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The socio-politics of teacher explanation in mathematics education

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Despite efforts for a more student-centred teaching in mathematics education, data from interviewed German students suggest that teacher explanation is the most dominant form of introducing new knowledge and skills. From a Foucaultian standpoint and on the basis of the interview data, it is firstly argued that explanation belongs to an institutionalisation of mathematics education in which explanatory power is reserved for the teacher, leaving students with a passive role both towards learning and towards questioning mathematics as a discipline. It is secondly argued that such an organisation of teaching might be functional in identifying well-disciplined and fast-learning students through their achievements in mathematics. Thirdly, the point is made that the ignorance of research concerning the socio-political role of explanation is effective in the conservation of the socio-political functions of school mathematics.

Keywords: Mathematics instruction, theory practice relationship, teaching styles, student interview.

The role of explanation in pedagogical theory and practice

Under ‘explanation’ I understand the verbal and embodied communication of knowledge and skills from one person to another with the purpose of enabling the other to do something which the first person is already capable of. This understanding of the term is narrow, as in a wider sense, for example, explanatory texts, recorded speeches, videos and other media, where experts explain something to an anonymous audience, might be considered explanation as well. This paper has an even narrower focus on the explanations which mathematics teachers provide for their students, and it is mainly based on the situation in German schools and in the German research community.

Historically, explanation by the teacher had been a method central to any school teaching (Tenorth, 1988/2000). For example, the German philosopher Johann F. Herbart (1806/1897) developed a teaching methodology based on explanation, exercise, application and abstraction. Its popularity among both educational theorists and practitioners of the 19th century elucidates the traditional importance of explanation within the pedagogical discourse. The discussions around Herbart’s pedagogy also stand exemplarily for the problems that modern pedagogy has developed with explanation. Claiming to follow Herbart’s tradition, a group of educators, now referred to as the Herbartians, reduced Herbart’s pedagogy to its methodological aspects and developed a strict teaching plan which was dominated by teacher presentations and copying by the student. The consequent critique of the Herbartian approach at the turn of the 20th century circled around the problems of the passive and obedient role of the learner, especially on the devastating effects on learning outcomes and democratic agency. Especially writers in the tradition of German *Reformpädagogik* such as Johannes Kühnel (1916/1950) considered the passivity that learners were introduced to as expressions and requirements of the civil obedience in the German Empire which allowed for the economic misery of the masses and the outbreak of the First World War in the first place. Ausubel (1968) argues that the fight against this passivity in learning has fuelled not only *Reformpädagogik* but many alternative pedagogical agendas up to that of discovery learning in his times, and that, over time, explanation has been increasingly denounced as a teaching method which

supports despotism, ignores the individuality of learners and denies them the benefits of self-regulated learning. Explanation, suspected to conflict with the aims of liberal education, has gained a negative connotation.

We run the risk that the condemnation of teacher explanation blocks the discussion of very different roles that explanation might have in teaching, reaching, for example, from introductory explanations followed by exercises over formalising explanations in the course of individual or collective explorations to summarising explanations at the end of learning activities, from whole-class talks to individual conversations, from short inputs to extensive presentations and so on. Recent developments in educational research however aim at a rehabilitation of explanation. Kathrin Krammer (2016, p. 76; all German quotes translated by D. K.) remarks in a teacher journal's special issue on "teaching":

Many reform initiatives in the area of classroom development aim at the expansion and high-quality arrangement of self-regulated learning. Which meaning is yet assigned to teacher-centred, instructive phases – do they disappear, are they preserved, or are they rediscovered and altered?

In mathematics education research and educational policy, explanation as a teaching method is not a central field of study. The federal German educational standards for mathematics education in the grades 5 to 10 (KMK, 2003) may serve as an influential example of the discourse of educational policy. There, "explanation" is not mentioned once, nor are any other activities of the teacher. Instead, it is demanded that mathematics education provides "competences which students acquire in active involvement with manifold mathematical contents" and that it aims at "self-regulated learning" (p. 6). In the German academic discourse, recent introductions to mathematics education for prospective teachers (e.g., Bruder, Hefendehl-Hebeker, Schmidt-Thieme, & Weigand, 2015; Reiss & Hammer, 2013) do not even address how to *explain* knowledge and skills to students, and the only German book on teaching methods for mathematics education (Barzel, Büchter, & Leuders, 2007) presents 30 different methods but does not cover teacher explanations. The only recent studies in the German field discuss explanation from an epistemological (Wörn, 2014) and discursive (Erath, 2016) perspective, but could not be included in this study due to a lack of access to the publications.

The marginal position of explanation in mathematics education research and educational policy is confronted by the dominance of explanation as reported in empirical studies. The TIMSS video study (Stigler & Hiebert, 1999) compared the national teaching "scripts" of the USA, Germany and Japan, showing that both in the USA and in Germany, teachers usually introduce new knowledge by explanation. Recent empirical data, which will be presented here, propose that, at least in Germany, the situation has not changed. Despite continuing efforts in mathematics education research and educational policy to change the classroom culture towards forms where the teacher and her explanations play a less central role, interviewed 9th grade students from a variety of German schools report consistently that new contents are usually introduced by teacher explanations. Thereby, teacher explanations are not only political as they tend to establish distinct hierarchies concerning the distribution of knowledge, they are also political due to the tension between their dominance in school and their taboo in research, resulting in a structurally fostered unpreparedness of prospective teachers and a lack of support by research on this form of teaching. In this contribution, these issues are studied through an analysis of the subjectivities which students express in relation to teacher explanations in the mathematics classroom. The leading question is what role explanation plays in the development

of the students' subjectivities and where the socio-political dimensions of these forms of subjectivity may lie.

The student perspective

As part of a research seminar at the Universität Potsdam in 2016, master students orally interviewed 23 students from grade 8 to 10 in regular public schools in and around Berlin. The interviews were conducted in school rooms in private, recorded and transcribed. All students but two, who went to the same class, attended different schools. The semi-structured interviews focussed on the students' relationships to mathematics and included the prompt "Describe what a typical maths lesson looks like!" and question "How content are you with your maths teacher?", which appeared in the interview as items 2 and 3 of 12 stimuli in total. These items triggered answers which mentioned teacher explanations. Although explanation was not a topic that was explicitly addressed in the stimuli, we found it surprising that *all* students reported that their teachers usually explain new topics to the class. Only four students stated that other ways of introducing new topics, such as solving problems individually, in small groups or in whole-class conversations, were frequent, but in all cases these approaches were said to be followed by teacher explanations as well. We were also surprised that 19 students associated their confidence in their teachers with their qualities in explaining.

For my argument, it will prove important to discuss the ontological status of the students' reports and the epistemological approach taken in the analysis of the data. Here, I want to apply a Foucaultian view (Foucault, 1982, 1978/1991, 2011) to understand mathematics education as a disciplinary institution where teachers apply certain techniques for the conduct of the self and others in order to produce the expected behaviour in students, and where students, for their part, develop and enact certain technologies of the self in order to cope with these demands. The reports of school experiences and relations to mathematics cannot be understood as an objective account presented in a depersonalised language, but belong to distinct discourses around school mathematics, which are shaped by a shared knowledge of the actors. These discourses comprise values, interpretations and supposed truths whose paramount function is not to provide academic insights into any objectivity of the mathematics classroom, but to allow each individual to weave her experiences and relations into a meaningful web of explanations. Under these circumstances, each student's report should not be read as a mere account of a real experience, but as the expression of a permanent struggle to articulate experiences and relations which, from our point of view, are usually scarcely verbalised.

Given the incidental manner in which the topic of teacher explanation was touched in the interviews and the consequently low data base, this contribution will have to limit itself to the presentation, interpretation and discussion of a selected set of themes, and for that I chose to discuss the relations between teacher explanation, power relations in the classroom and the subjectivity of the learner.

Explanation and power relations

The central role which teacher explanation plays in all of the 23 interviews does not only provide insights in the unbroken dominance of a teaching method which large initiatives of pedagogues have fought against for decades, but first of all documents how students integrate the teacher into their narratives of success and failure in learning. Rebecca (all names changed while still indicating the original gender), a high-achieving 10th grader, describes her teacher as "really good", "the absolute burner", who "puts it across really well", "tries to adjust and can explain really well", and holds these

attributes responsible for the learning success of her and her classmates. On the downside, the teacher's explanation qualities are also considered the source of serious complication and failure:

Interviewer: And how content are you with your maths teacher generally?

Ingo: Huh, I would say it could be better. Well, I find, some things he doesn't explain well at all. Then at home, I have to sit down and look in my book. Yeah, he does not really explain it. So, when I hear what other classes tell, they have better teachers, they all understand.

Interviewer: Is there something you'd like to change in your mathematics classes? [...]

Ingo: [If I were the teacher] I'd adapt myself to my students much more than my current maths teacher does. So, I'd go to them and ask if there's anything they don't understand, I'd do difficult exercises with them, those you need for exams [...].

Apparently, students such as the 9th grader Ingo find their learning troubled by insufficient explanation. They also show awareness that the quality of explanation varies from teacher to teacher. Rebecca and Ingo follow a narrative in which their learning and achievement depend directly on the quality of their teachers' explanations. Ingo is not content when his teacher leaves him with difficult exercises after having explained the easy ones; he demands series of explanations which also cover the most difficult tasks. Simon, also a 9th grader, is even more explicit concerning these demands:

Simon: The teacher should, when he comes to the students, when he sees from the front that students have problems, then he should go to the students or the students to him and ask. The teacher should try to explain as simple as possible, so easy, perfectly easy, so that the student understands very quickly, so that he can go on with the exercises.

Patrick, another 9th grader, says that he was "actually very content" with his teacher, who "can explain well, so that we actually all understand", but later he adds that the difficulty of the contents has been increasing since primary school:

Patrick: I believe that what he does is actually really good, our teacher, but we, with us it's simply, no idea, that we simply don't understand when he tells something. And in front, well, there are a few of our students who understand and try to somehow explain it to the others, but that doesn't help either.

The position that teacher explanations hold in the narratives of the students has specific consequences for the power relations between teachers and learners. The dependency of Rebecca's and Ingo's learning on the quality of teacher explanation documents the monopoly of expertise which lies with the teacher. Especially, the students do not report any other promising sources for understanding such as textbook study, collaborative work or learning videos. In Patrick's case, the students of his class apparently attempted to support each other, but failed. Indeed, in the narratives the teacher is presented as the only agent the students can turn to in their struggle to understand. This narrative puts the teacher in the position of an exclusive 'knower' without whose expertise and goodwill no learning is possible, and thus it releases the students into passivity. The student, whose only hope is to be presented an understandable explanation, cannot do anything but wait for that explanation. Ingo's and Simon's cries for ever better explanations show the lack of alternatives they see.

From the perspective of traditional critique as brought forward already by the *Reformpädagogik*, we could argue that these experiences simply give empirical evidence that the traditional teaching methodology of explaining and exercising leads to passive and obedient students who are denied the flexibility and effectiveness of self-regulated learning and socialised into passive and obedient social agents. From the perspective of Foucauldian governmentality, we could add that the institution of mathematics education is successful both in channelling the conduct of the students into a form where their learning is totally dependent on the teacher, and in establishing a discourse in which this organisation of the learning of mathematics is considered inevitable. Here, it is interesting to note that both teachers and learners are constantly reproducing this organisation and narrative. At this point it is only possible to guess where the motivation for this behaviour come from: While the teacher may be led by the will to be the social centrepiece of the classroom collective, channelling all power on herself, the students might eventually enjoy their passivity. Ingo's reluctance to "have to sit down and look in my book" indicates that students may indeed resist to take a more active position in their learning. This resistance is connected to a constantly reinforced economy of learning in which students aim to "go on with the exercises" and pass "exams" with as little effort as possible.

Apart from the traditional critique of teacher explanation focussing on its consequences for learning and democratic agency, the exclusiveness of approaching mathematics through the teacher leads to a specific relation to the discipline of mathematics itself. In the reports of the students, mathematics is not presented as a discipline which can be approached and understood individually, but as a discipline whose understanding depends on the support of experts. The presentation of mathematics as a discipline which is only mastered by experts and cannot be fully understood by laymen, despite all efforts of specially trained teachers, adds to the construction of mathematics as an obscure, elitist and indisputable discourse which may be used as a tool of power throughout our society. Mechanisms leading to this image of mathematics have been identified before (Dowling, 1998; Skovsmose, 2005; Kollosche 2014), but to my knowledge they had not yet been associated with distinct styles of teaching.

Subjectivities of listening

Changing the focus from the teacher to the learner opens up a wide field of experiences of receiving explanations. Christian, a 9th grader, excels in some subjects but has problems in mathematics:

Interviewer: What do you think is different in maths; what's the reason you don't like it that much?

Christian: Well, I've never liked maths. Maths was never what I was good at, I always had my difficulties there. Though my parents think I'm somewhat lazy, which is true for the most part, it also gets more and more difficult and I seldom keep up with it, also because the teacher is bad at explaining.

Interviewer: How does a typical maths lesson look like at your place? Can you describe it?

Christian: Yeah well, the teacher comes in. Consequently, it's noisy of course, because she can't assert herself. In between, you're also getting distracted, and I'm no different, I admit I'm also getting distracted, doesn't let you work well, doesn't let you pay attention. [...] Everything depends on paying attention deliberately.

It may be argued that it is the teacher's task to establish the quiet environment necessary for the students' understanding of any teacher explanation. But apart from the fact that such a narrative reproduces the active role of the teacher (who has to tame the students) and the passive role of the students (who have to be tamed), this narrative does not consider the subjectivities necessary to follow this form of teaching. "Paying attention deliberately" is a technique which students have to master, not only to follow teacher explanation individually, but to establish a fruitful learning environment in the classroom in the first place. Consequently, mathematics courses which build on teacher explanation give advantages to self-disciplined learners, especially when grouped together in socially segregated schools. The privileged school marks, which such advantages may result in, may then be taken as indicators for the self-discipline of an individual. In this sense, the pervasiveness of teacher explanation in mathematics education may have an underestimated economic function.

Yet of course, concentrated listening does not guarantee understanding. Students also have to be able to understand the presented contents in the pace in which the ideas are presented. Anna, a 9th grader, claims that her teacher's explanations are too fast for her to understand:

Anna: [...] And I just find maths difficult, I don't understand it that fast. And of course, she [the teacher] does not have the patience for so many students to explain that to everybody separately. And some are simply faster in understanding concerning maths exercises, and I need a little longer and don't understand that fast.

Interviewer: [...] If your teacher realises that several students put up their hands, will she then explain it again for all of you?

Anna: She is somewhat strange in this respect. She just says that she explains in a way that we all have to understand, and then we have to cope with the exercises somehow.

Anna realises that structural constraints in the organising of her teacher's approach hinder her to offer every student an understandable explanation. But instead of questioning the methodology of teaching altogether, some teachers succeed in hiding the problem. In Anna's case, the teacher's imperative that the students "have to understand" leaves the problem with the students, who do not seem to know how to cope with it. In the case of Emma, an 8th grader, the teacher asks the students to put up their hands if something is unclear, but "as we just know that she somehow cannot explain it properly", nobody would put up a hand.

In contrast to that, 9th grader Laura explains that her mathematics teacher has successfully taught her to indeed raise questions if something is unclear:

Laura: I had her in the fifth, sixth and seventh [grade]. I liked her. She was my favourite teacher. She's retired now. She has taught me to raise questions again and again, and that's it. Or to become more self-confident, because you don't know the others, you don't know the teachers. You still have some respect for them. [...]

Interviewer: What do you believe the teacher could do against it [students not daring to ask]?

Laura: Oh god, that's difficult. He could pose questions, answer questions. But some don't really dare to ask. They have their private afternoon lessons, but actually this is also like a teacher. I think it's this collective. In class, you always have a position to fulfil. You are either the cool one or the somewhat quiet one or the class clown.

[...] You also notice that when fewer students are in class, the class is quieter and can work better. I believe, this also depends on the fact that you do not have to prove yourself and that you can rather concentrate on your stuff.

Laura's story documents that there are slight variations in the forms in which teacher teach through explanation, and that these variations can have severe consequences. In opposition to Emma's report of her classmates not asking in order to avoid further explanation, Laura has learned to demand further explanation if she is not confident with the explanation presented. Thus, her teacher enabled her to take a more active part in her learning and to add elements of conversation to teacher explanations. In addition to that, Laura outlines a sociological explanation for problems with explanatory phases. Exposed to the whole class, students may have an intense urge to fulfil their social role within the learning group, and that role might hinder them to engage in a lively discussion on mathematical contents.

Discussion

The findings presented first of all shed light upon black spots in mathematics education research. Firstly, the prevalence of teacher explanation shows that decades of academic and political initiatives aiming at changes in teaching and learning arrangements have hardly affected the reality of the mathematics classroom. Although several nation-wide and regional projects have focussed on introducing learning environments focusing on active learning in Germany, teacher explanations are still reported to be dominant in the mathematics classroom. Considering the apparent ineffectiveness of previous interventions, it would be useful to dedicate more research to the understanding of the didactical and social role of teacher explanation *before* any new interventions are planned. Secondly, in light of the central role of teacher explanation in the mathematics classroom, the marginality of the topic in mathematics education research leads to blind spots in our understanding of teaching practice. Especially the socio-political dimensions of teacher explanation, which might prove antagonistic to pedagogical ideals and nevertheless functional in a systemic sense of society, deserve further study. Deeper insights could lead the way to a teaching practice which incorporates teacher explanation without constructing the student as a passive subject to mathematics. Apart from that, it may be wise to critically prepare prospective teachers for the role that they apparently assume anyway, namely that of the explaining authority.

Further research should also focus on the psychology and the socio-politics of teacher explanation. Firstly, why would teachers contribute to the narrative that it would be possible to allow a large proportion of the students an understanding through central explanation, while counter-arguments are obvious in teaching practice and have been discussed in literature for decades? Why would students contribute to that narrative against all obstacles they experience in their learning and in spite of the passive role they have to assume in this learning arrangement? And secondly, how does teaching through explanation contribute to the narrative that the understanding and mastery of mathematics is reserved to higher authorities, who can share their knowledge and skills to the extent they wish and whose expertise has to be trusted in due to the lack of approachable alternatives?

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