*	−0.29**	−0.25**	−0.32**	−0.16*	−0.18*
Public	0.05	0.24	−0.18*	−0.17*	−0.12	−0.06	0.01	0.07
Aloud	0.09	0.51	−0.22**	−0.13	−0.15	−0.08	0.00	−0.00
Student initiative	1.64	1.92	−0.07	−0.11	−0.07	−0.11	−0.03	−0.05
Focus of feedback								
Task	1.70	2.15	−0.23**	−0.24**	−0.23**	−0.21**	−0.10	−0.07
Process	1.20	1.69	−0.22**	−0.26**	−0.21**	−0.27**	−0.09	0.13
Metacognition	0.55	0.97	−0.13	−0.22**	−0.10	−0.23**	−0.01	−0.12
Self	0.76	1.17	−0.17*	−0.28**	−0.16*	−0.27**	−0.07	−0.12
Way of feedback								
Directive	2.73	3.56	−0.31**	−0.32**	−030**	−0.29**	−0.13	−0.12
Facilitative	0.72	1.02	0.11	−0.05	0.12	−0.09	0.07	−0.07
Total[2]	7.28	7.60	−0.24**	−0.31**	−0.24**	−0.30**	−0.11	−0.14

* $p < 0.05$, ** $p < 0.01$. Notes: (1) A = across classrooms, W = within classrooms; (2) total number of interactions is the sum of turns and feedback interactions (focus).

classrooms ($r = -0.13$, $p \geq 0.05$), suggesting that this relation was a between-teacher rather than a within-teacher effect.

Regarding feedback, low-performing students received more feedback on their task ($r = -0.23$ $p < 0.01$), their learning process ($r = -0.22$, $p < 0.01$), and themselves ($r = -0.17$, $p < 0.05$), and they received more feedback in a directive way than did high-performing students ($r = -0.31$, $p < 0.01$). Relations with expectations showed a similar pattern. Low-expectation students received more feedback on their task ($r = -0.23$, $p < 0.01$), their learning process ($r = -0.21$, $p < 0.01$), and themselves ($r = -0.16$, $p < 0.05$), and they received more feedback in a directive way than did high-expectation students ($r = -0.30$, $p < 0.01$). These correlations were slightly affected when controlling for differences between teachers, suggesting that these patterns were observed within classrooms.

Controlling for academic achievement, relations of teacher expectations were only statistically significant for direct turns. Teachers tended to give more direct turns to students they underestimated ($r = -0.16$, $p < 0.05$).

It should be noted that the correlations between specific types of interactions with student achievement and teacher

expectations could be explained by the overall effect that students with low achievements and low expectations were more involved in interactions with their teachers. These interactions were mostly of a directive style. Facilitative feedback was given in similar amounts to different students. However, for high achievers and high-expectation students, these facilitative types of interactions were a relatively higher portion of their interactions with their teachers. Indeed, when controlling for the total number of interactions, correlations of facilitative ways of feedback with student achievement ($r = 0.24$, $p < 0.01$), as well as teacher expectations ($r = 0.26$, $p < 0.01$), were statistically significant.

6. Discussion

In this study, interactions between eight fourth-grade teachers and their 152 students in Dutch primary mathematics school classrooms were analysed. Based on teacher expectation theory [6, 7, 9] and previous research on teachers' differential interactions with their students [5, 17] and teacher feedback [18–20], it was expected that teachers provide students with high academic achievements and of whom they had high expectations with more frequent and more challenging classroom interactions, giving them more opportunities to learn [7]. Contrary to these expectations, we found teachers to interact more frequently with their low-performing and low-expectation students. These students were given more turns and more feedback of different types. The teacher provided these students with feedback in a more directive way, indicating that teachers took more control over these students' learning. It was also found that especially the underestimation of students (expectations that were controlled for achievement) was related to more direct turns during individual work and more public turns, task-related, and directive feedback. No differences were found for facilitative feedback teachers gave to their students. This type of feedback was found to occur not very frequently, with averages of less than one occurrence in the course of three lessons.

The results of this study indicated that teachers in Dutch primary mathematics classes showed a rather directive style of teaching, more targeted at weaker students in their classrooms. This is a typical finding because most Dutch mathematics teaching methods are of a so-called tiered instruction type, with assignments for the whole class and additional instruction teacher guidelines for students who have difficulties understanding the concepts that are being taught [21]. The fast- and high-performing students are provided with more challenging assignments that they can do independently. They are assumed to require less teacher feedback and instruction, which is in line with the observations in this study.

Thus, it can be concluded that teachers indeed treat their students differently and that different teacher-student interactions are, to some extent, based on student achievement and teacher expectations. It seems promising for reaching educational goals for all students that teachers are strongly involved with low performers and low-expectation students in their classrooms and that they put much effort into supporting the learning of these students. However, the types of interactions with low performers reveal a rather directive teaching style. Research on effective feedback has, however, shown that facilitative types of feedback lead to higher levels of learning than directive ways of feedback [19–21]. We did not observe many of this type of interaction, and when observed, facilitative feedback appeared to be disproportionately more frequently given to high performers and high-expectation students. It, therefore, seems a bit premature to conclude that these teachers are successful in creating the best learning opportunities for their students.

This study had some limitations. First, the number of teachers included in this observation study was rather small. Although the observations resulted in a large amount of data, the generalizability of this study is limited because of the low number of participants. Second, all the observations and coding were performed by one researcher. Although the observer was trained and practice observations were discussed among authors before the observations were performed and although the observation schemes have proven to yield reliable data in the past [17, 20], there is some risk of observer bias in this study. For future studies, it would be helpful for the reliability of observational data to include multiple observers in a study and to conduct real-time observations with two or more observers.

For future research, it would be interesting to gain more insight into the precursors and effects of differential teacher-student interactions. Are teachers aware of their differential treatment of students and do they deliberately frame their instruction and feedback to students in a particular way? Or are they unaware of this and do they unintentionally differentiate in their instruction and feedback to different students? These questions are interesting in the context of effective teaching and equality of learning opportunities for students from different backgrounds. They also are interesting for teacher education to provide students with the most adaptive and supportive education in mixed ability classrooms, without biased expectation effects that may lead to unintended and undesirable divergent outcomes of students from different backgrounds. To get a better understanding of these mechanisms, more research is needed and more data should be collected on academic progress of students in differentiated classrooms.

Also, more research on the perceptions of students of their teachers' differential treatment would be welcomed. Research has shown that teachers' expectations and their differentiation practices, in particular when they apply ability-grouping, have negative effects on students, in particular on the low-achieving students (see, for example, [22]). It would be interesting to further explore the effects of differential teacher behaviour in different educational settings on students' learning and their beliefs regarding their own learning potential. For teachers', these insights would be helpful in developing interactions with their students from which all students can benefit.

Data Availability

The data of this study are publicly accessible and can be freely obtained from the first author.

Disclosure

This study was conducted at Leiden University, the Netherlands.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] S. A. Parsons, M. Vaughn, R. Q. Scales et al., "Teachers' instructional adaptations: a research synthesis," *Review of Educational Research*, vol. 88, no. 2, pp. 205–242, 2017.

[2] C. A. Tomlinson, C. Brighton, H. Hertberg et al., "Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms: a review of literature," *Journal for the Education of the Gifted*, vol. 27, no. 2-3, pp. 119–145, 2003.

[3] J. K. Hall and M. Walsh, "10. Teacher-student interaction and language learning," *Annual Review of Applied Linguistics*, vol. 22, pp. 186–203, 2002.

[4] R. Rosenthal, "The Pygmalion effect and its mediating mechanisms," in *Improving Academic Achievement: Impact of Psychological Factors on Education*, J. Aronson, Ed., pp. 25–36, Academic Press, San Diego, CA, USA, 2002.

[5] E. Babad, "Teachers' differential behavior," *Educational Psychology Review*, vol. 5, no. 4, pp. 347–376, 1993.

[6] L. Jussim and K. D. Harber, "Teacher expectations and self-fulfilling prophecies: knowns and unknowns, resolved and unresolved controversies," *Personality and Social Psychology Review*, vol. 9, no. 2, pp. 131–155, 2005.

[7] C. Rubie-Davies, *Becoming a High Expectation Teacher: Raising the Bar*, Routledge, New York, NY, US, 2015.

[8] J. Oakes, "Keeping track: structuring equality and inequality in an era of accountability," *Teachers College Record*, vol. 111, no. 3, pp. 700–712, 2008.

[9] R. Rosenthal and L. Jacobson, "Pygmalion in the classroom," *The Urban Review*, vol. 3, pp. 16–20, 1968.

[10] J. E. Brophy, "Research on the self-fulfilling prophecy and teacher expectations," *Journal of Educational Psychology*, vol. 75, no. 5, pp. 631–661, 1983.

[11] D. D. Ready and D. L. Wright, "Accuracy and inaccuracy in teachers' perceptions of young children's cognitive abilities," *American Educational Research Journal*, vol. 48, no. 2, pp. 335–360, 2011.

[12] K. E. Harvey, M.-A. Suizzo, and K. M. Jackson, "Predicting the grades of low-income-ethnic-minority students from teacher-student discrepancies in reported motivation," *The Journal of Experimental Education*, vol. 84, no. 3, pp. 510–528, 2016.

[13] J. N. Hughes, K. A. Gleason, and D. Zhang, "Relationship influences on teachers' perceptions of academic competence in academically at-risk minority and majority first grade students," *Journal of School Psychology*, vol. 43, no. 4, pp. 303–320, 2005.

[14] C. Howe and M. Abedin, "Classroom dialogue: a systematic review across four decades of research," *Cambridge Journal of Education*, vol. 43, no. 3, pp. 325–356, 2013.

[15] T. L. Good, "Teacher expectations and student perceptions: a decade of research," *Educational Leadership*, vol. 38, pp. 415–422, 1981.

[16] A. Flieller, A. Jarlégan, and Y. Tazouti, "Who benefits from dyadic teacher-student interactions in whole-class settings?" *The Journal of Educational Research*, vol. 109, no. 3, pp. 311–324, 2016.

[17] J. E. Brophy and T. L. Good, "Teacher-child dyadic interaction: A Manual for coding classroom behaviour," (report No. 27)," 1969, https://www.researchgate.net/publication/234721840%20_Teacher-Child_Dyadic_Interaction_A_Manual_for_Coding_Classroom_Behavior_%20Report_Series_No_27%20.

[18] J. Hattie and H. Timperley, "The power of feedback," *Review of Educational Research*, vol. 77, no. 1, pp. 81–112, 2007.

[19] V. J. Shute, "Focus on formative feedback," *Review of Educational Research*, vol. 78, no. 1, pp. 153–189, 2008.

[20] L. van den Bergh, A. Ros, and D. Beijaard, "Teacher feedback during active learning: current practices in primary schools," *British Journal of Educational Psychology*, vol. 83, no. 2, pp. 341–362, 2013.

[21] J. M. Faber, C. A. W. Glas, and A. J. Visscher, "Differentiated instruction in a data-based decision-making context," *School Effectiveness and School Improvement*, vol. 29, no. 1, pp. 43–63, 2018.

[22] B. Francis, P. Connolly, L. Archer et al., "Attainment groupingas selfulfilling prophesy? A mixed methods exploration ofself confidence and set level among among year 7 students," International Journal of Educational Research, vol. 86, pp. 96–108,2017.