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AUTO-EXCLUSION IN MATHEMATICS EDUCATION

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Abstract: Auto-exclusion from mathematics education can be conceptualised as the exclusion from the mathematical discourse by the learner. While auto-exclusion has been reported in several publications, it has not yet been empirically contrasted with teaching practices and analysed for its socio-political implications. This paper can be understood as an exploratory study to gain a first research access on the above-mentioned connections. After introducing auto-exclusion on the basis of previous research and situating it socio-politically, this paper uses discourse theory to examine texts from questionnaires and interviews with secondary school students from Germany on their relationship to mathematics. Thereby, it is shown that auto-exclusion from mathematics can result from a rejection of basic assumptions of mathematical thinking, from humiliating experiences, and from teaching practices that disregard the students' individuality. Furthermore, it is shown that auto-excluded students are not necessarily passive and helpless victims of their educational experiences but often play an active and reflective role in defining their relationship to mathematics. Eventually, possibilities to take action are discussed.
Keywords: Auto-exclusion. Maths anxiety. Teaching practices. Mathematics and power.

AUTOEXCLUSÃO NA EDUCAÇÃO MATEMÁTICA

Resumo: A autoexclusão na educação matemática pode ser conceitualizada como a exclusão do discurso matemático pelos estudantes. Embora autoexclusão já tenha sido relatada em várias publicações, ela ainda não foi empiricamente contrastada com práticas de ensino e analisada por suas implicações sociopolíticas. Este artigo pode ser entendido como um estudo exploratório para um primeiro acesso à investigação sobre as conexões mencionadas acima. Depois de introduzir o conceito de autoexclusão com base em pesquisas anteriores e situá-lo sociopoliticamente, este artigo usa a teoria do discurso para examinar questionários e entrevistas sobre a relação de estudantes do ensino secundário de escolas Alemãs, com a matemática. Deste modo, é mostrado que a autoexclusão da matemática pode resultar da rejeição dos pressupostos básicos do pensamento matemático, das experiências humilhantes e das práticas de ensino que ignoram a individualidade dos estudantes. Além disso, é mostrado que os estudantes autoexcluídos não são necessariamente passivos e vítimas indefesas de suas experiências educacionais. Muitas vezes eles desempenham um papel ativo e reflexivo na definição de sua relação com a matemática. Eventualmente, as possibilidades de ação são discutidas.
Palavras-chave: Autoexclusão. Ansiedade Matemática. Práticas de Ensino. Matemática e Poder.

Introduction

In her detailed study of "mathematical journeys" of 31 Australian secondary school students aged 14-15 years, Naomi Ingram (2011) concludes:

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> The majority of the students were not thriving mathematically. They did not feel confident in their ability, had ineffective engagement skills, sought instrumental understanding, disliked mathematics, were not convinced of its importance, and had tenuous motivational factors. The continued participation of these students in mathematics was vulnerable (p.ii).

Troubled relationships with mathematics education have also been observed in other countries (KISLENKO; GREVHOLM; LEPIK, 2007; KOLLOSCHE, 2017a), and appear to be a common phenomenon at least in Western societies. From a pedagogical perspective, these forms of disengagement are problematized as an obstacle to successful learning (see, e.g., INGRAM, 2011). Identifying reasons of disengagement and finding techniques to turn disengagement into engagement can then be understood as attempts to allow a more effective learning of mathematics, both for the sake of the individual and society. From a sociological perspective however, avoidance of mathematics can be understood as a form of auto-exclusion, whereby auto-exclusion in education is a process in which an individual partly or totally excludes herself from a practiced discourse, thus leaving the authority over this discourse to others (FREITAS, 2002).

This paper follows the sociological position and problematizes how auto-exclusion is systematically produced in mathematics education. This perspective includes the assumption that auto-exclusion is not merely the result of psychological dispositions of the individual, which could then be changed by pedagogical intervention, but that auto-exclusion is created in the interplay of the individual and the social environment. In order to discuss how auto-exclusion is produced in the mathematics classroom and how it is related to the socio-politics of mathematics education, it will prove useful to also differentiate between different forms of auto-exclusion and to discuss possible reasons for this behaviour. Drawing on research from critical mathematics education, sociology, and empirical data from German secondary school students, I will show that auto-exclusion can take different forms and have different reasons, that auto-exclusion cannot be sufficiently explained by a lack of motivation or ability, that, instead, it is systematically produced in the mathematics classroom by its institutional organisation, and that nevertheless, the position of affected students cannot be sufficiently understood as that of a passive victim.

Auto-exclusion

Research results (e.g., INGRAM, 2011; KOLLOSCHE, 2017a) reflect the common experience of teachers when teaching a secondary school class in mathematics: Usually, there are students who exclude themselves from the mathematical discourse. Here, I propose to differentiate between three different forms of auto-exclusion: Firstly, physical *absence* from the classroom is the most radical form of excluding oneself from the mathematical discourse. Secondly, *passivity*, that is the physical presence of a student without any intellectual engagement in the classroom discourse, is the most obvious form of auto-exclusion. Both of these forms appear to be closely connected to maths anxiety. While a student might still be participating in the classroom discourse despite her maths anxiety, the student might connect mathematics with negative emotions which can discourage this student to face mathematics in the future. Mark H. Ashcraft and Jeremy A. Krause (2007) report from empirical analysis that "[m]ath anxiety leads to a global avoidance pattern – whenever possible, students avoid taking math classes and avoid situations in which math will be necessary, including career paths" (p.247). Apart from these forms, I propose to consider *low self-efficacy* a third form of auto-exclusion. Although originally a psychological concept, self-efficacy has proved open for usage in sociological paradigms, also in mathematics education (e.g., VEKIRI; CHRONAKI, 2008). Albert Bandura (1977) showed that individuals drastically differ in the confidence they have in their own abilities to achieve certain goals, in our case the understanding and performance of mathematics. The individual assumption of low ability is a form of auto-exclusion as it may negatively influence the motivation to learn mathematics, future choices in educational and occupational paths, and the willingness to critically question applications of mathematics. Later in this paper, I will illustrate the last two of these forms with texts from students.

Reasons that may lead to auto-exclusion can be seen in the individual's experience with learning mathematics, especially in the interplay between demands in the learning process, the relevance individually associated with these demands and the individual abilities to fulfil these demands. A combination of recurring failure and sometimes even humiliation in the mathematics classroom can result in forms of auto-exclusion. Auto-exclusion can then be

seen as the result of mere despair. On the cover of his book on motivation, Martin V. Covington (1992) writes:

> Achievement behaviour in schools can best be understood in terms of attempts by students to maintain a positive self-image. For many students, trying hard is frightening because a combination of effort and failure implies low ability, which is often equated with worthlessness.

Chinn (2012) shows that auto-exclusion is not a strategy that can only be found with students with specific learning difficulties, but also with students of above average intelligence. Apart from that, he argues that avoidance can be a strategy which is consciously exercised by learners. As I will show in this paper, auto-exclusion from mathematics cannot only be understood as the result of a passive helplessness but often represents a conscious and well-founded decision of the students involved. Moreover, in contrast to the assumption that auto-exclusion can be fully understood as a reaction to recurring failure and humiliation, I will show that auto-exclusion can result from a rejection of mathematics as a discipline, even though the individual might be successful in learning mathematics.

Brown, Brown, and Bibby (2008) present specific reasons which English 16-year-old students gave for not continuing their study of mathematics when confronted with the choice to continue or not. The majority of students explained that mathematics was too difficult and about a third of the students explained that mathematics was not enjoyable. Other reasons such as boredom and uselessness were also mentioned, although to a much smaller degree. In a questionnaire study, 199 German students in their ninth year of schooling were confronted with open questions about their relationship to mathematics. 33% of the students connected mathematics with mental or bodily discomfort and 40% connected mathematics with little interest and boredom (KOLLOSCHE, 2017a). However, while studies with big populations of students succeed to prove that students experience problems to positively engage with mathematics, they fail to explain the interplay of institutional mechanisms and individual experiences which lead to the avoidance of mathematics. Consequently, there is a research interest to look at more individual cases.

Elsewhere, I have already discussed findings from a subsequent interview study about the relationship of 23 German eighth-, ninth- and tenth-grade students to mathematics. This

study did not only reveal that all of these students experience an education where mathematics is mainly communicated by teacher explanations and where contributions are mainly judged by the teacher, leaving hardly any space for self-organised learning or an informal exchange of ideas, questions or doubts (KOLLOSCHE, in press). The study also showed that the students expect and at the same time doubt the relevance of the contents learnt for their later life, and that other possibilities for seeing the relevance of mathematics (such as learning to express situations formally or learning a specific style of thinking) were not represented in the students' texts and thus unavailable for experiencing mathematics education as a meaningful endeavour (KOLLOSCHE, 2017c). These findings suggest at least two connections between the institutional organisation of mathematics education in Germany (its domination of teacher explanations and its lack of a wide discourse on its possible relevance) and the difficulties of students to participate in the classroom discourse.

While we should be very explicit in acknowledging that every student should have the right not to like mathematics and to avoid mathematics as far as felt necessary, it should also be clear that mathematics education has a problem if it does not at least consider various means to help students engage with mathematics in dignity, or if it even systematically hinders certain students to engage with the subject. As empirical data as discussed above however proves auto-exclusion from the mathematical discourse to be pervasive throughout various school types in Western countries, we can assume that auto-exclusion is a systematic phenomenon of the institutionalisation of mathematics education. Therewith, school actively (although maybe not intentionally) produces auto-exclusion among students.

Socio-politics of avoidance and auto-exclusion

Luiz C. de Freitas (2002) describes the historical development of "a field of subjective exclusion, in which the very person excluded is responsible for their exclusion" as a new form of educational government (pp.299–300). While exclusion is a necessary part of any assessment-oriented school, especially in mathematics (see PAIS, 2014), it is argued that modern schools shift to forms of institutional organisation where exclusion is no longer explicitly exercised by the institution but by the individual learner. Sociologically, this shift

can be understood as a part of a more general change in the mechanisms of power in modernity: Michel Foucault (1982) speaks of 'disciplinary' techniques for the conduct of other people to describe techniques which allow choices for individuals while limiting these choices within certain boundaries. Just as we, for example, have to follow a certain dress code in our professions and public relations but still have the liberty to express our individuality in the way we meet this dress code, mathematics education can be understood as an institution which allows learners to engage with mathematics within certain institutionally given boundaries – even if this way is not attractive or even possible for certain learners –, or to avoid mathematics education. Thus, the organisation of the learning experience makes some students create themselves as somebody who avoids or even fears mathematics (see also KOLLOSCHE, 2016). Critical research is therefore occupied with the question how auto-exclusion is supported by the institution of mathematics education.

It has already been shown that different opportunities for understanding certain discourses (e.g., DOWLING, 1998) and different treatments of learners (e.g., STRAEHLER-POHL; PAIS, 2014) lead to structural exclusion along class, ethnicity, gender and other social demarcations, reproducing social benefits for White middle-class males. What is more, we see another social demarcation being created in the mathematics classroom. Contemporary society relies on mathematics probably more than any society before. Mathematics is not only used to build the newest smartphone, to equip it with powerful software or to carry a nuclear warhead from one continent to another, it is also used to prescribe the distribution of goods (via the mathematical modelling of taxes, pensions, income support) and to create truths (via mathematical models in research) (see, e.g., PORTER, 1996). The survival of contemporary society therefore not only depends on the few who master the mathematics involved but on the big mass of people accepting the mathematical organisation of social reality. In this sense, Roland Fischer (1984) has issued his warning:

> There is the risk that mathematics is conceived either as a monumental threat, as a Moloch who devours everything, which you have to escape from if you want to stay human, or as a safe refuge, which you can dedicate yourself to without compunction, which solves all solvable problems, which tells you what is right and what is wrong. Both attitudes result in the domination of mathematics over man (p.52, my translation)

Ole Skovsmose (2005) was very explicit in describing exclusion as a mechanism that is productive in the maintenance of social control:

> Could it be that mathematics education in fact acts as one of the pillars of the technological society by preparing well that minority of students who are to become 'technicians', quite independent of the fact that a majority of students are left behind? Could it be that mathematics education operates as an efficient social apparatus for selection, precisely by leaving behind a large group of students as not being 'suitable' for any further and expensive technological education? [...] Nonetheless, a large group of students might be left, and they will have learned a substantial lesson: that mathematics is not for them. To silence a group of people in this way might also serve a socio-political and economic function (pp.11–12).

In a more speculative theorisation of the exclusion process in mathematics education, it would make sense to assume that society has an interest in producing, through positive assessment, those students who are able and willing to learn and apply mathematics in a rather technical manner while excluding those learners who are open for criticising specific applications of mathematics. Following Foucault (1997), we should not interpret auto-exclusion from mathematics as a form of resistance that would challenge the institution of mathematics education. Instead, auto-exclusion, as indicated by Fischer and Skovsmose, is highly functional for the social system. For Foucault (1997), resistance and critique against such systems of disciplinary techniques are possible by finding ways "how not to be governed like that, by that, in the name of those principles, with such and such an objective in mind and by means of such procedures, not like that, not for that, not by them" (p.44). If we want to help students find these ways beyond conformity and avoidance, we will have to learn more about the circumstances that lead to the avoidance of mathematics in its different forms.

Two initial stories of avoidance

A more specific understanding of the mechanisms underlying auto-exclusion can be obtained by looking at individual cases. In her retrospect, the pastor Renate Voswinkel (1998) described her experiences with mathematics education in West Germany in the late 1940s and 1950s in a journal for teachers of mathematics:

> I soon fell by the wayside when I began to ponder if two and two really were four. Maybe the two were no dragons or ducks, maybe they were not even a single thing but many things together. And where does a two begin and where does it end? […] I dared not ask my teacher. I asked my mother, but she did not understand me. My father took a sharpened pencil and all the patience he could afford and practiced with me: "Two and two equals…" he said. […] The result was a growing but quiet devaluation of my thoughts. I forbid myself to ponder as it confused me, even though in all other subjects I drew my own connections, had ideas, developed a lot of phantasy […] (p.18, my translation).

Renate, an intelligent and successful student, reflects how she developed a low self-efficacy in mathematics. Apparently, this development was closely connected to how Renate was treated in the mathematics classroom when she struggled with questions that relate to the more general nature of mathematical knowledge. Although these experiences have been made more than six decades ago, we may assume that the conditions under which they were made have not changed drastically. As Valerie Walkerdine (1988) reveals, mathematics education is from its very beginning dealing with concepts that are artificially objectified and potentially in conflict with everyday thinking, while teachers are still influenced by developmental psychology and tend to assume these concepts to be natural steps of cognitive development needless of any further discussion. In the above-mentioned questionnaire study, 29% of the students mentioned a connection between mathematics and logic (KOLLOSCHE, 2017a). Therewith, they showed awareness of the special epistemic form of mathematical knowledge. However, their difficulties to describe in how far mathematics was logical indicates that these connections are hardly articulated and discussed in the mathematics classroom. Thus, for some learners, mathematics may stay a fund of knowledge whose inner organisation remains mysterious.

Thomas Jahnke (2004), whose student in her 11th year of schooling wrote "fucking maths" ("Scheiß-Mathe" in the German original) on her exam paper, asked the student to explain her comment and was given a letter which the student agreed to have published. Here, I can only cite extracts from the letter:

> […] At the end of the lesson [in primary school], our maths teacher practiced a game called "corner calculations". Students chosen by him had to arrange in the corners of the classroom. Mr. H. then posed calculation tasked that we had to solve. If you knew the answer, you were allowed to proceed to the

> next corner, and the one who was through first, was the "calculation king". The others were "dead". While I always had little problems with written calculations in my exercise book, thinking of mental calculations almost made me sick. […] I did not get along at all with the teacher in year 7 and 8. He simply threw some numbers at us and we were supposed to operate with them. Number strings and operation chains, which were completely incomprehensible to me, made me give up hope. […] I believe that I detest mathematics because I do not have the necessary intellectual capability. It is a subject which for me is not picturesque at all. […] I perceive mathematics as hardly creative, because it leaves so little space for individual thoughts. Maths is such a dead matter. […] Numbers frighten me, because they are so obscure and yet so unambiguously defined and proven (p.5).

This account is significant as it does not only give an example of auto-exclusion resulting from problems in understanding mathematics. First, it also reports a scene of humiliation when slower calculators are regularly branded "dead" in the game at the end of the lesson – a humiliation which may result in stress and the association of mathematics with negative emotions. Then, it also provides insights in the problems which the student had with the way mathematics was taught, that is as a "hardly creative" activity, as a "dead" and unambiguously fixed matter with no room for individuality. Although mathematics can be approached in a more creative and individualised way, the student's concern also touches the very essence of mathematics as a discipline that strives hard to avoid any ambiguity and individual differences in its understanding (KOLLOSCHE, 2013). What is more, the student's letter shows that, in her case, mathematics education has already been successful in creating auto-exclusion: She explains her dislike with her own failure rather than with the institutional organisation of mathematics education. Consequently, her story can be understood as a case where mathematics education has succeeded in driving a student who is critical of the merely technical and no longer personalised processing of human affairs towards auto-exclusion through low self-efficacy.

Methodology

In the following discussions, I will present and analyse the texts of six students on their relationships to mathematics, especially concerning expressed forms of avoidance and the interplay of avoidance with experiences from the mathematics classroom. The data was

collected in two studies among students who are mainly in their ninth and partly also in their eighth or tenth year of schooling and attend German public schools of different school tracks in and around Berlin. In the first study, nine classes from different schools, comprising 199 students altogether, filled out a questionnaire with open questions about their relationship to mathematics (also see KOLLOSCHE, 2017a). In the second study, 23 students, with only two of them coming from the same class and school, were interviewed using a semi-open interview scheme which allowed the interviewer to follow a set of pre-defined open questions while still being able to react to certain issues that the interviewees bring up (also see KOLLOSCHE, 2017c). In both studies, data were recorded in school by postgraduate students without the presence of any teachers. For this paper, specific questionnaires and interviews, whose texts touched on avoidance and auto-exclusion, were chosen. This choice is not representative but aims at providing case studies which express a wide variety of student texts and provoke the development of more elaborate explanations.

The students' texts are used as the main access to the students' experiences and classroom reality. Admittedly, other methodical forms of access, such as video studies, ethnographic observations, teacher interviews and the analysis of students' in-class writings might constitute a counter-narrative with which the students' texts could be contrasted. In this light, the students' texts constitute a one-sided access to the students' experiences and their classroom reality. For example, the students' texts might be influenced by the wish to excuse one's failure or to present oneself emotionally unaffected and 'cool'. However, I hold the exclusive use of the students' texts to be justified as I assume that it is precisely the act of discourse creation, including its reaction to the individual's emotion, which helps the individual to make sense of classroom experiences and to establish or overcome practices of exclusion. Here, I build on discourse theory were discourse is not only understood as the written or spoken texts which somebody produces, but as the narrative with which the individual explains the world to herself (JØRGENSEN; PHILLIPS, 2010). In this sense, the students build their discourses by relating to, contrasting to and incorporating various different and sometimes mutually conflicting discourses from their social environment. In the discourse theory based on the work of Ernesto Laclau and Chantal Mouffe (2001), power struggles in society are located in the quest of these differing discourses to achieve hegemony.

Thereby, Antonio Gramsci's (1966) theory, that all participants of a discourse are constantly reproducing and possibly altering its meaning and social scope, is taken up, setting the student in the position of a central agent in the construction of classroom reality. A central element and anchor for discourse analysis are what Laclau and Mouffe (2001) call "nodal points", that is "a privileged sign around which the other signs are ordered; the other signs acquire their meaning from their relationship to the nodal point" (JØRGENSEN; PHILLIPS, 2010, p.26). The methodological approach presented here benefits from the work of Anna Chronaki (2013) who has introduced Laclau and Mouffe's discource theory to mathematics education in her analysis of the relationship between teacher identities and their use of computer technology. In our case, the students' texts will refer to different nodal points to provide meaning to their experiences with mathematics education. The analysis of these nodal points and of the discourses they are central to will help to unfold relationships between auto-exclusion, classroom practice and the socio-political.

Patrick and Rebecca: Struggle and avoidance

Patrick and Rebecca (codes A7 and A11 in the coding scheme used in KOLLOSCHE, 2017a; all names changed) are 15-year-old students from the same class and participated in the questionnaire study. Both of them call mathematics their "most-hated subject" and achieved the lowest passing mark on their last school certificate. Asked to describe their moods in mathematics education with three words, Patrick notes "stressed, bored, tired" while Rebecca writes "boring, crap, over-challenged". Both state that one does not need talent but only "diligence" to be good in mathematics. Patrick adds that he seldom finds diligence in himself. He likes sports and English, where he does not have any problems, and connects mathematics with "struggle, because I have difficulties with maths and always have to invest labour to get good marks". Patrick often feels "angry, because when I don't understand something, then only because it's the biggest crap that nobody needs". He also states: "I avoid maths as often as possible, but I do not always manage that." Rebecca reports that "maths is too high for me" and that "understanding is hard". She "rather appreciates people who understand maths" and attends after-school tutoring "which, however, does not help me

much".

The questionnaires of Patrick and Rebecca's classmates suggest that their class experiences teacher-centred teaching and more or less likes the teacher, including some students who explicitly enjoy their mathematics lessons. In this environment, Patrick and Rebecca both express problems to find a positive relation to mathematics. Interestingly, they both argue that being good at mathematics does not require talent but rather hard work. Beyond that, the two texts present different discourses constructed around different nodal points. The nodal point which links the themes in Patrick's text is "struggle". Patrick reports that he likes other subjects because he does not have any problems there, while mathematics requires struggle to be good. The intellectual struggle that Patrick has to invest also explains why he is often "stressed" and "tired" in the mathematics classroom. In consequence, Patrick avoids mathematics through passivity in order to avoid working hard. From a socio-political perspective, Patrick's discourse presents mathematics education as a selective device for identifying the hard-working. Through his avoidance of mathematics, his low marks in mathematics represent his inability or unwillingness to "invest labour".

Rebecca's text is very different. Her discourse is constructed around the nodal point of understanding mathematics. She "appreciates people who understand maths" and seems to wish the same for herself, but admits that "understanding is hard", even though she attends after-school tutoring. Different to Patrick, Rebecca presents herself as highly motivated and working hard to understand mathematics, but does not seem to succeed. Rebecca concludes that she lacks the intellectual capabilities to understand mathematics. Therewith, she excludes herself not from the struggle of learning mathematics but from the group feeling capable of mastering mathematics: She shows low self-efficacy. From a socio-political perspective, Rebecca has developed to a highly motivated worker who is in awe of mathematics and might hardly question the application of complex mathematics. Yet, there is no way of explaining why Rebecca does not understand. Her case is similar to that of Jahnke's (2004) student, but Rebecca does not provide any insights in her intellectual struggle with mathematics.

The analysis of the texts of Patrick and Rebecca leads to several insights. Firstly, we learn that struggling students may be troubled in very different ways which can be analysed and explained by discourse analysis. For Patrick, school appears to be all about avoiding hard

work, and the performance he deems necessary to succeed in mathematics does not appear to fit to that goal. For Rebecca, school appears to be all about understanding, motivating her to work hard in spite of all her troubles. Secondly, we observe that there are very different ways to exclude oneself from mathematics. While Patrick tries to avoid mathematics as often as possible, Rebecca works hard to participate. However, she excludes herself from higher and possibly socially relevant mathematical discourses by denying herself the intellectual capability to fully understand mathematics. Thirdly, we see that, in both cases, the interplay of individual discourses and practices on the one side and of the institutional organisation of mathematics on the other side create a situation in which the failure of these students does not cause any danger for the role of mathematics in society, but helps to strengthen this role. Neither Patrick nor Rebecca appear likely to critically question the role of mathematics in society, and although the low marks for Patrick and Rebecca signalise very different problems in the mathematics classroom, they still document a lack of willingness or ability to succeed in mathematics education as it is organised in this classroom.

Wiebke's passivity related to teaching styles

Wiebke is a student in her ninth year of school who also tries to avoid the struggles of learning. She states that she "has never enjoyed having to understand" mathematics and that she would prefer mathematics to be "easy". Unlike Patrick, she does not generally try to avoid mathematics. She tells that mathematics education is a duty and that she has no problem with that, although she is not looking forward to her mathematics lessons. However, she shows a form of temporal passivity depending on her motivation:

> Depending on whether I am motivated or not, I either participate and listen, take notes and do the exercises, or I sit there and wait until the lesson is over. […] Depending on whether I am motivated or not, I am good or not so good.

Wiebke explains further why she might have problems to motivate herself for mathematics:

> I like to write stories, when you can express yourself a lot, tell a lot. […] In maths, there are simply exercises that you have to calculate, and there is

> nothing really personal in it […]. Sure, you can compute stuff, but you cannot really do much with it.

Clearly, this perception of mathematics is closely related with the style of teaching that Wiebke has been experiencing:

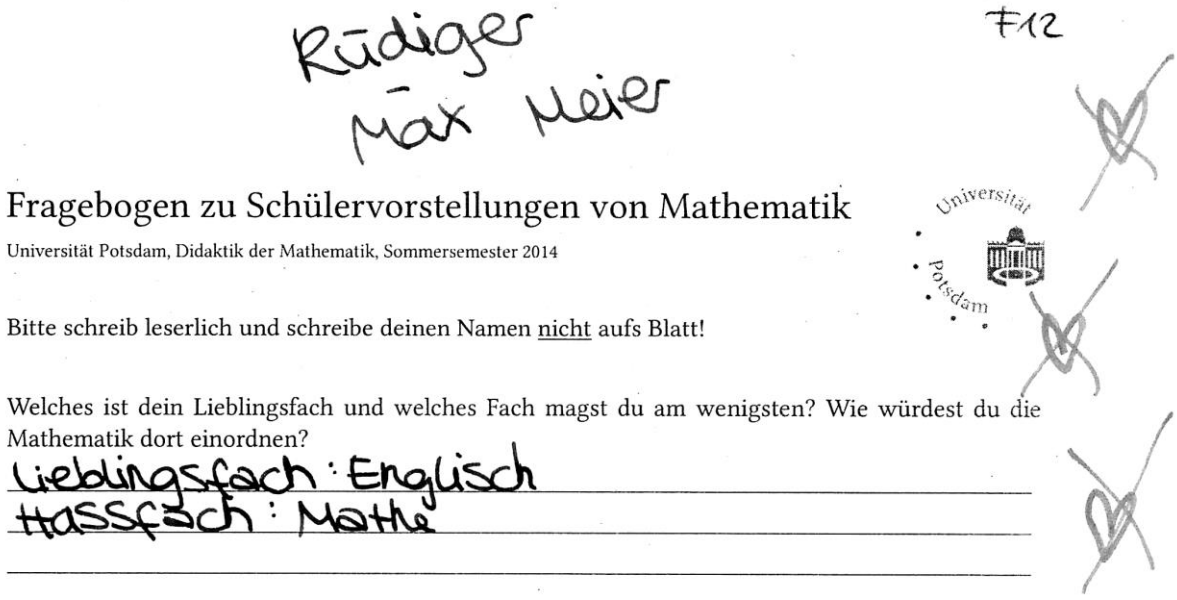
> Well, we sit on our seats, then our maths teacher enters, says 'hallo', then we say 'hello', then he draws something on the board and tells us something about it all the time, then we get exercises, then we are supposed to solve them, and then the lesson is over. And then he sends us a picture of the blackboard [via email].

Motivation might be considered the nodal point of Wiebke's discourse. If her motivation is low, Wiebke is in fact excluding herself from mathematics education by passively sitting in the classroom and waiting for the end of the lesson. She is well aware that her marks depend on her motivation and that she could be a good student. She is also able to provide possible reasons for her lack of motivation: Mathematics appears too impersonal to her. Apart from the fact that mathematics as a discipline indeed strives to provide an impersonal language to describe, predict and prescribe situations of our world (FISCHER, 2006), the feeling of impersonality seems to be strengthened by the teaching style of Wiebke's teacher. Her activities being reduced to listening to teacher explanations and finding answers to presumably closed questions, she does not see a way to express herself in the subject of mathematics. Apparently, Wiebke's partial lack of participation does not stand in conflict with her teacher's pedagogy, which seems not to build on student activity anyway. From a socio-political perspective, this mismatch of the classroom experience with Wiebke's educational needs results in a lack of involvement with mathematics, a lack of learning and worse marks, and therewith in partial exclusion of Wiebke from the mathematical discourse. Here, mathematics education appears successful in selecting students who are able and willing to perform impersonal 'bureaucratic' tasks as discussed elsewhere from a theoretical perspective (KOLLOSCHE, 2014). Interestingly, Wiebke is a case where a learner is well capable but explicitly unwilling to disregard her individuality and pursue the impersonal practices in the mathematics classroom.

Rüdiger Max Meier's provocation

"Rüdiger Max Maier" is the name written on a questionnaire from the questionnaire study (code F12, see Figure 1). Given the fact that names were not asked for in this study, that this male name sounds excessively German, that the student states "19 years" as his age, that he states "good" as his mathematics mark in spite of his expressed rejection of mathematics, and that he claims to be male although the handwriting and pictures on his manuscript would have suggested a female author at first sight, it can be assumed that Rüdiger had been very creative is misleading the readers of his questionnaire. His further comments, incorporating phrases in English and references to themes from contemporary popular culture, present Rüdiger as an outstanding author of a literary highly complex questionnaire.

Figure 1: First part of the questionnaire of Rüdiger


Rüdiger Max Meier

F12

Fragebogen zu Schülervorstellungen von Mathematik

Universität Potsdam, Didaktik der Mathematik, Sommersemester 2014

Universität Potsdam

Bitte schreib leserlich und schreibe deinen Namen nicht aufs Blatt!

Welches ist dein Lieblingsfach und welches Fach magst du am wenigsten? Wie würdest du die Mathematik dort einordnen?

Lieblingsfach: Englisch

Hassfach: Mathe

Fonte/Source: Personal archive.

Concerning mathematics, Rüdiger writes that it is his "most-hated subject" and that he associates mathematics with "annoying, uninteresting, tired", with "shit, can't be bothered" and adds "please no more, in no case for the future". While he states that basic arithmetic and fractions are "easy" and that mathematics is useful "at the checkout", he explains that

"everything else" is "difficult", that mathematics is "incomprehensible", "unnecessary" and "boring". Faced with the question whether it needs diligence or talent to learn mathematics, Rüdiger writes that "[w]ith diligence you can only learn by heart and understand once in a while" while "[t]alent always conjures a 1 [the best mark] on your school certificate".

From his account, it is obvious that Rüdiger seeks to avoid mathematics. Unfortunately, the creative expression of his rejection also works as a shield, for the reader does not get any direct insights in why Rüdiger considers mathematics "incomprehensible", "unnecessary" and "boring". Playing with the discursive form of the questionnaire, Rüdiger makes it impossible to obtain a consistent impression of his relationship to mathematics, and from the perspective of discourse analysis no nodal points can be identified. Rüdiger's rejection of mathematics might be based on a very conscious decision against a subject whose traits Rüdiger cannot identify with, but it might as well be based on traumatic experiences of failure or on yet other experiences and thoughts. We can only guess if his presumably serious statement that rather talent than hard work will result in a very good mathematics mark on the school certificate is suggesting that Rüdiger feels talented in ways that lead him away from mathematics, or if his statement that fractions are "easy" and everything else is "difficult" is not sarcastic but showing that Rüdiger has nevertheless mastered a topic that many German students have severe problems with. In the end, his case does not only demarcate the limits of the combination of the questionnaire method and discourse theory, it also shows that avoidance and auto-exclusion can take very active and unexpected forms that resist easy interpretations.

Reflecting auto-exclusion: Ute's diverging thoughts

Ute is a student in her tenth year of schooling and participated in the interview study. Her favourite subject is German as "you do not have to learn for that" and she considers mathematics "rather demanding". Asked to compare the subject German with mathematics, Ute says:

> In maths, there is always only right or wrong. In German, you can always write something and at least something right results from it, but not in maths.

> […] In German, if there is something you do not know, you can always write a thousand things around it and simply pretend as if you knew it. In maths, that doesn't work.

About her participation in the classroom discourse, Ute adds:

> Well, usually I always listen to what she [the teacher] says. By now, it's really like that in maths that I always listen, because I know that otherwise I won't stand a chance. Yes, I do work and stuff, but for participating in the lesson I am simply too slow, already in my understanding.

Ute also describes her mathematical abilities:

> Well, I would say that I do try but it does not come naturally to me. […] Well, I cannot combine well […]. [W]hat do I lack? Well, sometimes this logical thinking, I guess. Sometimes, I can think well spatially but when it comes to numbers I lack it. But in maths, I also lack self-confidence.

Interestingly, Ute considers her problems with logical thinking to be socially situated:

> Well, in any case we are a rather language-oriented family. Actually, nobody ever managed maths. I think that it is true that, if you, from a certain point in time onwards, always tell yourself or are being told that you can't do it anyway, also by the teachers and by your environment, or if your whole environment isn't that committed, then it isn't bad when you aren't that good yourself, then the expectations aren't that high.

Elsewhere, Ute explains why she thinks people do not like mathematics and what could be improved in her mathematics education:

> In other subjects, the teachers simply try to arrange group work or some PowerPoint stuff, watch movies in English in English classes. All that is hardly being done in maths. Our teacher herself says that she does not find that group work belongs to mathematics, because, well, just because. So that then, you simply don't have that variety, so that there is always only black and white. Either it's right or it's just wrong. There is no in-between […]. I would somehow change something, how it's being presented in the lesson. Yes, I also want the way to be valued again, not only the solution. Because previously, it was also like that.

Ute's discourse is very rich in different ideas. Obviously, Ute is not happy about the dichotomic nature of mathematical knowledge and the corresponding classwork along closed

exercises – a common objection to mathematics which elsewhere has been discussed from a theoretical perspective (KOLLOSCHE, 2013).[2] However, Ute discusses two very different reasons for her problems in understanding mathematics. On the one hand, she refers to low expectations and low self-confidence which might make her accept gaps in knowledge more easily; on the other hand, she refers to the style of teaching she is experiencing compared to her experiences in other subjects or with former mathematics teachers. It could therefore be argued that Ute's discourse is organised around the teaching style and her social background as two nodal points which compete for the hegemonic interpretation of Ute's experiences.

Ute's case illustrates a form of auto-exclusion that is hardly visible and very actively reflected. Similar to Rebecca, Ute actively participates in the mathematics classroom but regards herself mathematically incompetent. As discussed before, that might mean that Ute's mathematics education made her develop as somebody who considers mathematics important enough to learn but too hard to master, laying the foundation for depending on mathematical experts in later life. However, while Ute still feels defined by her social background, she is very aware of it and reflects it critically. Suddenly, her problems in mathematics are no mere indicator of her intellectual inability but at least partly socially constructed and possibly negotiable. Ute's reflections that the teaching style of her teacher does not fit to her interest, and her vision of a different style of teaching mathematics outline a way on which Ute thinks she could improve her learning of mathematics. Unfortunately, it is hardly questionable in how far Ute will be able to walk this path. It is unlikely that her teacher will change her style of teaching, and only by chance would she get a new teacher whose style of teaching fits better to Ute's educational needs. Therefore, it is well possible that Ute's unpleasant experiences continue and that her doubts about her mathematical abilities solidify.

Anna's reflected auto-exclusion

Anna is a girl in her ninth year of schooling and participated in the interview study. If

[2] It might be added that the expectation of *the* right answer as often practiced in mathematics education seems to be so powerful in Ute's case that it emanates on Ute's perception of her German classes. Although she might know "a thousand things" about a topic, she still considers herself to cheat as she fears to miss the presumably existing and expected *one* right answer.

it was free for her to choose, she would "never" go to mathematics education as she does not enjoy it and is afraid of being humiliated at the blackboard. She argues that she does not "need that [mathematics] for life" and she has her "mobile phone where I can check everything if I want". When asked how she would know the price of a jumper which has only its original prices tagged to it and is eligible of a 30% discount, Anna replies that she would "go to the shop clerk and ask her for the new price". Anna finds that mathematics has become "too difficult" since the end of primary school and she associates mathematics with the colour "red" and with the "lion" because both indicate "danger". She reports her experiences from a strictly governed, teacher-centred mathematics classroom. On the one hand, Anna explains why she does not like mathematics:

> In physical education, you can simply have fun, you are not put so much pressure on, also concerning marks. You are usually marked in a more relaxed manner than in mathematics education, I would say. In maths, there is only right and wrong […]. [Anna would prefer] that you do group work, that you can exchange ideas a little and maybe calculate together.

Anna is especially troubled by her teacher's oppressive style of teaching. She reports that at each lesson her teacher calls somebody up to present the homework, "even those who do not want to". Anna adds that troubled students do not receive any support by the teacher and often feel humiliated:

> I do find that the teacher expects that you can do it, because you should work on it at home. If, then, you can't do it, then I also feel humiliated, right? In front of the class, when she then repeatedly tells that we should be able to do it, right? But often, I learn at home and try to understand it but I just don't and then I have to come to the front, she doesn't help me, and I sometimes even get a bad mark. There, she could indeed help me a little and not let me alone like that. […] I'm a little anxious that the others will laugh at me, because it was easy for them. Usually, that doesn't happen often, but still you have that anxiety that the others think that you are stupid. […] One girl even cried.

The nodal point of Anna's discourse is not her lack of understanding but the humiliation she has experienced and is afraid of. This humiliation links her lack of understanding to her experiences with mathematics and the problematic teaching style of her teacher. Anna seems to be traumatised by her experiences from the mathematics classroom,

and it can be assumed that she will avoid mathematics as soon as possible. From a socio-political perspective, Anna might have presented herself too critical of and not competent enough in mathematics to be allowed the status of an institutionally legitimised expert of mathematics. Therefore, it seems functional to have her exclude herself from the mathematical discourse and subject herself under the judgement of experts, who, in Anna's case, might even be a shop clerk.

Interestingly, similar to Ute, Anna is partly aware of the reasons for her problems with mathematics, and she has ideas how to tackle these problems. However, similar to Ute's situation, these problems concern the way in which the learning of mathematics is organised in the classroom, and a change of these circumstances appears hardly reachable to the students. Nevertheless, Anna cannot only be understood as a passive victim of a humiliating teaching practice. Instead, she presents herself as a well-reflected and self-determined learner who can give understandable reasons for her auto-exclusion from mathematics.

Discussion

The discussion of the empirical data did not only allow to prove the existence of the three last forms of auto-exclusion initially discussed, it also showed that auto-exclusion can be the result of various different concerns. Some of these concerns are closely related to mathematics, whose social importance can be understood by its constant struggle to provide a language which allows for interpretive consensus along a dichotomic logic (FISCHER, 2006; KOLLOSCHE, 2013; KOLLOSCHE, 2015): Obviously, Ute's remark that she misses the "in-between" between "always only right or wrong" can be understood as an implicit critique of the principle of the excluded middle, and the concerns with numbers as "obscure and yet so unambiguously defined and proven" as stated by Jahnke's student can be seen as a critique of the abstract character of mathematics which has to be accepted in order to ensure consensus.

However, many concerns of the students are more closely connected to the teaching style. In the case of humiliating teaching practices, which possibly result in maths anxiety as reported by Jahnke's student and Anna, this is only too obvious. But also the domination of mathematics education by teacher explanations and closed student exercises has been

identified as a problem. While the impersonality of mathematics education as contested by Jahnke's student, Wiebke and Ute might be an issue of concern which is routed in the cultural foundation of mathematics itself, reducing the discourse to only one explanation (that of the teacher) and to exercises with only one solution must intensify the experience that mathematics education does not involve individual differences. Thus, the reported style of teacher-centred teaching, which has been found in all classrooms of the questionnaire and interview study, appears to be a systematic obstacle in building a relationship to mathematics at least for some students, and leads these students to create themselves as persons who have excluded themselves from mathematics.

Thereby, auto-exclusion from mathematics does not appear to necessarily be a passive, unreflected or even helpless response to inability or general motivational problems. Students such as Renate Voswinkel and Rebecca present themselves as generally highly motivated but exclude themselves from mathematics, and students such as Renate Voswinkel and Rüdiger show high abilities in other subjects, thus proving to be generally interested and intellectually capable, but nevertheless exclude themselves from mathematics. While the auto-exclusion of students such as Renate Voswinkel and Rebecca appears to be helpless in their lack of reflection and self-determination, students often discuss their auto-exclusion in a very reflected and self-determined manner, and they state good reasons not to like mathematics. With the avoidance of struggle, lack of personality, dichotomic logic, and perceived uselessness, Patrick, Wiebke, Ute, and Anna draw on a large variety of well-communicated reasons to exclude themselves from mathematics. Thereby, their self-assumed inability to understand and unwillingness to participate is very neatly directed at the subject of mathematics.

From a socio-political perspective, the discussed forms of auto-exclusion can be understood as productive outcomes of governmental practices. It is precisely those students who are excluding themselves who also do not fit to the ideal of the modern person who is able and willing to uncritically handle mathematics technically without any questioning of its suitability in social affairs. While some learners such as Patrick may question the suitability of mathematics in relation to its hard comprehension, Wiebke and Ute might criticise applications of mathematics for their disregard of individual differences or its epistemological

restrictedness of reducing everything to oppositions. The uselessness which Anna sees in her learning of mathematics might then be an indicator for the fact that her teacher does not discuss the nature and appropriateness of applications of mathematics in politically problematic contexts but limits the classroom discourse to constructed but unrealistic applications of esoteric contents (KOLLOSCHE, 2017b). Eventually, contemporary mathematics education, explicitly including the conditions which lead to the auto-exclusion of specific students, proves to be highly successful in the reproduction of an ideology and of cultural capital which supports the use of mathematics as a societal tool of power.

Methodologically, this study showed that discourse analysis of student questionnaires and interviews can be a very fruitful approach towards studying auto-exclusion in the mathematics classroom. Thereby, the high quality of student responses allows for a detailed and insightful analysis of the students' situations. The case of Rüdiger's questionnaire shows the limitations of the questionnaire method and discourse analysis in an extreme form, but I would argue that social research always risks this form of resistance if it does not limit itself to passive observations but actively approaches its protagonists. However, for a close analysis of psychological processes encompassing auto-exclusion, of its social situatedness, of its relation to certain teaching styles or characteristics of mathematics, the methods used here will have to be connected to further approaches such as socio-psychology, socialisation theory, classroom studies or philosophy of mathematics.

Look ahead

Auto-exclusion has been shown to exist in the mathematics classroom and to imply pedagogical and socio-political problems. But what could be ways out of this situation? While auto-exclusion also depends on the background of each student as illustrated in the case of Ute, and certain characteristics of mathematics might always cause some students to keep a distance to it, it is the teaching style which has been identified as a decisive factor and which is most easily accessed by the teacher. Annica Andersson, Paola Valero and Tamsin Meaney (2015) showed that changes in the contexts of teaching and learning can motivate auto-excluded students to productively re-engage with mathematics. Teaching and learning

concepts such as Urs Ruf and Peter Gallin's (1998) dialogical mathematics education, where both teachers and students are required to reflect on and discuss their individual thoughts, ideas and approaches, have already been successful in including a wide variety of students into the discourse of the mathematics classroom. Unfortunately, we do not have research results concerning the connection between teaching styles and auto-exclusion beyond the analysis of case studies. What is more, the flexibility of teaching styles might prove limited by institutional circumstances, including the time management of school, the necessity for marking, or the increased importance of constant assessment.

However, a reform in teaching styles possibly contradicts the functionality of the current institutionalisation of mathematics education, for example in excluding potential critics of mathematics. Apart from that, Alexandre Pais (2014) points out that the credit system, in which students are assigned a mark for their performance in mathematics education, constitutes an economic function of mathematics education which cannot easily be altered as various social actors depend on it. In other words, mathematics education is inseparably linked to social selection processes, to performance assessment and therewith to competition, which has been shown to harm students' relationships to mathematics (CHINN, 2012). Consequently, the search for teaching practices which do not hinder any student to develop a positive and active relationship with mathematics is necessarily a political quest, which would not only alter the experiences of students in mathematics education but change the societal functions of mathematics education altogether. We will need more research to see how such a world can be created.

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