Is Demonstrating Understanding Rewarding? Student Academic Performance and Student Expression Mode in the Context of Micro Differentiation

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ABSTRACT

High-performing students receive higher levels of micro differentiation (i.e., higher quality of tailored support) compared to low-performing students [1]. The present study investigated an explanation for this practically relevant finding, hypothesizing that high-performing students utilize more *demonstrations* of understanding than *claims* of understanding compared to low-performing students. Thereby, they enable better teacher assessment of students' needs, thus eliciting higher levels of micro differentiation. Research methods included coding scheme development and correlational analysis. Results revealed no evidence for the hypothesized relation between student academic performance and student expression mode. Findings of subsequently conducted exploratory analyses indicate important directions for future work.

Keywords

Micro differentiation, student-teacher interactions, student expression mode, demonstration or claim of understanding, academic performance.

INTRODUCTION

Recent educational developments have focused the attention of politicians, scientists, school boards and parents on student diversity in classrooms and school types. Since the introduction of the Inclusive Education Law (Wet Passend Onderwijs, 2014), adaptive education has become the norm in Dutch educational institutions. Adaptive education refers to education in which the curriculum and instruction are tailored to students' readiness, interest, and learning profile [2]. The present study focuses on a particular form of adaptive education: micro differentiation. Micro differentiation involves providing continuously less support as students demonstrate increasing task control, i.e. providing contingent support, adapted to student understanding [3].

The current study mainly focuses on the *student* role in micro differentiation. Although, traditionally, the student role has received very limited attention in micro differentiation research [1], taking it into account is preconditional to successful micro differentiation [4] and effective instruction [5]. Teacher guidance is central to micro differentiation; the equally essential student role [6] gives the interaction a reciprocal nature [7]. Note that this implies that micro differentiation partly depends on the learner [7]. Students influence teachers' instruction in various ways, even indirectly via student characteristics like academic performance [6]. The influence of academic performance is especially relevant in relation to micro differentiation: teachers construct perceptions of students' academic performance "as a first step to *tailor instruction* for that student" [6, emphasis MvB].

The notion that variations in student academic performance evoke *varying levels* of micro differentiated instruction is of great importance, since effective instruction is instruction that is (maximally) micro differentiated [1]. From the described research, however, it is unclear *why* academic performance influences micro differentiation. In this study, I suggested that higher academic performance is related to the quality of student expression of understanding; higher quality of student expression of understanding enables better teacher assessment of student level of understanding – and thus higher levels of micro differentiation. The study's aim was to provide evidence for differential expression modes of students with varying academic performance.

Academic Performance and Expression of Understanding

Student expression of understanding and general verbal participation are crucial to the process of micro differentiation (cf. [4] [8]). Active student verbal participation allows for "online diagnosis and accompanying calibration of support carried out by the teacher" [4]. Following this reasoning, micro differentiation thus depends on the content (i.e., what is said) and reciprocality (i.e., to what extent both partners contribute) of the student-teacher interaction.

Early analysis of high- and low-performing students' contributions showed that high-performing students generate more (quantity) and more specific (quality) explanations compared to low-performing students [9]. A qualitative distinction in possible student contributions, described in [10], is that between *claims* of understanding (e.g. "Yes, I get it.", which is a display of knowing) and *demonstrations* of understanding (e.g., explanations of a concept, which are displays of understanding) [10]. Both expression modes can aid the teacher in assessing students' needs. Demonstrations, however, "give teachers more detailed information about the students' understanding” than claims [11]. Also, claims are not necessarily valid or correct [12]. Demonstrations of understanding, therefore, seem to be most effective.

Expression of Understanding and Teacher Elicitations

As well as students might elicit varying levels of teacher micro differentiation, teachers elicit varying student expression modes [11]. Effective teacher contributions in the context of micro differentiation involve eliciting demonstrations of understanding (e.g. “Can you explain why …?”) instead of merely claims of understanding (e.g., “Do you understand that?”), resulting in a) better assessment of student performance, learning, and needs, and b) higher quality of support [11].

In this study, both student and teacher contributions were analyzed to gain further insight into the reciprocal nature of interaction and its consequences for effective micro differentiation implementation. Relations between the study’s key concepts are depicted in Figure 1.

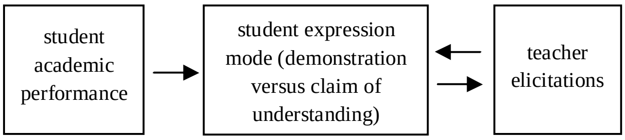

Figure 1. Schematic representation of relations between teacher elicitations, student expression mode, and academic performance.

As shown in Figure 1, I hypothesized that variations in student performance levels come with differential student expression modes (such that the higher the performance level, the more *demonstrations* of understanding will be used). Furthermore, I hypothesized that students elicit varying levels of teacher micro differentiation (i.e., differential teacher elicitations) and vice versa.

To test the hypothesized relations, I developed a coding scheme for student utterance analysis in the context of micro differentiation. I used the coding scheme together with an existing coding scheme for teacher elicitation analysis [11] to analyze student-teacher interactions and relate the results to students’ academic performance.

METHODS

Participants

Participants whose interactions were recorded, were 45 first class VMBO-T students from four classes of four secondary schools, ages ranging between 12 and 14 years (M = 12.77, SD = .56). Four teachers (with 2 to 12 years of teaching experience) were recorded in interaction with the students (2 male, 2 female; 153 interactions in total).

Data

For the analysis of student and teacher contributions to interactions, I used transcripts of video fragments of math interactions (which correspond to data analyzed in [10]). Video fragments and transcripts were part of a larger data set [1] and featured content-related dyadic student-teacher interactions, recorded between March and June 2013 by two video cameras installed in participating classes for two weeks. Teachers received no teaching instructions. Interactions took place during seatwork time.

For technical reasons, 12 transcripts were excluded from the data set, resulting in 153 transcripts with a total duration of 122.08 minutes. From these, 40.66 minutes (33.3%, 51 transcripts) were used for coding scheme development. The remaining 102 transcripts (81.43 minutes) were coded for analysis.

Measures

Student expression of understanding was represented by the ‘percentage of student utterances coded as demonstrations of understanding’. Since a coding scheme for student utterance analysis in the context of micro differentiation was non-existent, I developed one by following the principles of directed content analysis. Initial key coding categories (demonstration of understanding and claim of understanding) were identified using existing theory, and secondary codes defining these categories were developed using data [cf. 13]. A codebook was developed to enhance consistent coding and serve as a written representation of the development process [13]. The resulting coding scheme is depicted in Figure 2.

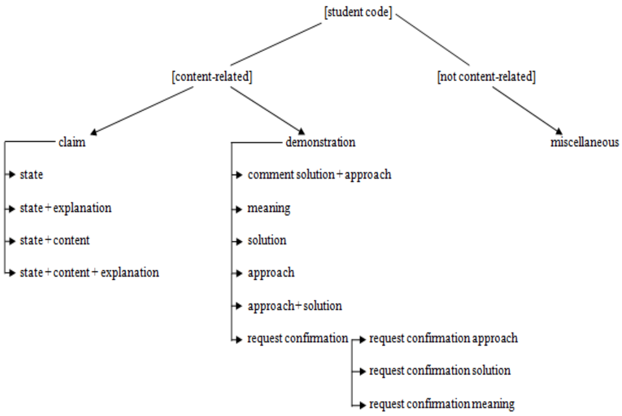

Figure 2. Developed coding scheme for analysis of student expression of understanding in student-teacher interaction.

Content validity was ensured by using concept labels grounded and tested [11] in earlier research. Data-based concept labels were compared to codes developed in the context of student utterances in general classroom interactions [14] to further ensure validity.

Data on student academic performance were represented by students’ grades and were available from [1]. Participants’ grade marks for the subject mathematics (M = 6.73, SD = 1.06) ranged from 3.25 to 9.14.

Teacher elicitations were coded using an existing coding scheme [11]. The unit of analysis was a teacher utterance. Teacher utterances were coded as an elicitation of a claim of understanding, a demonstration of understanding, or no elicitation. ‘Percentage of total teacher utterances coded as elicitations of demonstrations of understanding’ was used to represent teacher elicitation mode.

Design and Procedure

Coding of the transcripts was done using the QSR NVIVO 10 software. A second coder and the author independently pilot coded 20% of the remaining math instruction transcripts to ensure reliable coding. Cohen’s kappa over all codes was .70 after the first coding round, which indicates substantial agreement (following the norms of [15]). Kappa’s for student utterance coding and teacher utterance coding were .66 and .87, which indicate substantial student code agreement and almost perfect teacher code agreement. After pilot coding, the transcripts that had not yet been coded were coded by the author, using the teacher elicitation coding scheme and the final version of the student utterance coding scheme.

Analyses

Analysis was done using SPSS Statistics 20. I investigated the hypothesized relation by conducting a partial correlation between 'percentage of demonstrations of understanding' and 'student grade', while controlling for 'percentage of demonstrations of understanding elicitations'. In addition, I examined the distributional differences between (sub)-codes exploratively.

RESULTS

Distribution of Assigned Codes

The resulting distribution of codes over the total of transcript utterances is presented in Table 1.

Table 1

Percentages of total codes assigned to each code, in descending order

Code type	Code	% of codes assigned to this code
student codes	demonstration of understanding	39.6
	request confirmation	12.4
	request confirmation approach	8.3
	request confirmation solution	2.4
	request confirmation meaning	1.7
	solution	9.3
	approach	9
	comment approach/solution	4.7
	meaning	2.7
	approach + solution	1.5
	miscellaneous	37.3
	claim of understanding	23.1
	state + content	14.3
	state	7.2
	state + content + explanation	0.9
	state + explanation	0.4
teacher codes	no elicitation	70.9
	elicitation of demonstration	18.7
	elicitation of claim	4.2
	miscellaneous	6.2

Note. Miscellaneous utterances were non-content related.

Correlational Analysis

To assess the relationship between the percentage of student demonstrations of understanding and student grades, a partial Pearson's correlation was calculated. The assumptions of normality and linearity were not confirmed by the normality test (Shapiro-Wilk). Therefore, a bootstrapping procedure was run using 2000 bootstrap samples (cf. [16]) before analyzing the data. The correlation between grade and percentage of student demonstrations was almost zero, $r(81) = .022$, $p = .422$ (one-tailed). Adding the control variable percentage of teacher demonstration elicitations slightly increased the correlation size, $r(80) = .088$, $p = .215$ (one-tailed). Both correlations did not reach significance ($\alpha = .05$).

Explorative Analyses

Although data analysis did not reveal a significant relationship between student academic performance and student expression mode, several considerations triggered further analyses. First, I suspected that correlations between *sub* codes and student grades might vary as well. Second, although higher performing students did not appear to use a higher percentage of demonstrations, it might still be expected that they would use less claims than lower performing students. In addition, I had noticed marked variation between transcripts featuring different teachers. These factors of consideration together induced me to carry out several explorative analyses, to obtain better insight into how the data were structured. The results of these analyses are displayed below. Bootstrap procedures were applied for all analyses if relevant.

Additional analyses of student demonstration sub codes revealed just two small but non-significant correlations. Adding the control variable percentage of teacher demonstration elicitations to these two correlations yielded comparable and still insignificant results. Similar results were obtained for claim (sub) codes.

Since dissimilar variances and location of grades could have negatively influenced the comparability of student grades across teachers (and thus influence the comparability of students in the sample), a one-way ANOVA with teacher ID as independent variable and student grade as dependent variable was carried out. Student grades differed significantly between teachers, $F(3, 79) = 14.881$, $p < .001$. Post hoc analyses (Tukey HSD) indicated that three 'subsets' of teachers could be constructed. Separate correlations were conducted for each teacher subset. None of these reached significance, although, remarkably, some were in opposite directions.

CONCLUSION

The aim of the present study was to investigate the relation between student academic performance and student expression mode (as elicited by and facilitating teacher micro differentiation). Before turning to an evaluation of the formulated hypothesis, I briefly discuss the distribution of codes assigned to student and teacher utterances in the analyzed transcripts.

Analysis of the distribution of codes revealed that almost 40 percent of student utterances were demonstrations of understanding, one third of which were requests of confirmation. These results suggest that student utterances that enable assessment of students' needs (i.e. demonstrations) are definitely not scarce. Importantly, the majority of teacher utterances were no elicitations, which are ineffective needs assessment tools [11].

The study's major finding is the absence of the hypothesized correlation between student academic performance and student expression of understanding (both for student use of demonstrations, and for student use of claims). This finding seems to challenge earlier described literature, although it partially corresponds to findings of [9]. Careful interpretation of the results is required. Although steps were taken to ensure coding validity and reliability, the data set was merely coded once and by one coder. Ideally, double coding would have functioned as an extra reliability check, as would have comparison of teacher utterance coding with excerpts originally coded in [11].

The substantial dissimilarity found between grades of students taught by different teachers is another point of consideration. Students taught by different teachers might have received identical grades and still perform at different levels of academic performance. This would implicate that the validity of student grades as a measure of academic performance might be dubious. Questioning this validity, however, might prove problematic. Student grades were assumed to be valid measures of academic performance by [1], which research conclusions constitute part of the current study's research basis. Questioning grade validity would consequently question prior conclusions that led to the current research question. Alternatively, one could assert that teachers simply teach differently or that student performance could have been unevenly distributed over classes. Notwithstanding these explanations, the present grade variations highlight the relevance of using analyses that take the nested character of the data (i.e. within-class variations are smaller than between-class variations) into account. Future research including a larger number of teachers and analyses that consider data nestedness might prove fruitful.

In sum, the present research found no evidence for a relation between student expression mode and academic performance. The result should be interpreted with caution due to the nature of the data, i.e. its nested character and limited scope. Despite the limitations, the present study's coding scheme development contributes to the array of student-teacher interaction assessment tools. Furthermore, the study constitutes a first start to research into the role and composition of student contributions to micro differentiation. Additionally, the current research is also of practical relevance. Results suggest that teacher support focusing on increasing effective elicitations might help to improve the level of teacher adaptivity during student-teacher interactions. This is in line with earlier findings that teachers consider diagnosis of student understanding very difficult and has suggested diagnosis-based teacher support [17]. The suggestion can serve as part of educationalists' reply to the recent political and educational call for (improvement of) adaptive education.

ROLE OF THE STUDENT

The author was an undergraduate student working under the supervision of dr. J. E. van de Pol when the reported research was performed. The topic was proposed by the supervisor; videos used were available from her earlier research. The study's design, coding process, processing of results and reporting were done by the student.

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