Chapter 11
A Socio-critical Analysis of Students' Perceptions of Mathematics

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Abstract Rather than studying students' perceptions of mathematics from a beliefs or identity framework with the purpose of improving the learning of mathematics, this study develops a Foucauldian framework, which allows a socio-critical interpretation of students' perceptions, which are considered an indicator for their developing subjectivities. This allows me to discuss how diverging devotions to mathematics, suffering from mathematics as well as seeing personal relevance and challenges in mathematics connects to the institutional and societal functionality of mathematics education. Thereby, I also present data obtained in questionnaires from German ninth grade students.

Introduction

Mathematics education research is often assuming that mathematics education is primarily concerned with providing opportunities to all students to "learn" mathematics and develop mathematical "competences". Therefore, much research in mathematics education connects educational, psychological and mathematical theories in order to improve the learning of mathematics (Kilpatrick, 1992). This kind of research can be considered normative as it lays an ideological foundation of what mathematics education should be about. Within this endeavour, students' perceptions of mathematics have become of interest, on the one hand conceptualised as students' "beliefs" or "attitudes" about the nature and the learning of mathematics (Leder, Pehkonen, & Törner, 2002; Maaß & Schlöglmann, 2009), and on the other hand as part of students' mathematical "identities", which shape their belonging to communities of practice in the mathematics classroom (Grootenboer & Jorgensen, 2009; Sfard & Prusak, 2005). Although these approaches build on different theoretical backgrounds, both share the traditional assumption that mathematics education is primarily for the learning of mathematics and both approaches understand the

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analysis and manipulation of beliefs, attitudes and identities as a contribution to the narrative of progress (cf. Llewellyn in this volume) in the teaching and learning of mathematics.

In contrast to the above-described conceptualisation of mathematics education, a growing branch of research is concerned with sociopolitical aspects of mathematics education (Valero, 2004), developing alternative perspectives on the mathematics classroom. Typically, authors from this branch strive to distance themselves from normative presumptions and attempt to provide descriptive analyses of the connections between mathematics education and the sociopolitical. As it has been shown that mathematical knowledge and competence is usually not transferred from school to other social domains but learnt in practice (Lave, 1988) and as it has been documented at least for the German case that adults remember hardly any contents, which they had learnt in secondary mathematics education (Maaß & Schlöglmann, 2000), mathematics education would be a gigantic failure, was its primary social function the learning of mathematical content knowledge. Consequently, it could be argued that there must be different social functions, which explain the persistence of such an enormously expensive institution as mathematics education—social functions, which may be at odds with the normative ideology of traditional mathematics education research (cf. Pais in this volume).

Different contributions have highlighted various dimensions in which mathematics education is connected to the sociopolitical formation of the individual and society. Mathematics education can be understood as a "gate-keeper" which decides over opportunities in further education and work (Stinson, 2004; Volmink, 1994). It has been shown that school mathematics systematically disadvantages students from low socio-economic backgrounds (Dowling, 1998) and from certain ethnicities despite their mathematical abilities (Gutiérrez, 1999; Martin, 2009; Stinson, 2013), thus reproducing existing distributions of power in society. Interestingly, these distributions of power are not only based on how mathematics education is organised, but on the ideology at work in the mathematics classroom (Straehler-Pohl & Pais, 2014). Stinson (2013) discusses the "white male math myth", an understanding of mathematics as an endeavour reserved for (Western and Asian) white males only. However, we can see ideology at work beyond the differences between socio-economic status, ethnicity and gender. In spite of its controversial philosophy, mathematics is often presented as an apolitical, undebatable, rational, omnirelevant and universally valid endeavour, thus installing mathematics as a tool of power throughout society and hindering students from questioning applications of mathematics or mathematical thinking (Dowling, 1998; Skovsmose, 2005; Ullmann, 2008).

From this perspective, mathematics education can be understood as an institution, which allows society to use mathematics for its organisation, preparing some students to participate in this form of organisation and preparing the rest to accept it:

> 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 sociopolitical and economic function.
> (Skovsmose, 2005, p. 11)

Such form of critique is directed against the ideals and presumptions of mathematics education, for example, the presumption that mathematics education is good per se. It sets out to reveal what is hidden by these ideals and presumptions, for example, how mathematics education establishes mathematics as a tool of social power.

While the sociopolitical concerns above have been gained both from theoretical considerations and empirical observations, yet little research has documented if and in how far students report experiences that can severely influence their possibilities to engage with mathematics outside school, especially where mathematics is used to organise our society. However, students' perceptions of mathematics are of central interest as they can be considered manifestations of the socialisation processes the students underwent in the mathematics classroom. Therefore, the first research question of this chapter is: *How do students perceive mathematics?* Inseparably connected to this question is the difficult task to find a methodological and theoretical framework to document students' perceptions and to interpret them from a socio-critical perspective. Therefore, the second research question of this chapter is: *How can students' perceptions of mathematics be interpreted from a socio-critical perspective?* Together, both questions open up a wide field of study, and this chapter can only present a first grasp on the issue. Accordingly, it should be read as an explorative study.

Towards a Theoretical Framework

Much research on students' perception of mathematics has originated in the field of beliefs and affect concerning mathematics education (Leder et al., 2002; Maaß & Schlöglmann, 2009). Originally starting out to analyse students-held beliefs about the epistemology, teaching and learning of mathematics, this field of research has broadened its focus by also analysing students' attitudes and emotions towards mathematics, coining the term of "affect" (Goldin, 2002; Di Martino & Zan, 2011). For example, following an inductive approach, Pietro Di Martino and Rosetta Zan (2011) analysed 1662 essays from presumably Italian students from first to thirteenth grade in which they report their relationships with mathematics. They found that many students disliked following rules, the lack of emotions, the lack of individuality and a lack of sense-making. Maria de Lourdes Mata and colleagues (2012) conducted a qualitative study on the self-perceived competence, choice and value of mathematics among 1719 Portuguese fifth-to-twelfth graders. They showed that attitudes become less positive during the school career and that they correlate with self-perceived achievement, value, choice, competence and support in mathematics.

However, the studies focussing on beliefs and affects do not align with the sociological intention of this chapter (for a broad discussion of the shortcomings of beliefs and affects research cf. Skott, 2014). Firstly, they rely too heavily on quantitative methods, especially on Likert-scale questionnaires (e.g. Kislenko, Grevholm, & Lepik, 2007), which do not result in a description of the students' own voices but in a mere measurement of statements, which the researchers find most significant. Secondly, and more severely, research in this field hardly connects to sociological theories but stays psychologically oriented. Jürgen Maaß and Wolfang Schlöglmann (2009, p. vii) outline that "common to all research into affect is the idea that the categories of affect are based on mental systems", thereby excluding the sociopolitical a priori. Even qualitative research into beliefs and affect such as the study by Di Martino and Zan (2011) links its findings to motivational psychology but not to any theory of the social. Eventually, even such socially relevant findings, such as the perception of mathematics as "important but boring" (Kislenko et al., 2007), are not interpreted on a sociopolitical level.

An alternative approach to students' perception of mathematics is presented in the study of students' mathematical identities and their formation in communities of practice (Grootenboer & Jorgensen, 2009; Sfard & Prusak, 2005). This research perspective emphasises the social production of students' identities and regards these identities as decisive for the success in learning processes. While these contributions understand identity and learning rather as a social than as a cognitive phenomenon, they hardly address sociopolitical concerns. Especially, they do not distance themselves from the common narrative that mathematics education was primarily concerned with "learning" mathematics. Sfard and Prusak (2005) state explicitly that they develop their theory of identity to investigate and support learning processes. Grootenboer and Jorgensen (2009) report students' disengagement with mathematics, but do not wish to analyse it as a sociopolitical phenomenon but to find "a way out" by providing students with a professional understanding of agency as a working mathematician.

I propose to build on the work of Michel Foucault to find a theoretical framework, which allows to conceptualise and analyse students' perceptions of mathematics from a sociopolitical perspective (for a discussion of the use of Foucault for research in mathematics education see Walshaw, 2007; Kollosche, 2015). In his late concept of governmentality, Foucault (1982) argues that power should not be understood as a good, which a person or a group of people possesses, but as the control over techniques for the conduct of the self or others. Such techniques do not only comprise physical action, but also manners of feeling, thinking and speaking. By distinguishing the self and others, Foucault emphasises that people have power over themselves in that they can change their very existence. He calls the individual development of a technique for the conduct of the self an "ascesis". Foucault (1975/1979) is especially interested in what he calls "disciplinary techniques", that is, techniques for the conduct of others by means of their conduct of the self. For example, having students solve mathematical problems under the threat of bad marks is a teacher's technique for the conduct of others, while solving mathematical problems requires the development of techniques for the conduct of the self. Foucault argues that it is the need for developing individual techniques which accounts for the success and spread of disciplinary techniques throughout society in modern age. Indeed, it is also a core idea of any pedagogical action to expose students to demands, which provoke an ascesis. Teachers execute their power in the wish to improve their students' ability to calculate, to think logically or to apply mathematics. However, it is important to note that students cannot comply with these demands by simply imitating their teacher, but have to find individual techniques—techniques that may vary from student to student and result in many different ways of acting in and perceiving mathematics.

Apart from that, Foucault (1984, p. 334f.) uses a wide interpretation of the concept of knowledge, including beliefs, values, morals and presumptions. He then regards knowledge as inseparably linked to techniques of conduct (1979) and coins the concept of "power-knowledge" relations. On the one hand, knowledge may produce, improve and justify certain techniques of conduct. For example, mathematical considerations often inform social decisions, or mathematics education research produces knowledge to legitimate and improve the teaching of mathematics in schools. On the other hand, knowledge itself needs a basis of legitimisation, that is, techniques of conduct, which justify it as truth. For example, the knowledge of mathematics relies on logical, calculatory and other techniques for the conduct of the self and others, while the knowledge produced by mathematics education research justifies itself on the ground of educational, psychological, sociological, and other theories and methods. It is therefore impossible to separate knowledge from power. Indeed, knowledge requires power in order to become accepted, just as power needs knowledge in order to be executed.

This theory of the social has several implications for the concept of the individual. The individual finds herself exposed to the conduct by others, in the case of the school primarily by that of the teacher and fellow students. In order to cope with these external demands, the individual has to develop her own techniques for the conduct of the self. While these techniques can differ in the extent to which they allow a dignified survival in school—reaching from being a role model student to avoiding mathematics—these techniques can also differ in the way in which the ascesis is perceived by the individual: whether she finds it easy or hard to develop such techniques; whether she values or dislikes the techniques she creates; whether she fancies the existence the new techniques lead her towards. Knowledge, then, is not only a desired outcome of the pedagogical endeavour, but serves as a legitimising basis for both the teachers' techniques for the conduct of the students and the students' techniques for the conduct of the self. Knowledge is used to make sense of the ways in which the individual meets or avoids the demands; it is used to explain why it is reasonable to participate or not to participate. Consequently, students' perceptions of mathematics are no mere opinions on a socially impartial phenomenon, but an expression of the ascesis experienced in the mathematics classroom, constructing the mathematical individuality of each student.

Recent studies draw on Foucault's theory to analyse how mathematics is inseparably interwoven with the constitution of our society and how mathematics education is functional in constantly reproducing these connections. For example, Andrade Molina and Valero (in this volume) studies how geometry classes install a certain perception and understanding of "space" as a technology of the self. Elsewhere, I show that mathematics can be understood as a prototypical manifestation of the technology of logical and bureaucratic thinking, which are both used throughout society and introduced in the mathematics classroom (Kollosche, 2014). I argue these social functions of mathematics education are explicated neither in mathematics education research, nor in the mathematics classroom, but the mathematics classroom is organised as a disciplinary institution, which leads students either to adopt and reproduce the logical and bureaucratic thinking in order to be successful or to ignore and avoid mathematics in order to not be humiliated by constant failure. In both cases, the functionality of the mathematical power-knowledge relation is not threatened.

When analysing voices of students, the framework presented above may serve as an analytical lens. Understanding students' perceptions of mathematics as results of processes of ascesis, we may then ask, which techniques of the self students developed, what they developed them for, and what knowledge they use to make sense of their behaviour. Thus, the Foucauldian framework allows to build an analytical bridge between individual perceptions and sociopolitical phenomena.

Method

The data set consists of students' answers to an anonymous questionnaire developed with master students who had varying interests in this study. The questionnaire (Table 11.1) includes the wide range of 13 different open questions on the perception of mathematics and three questions on personal data (marks, age and gender). The purpose of the questionnaire was to raise data in the students' words for an exploratory analysis of students' perceptions of mathematics. Developing the questionnaire, we faced the problem of providing enough stimuli to gain a wide range of student answers without directing the students' attention to certain aspects more than necessary.

199 ninth-grade-students from nine different German secondary schools participated in the study. The data set is biased in the sense that the survey has been conducted nearly entirely in the North-East of Germany and addressed mostly students who aim at obtaining a certificate for higher education. Nevertheless, the data set proved to allow a widely focussed and differentiated analysis.

The analysis presented here followed several steps. First, thematic analysis was used to construct themes out of the data set. Second, the themes were analysed quantitatively, preparing the last step, where exemplary answers were analysed qualitatively in order to gain a deeper understanding of themes found and to open these for sociopolitical interpretations.

Table 11.1 English translation of the questionnaire used for the survey

Questionnaire	
1.	What is your favourite subject and which subject do you like least? Where would you position mathematics?
2.	Find at least three words that describe your mood and attitude towards mathematics!
3.	What animal comes to your mind regarding mathematics? Why does it fit well?
4.	What distinguishes mathematics from other subject? What do you like more or less in other subjects?
5.	What do you think of when you hear the word "mathematics"?
6.	What is easy in mathematics and what is hard?
7.	Some consider mathematics logical, others incomprehensible. What do you think?
8.	"Mathematics is not vivid enough." How do you evaluate this statement?
9.	Where does mathematics help in everyday life?
10.	Is it possible to learn mathematics on purpose or does one need talent? Explain!
11.	What do you like about mathematics and what repels you?
12.	How do you feel when you fail to understand something in maths?
13.	What was the mathematics mark on your last school report?
14.	How old are you?
15.	Are you male or female?

Thematic analysis as presented by Virginia Braun and Victoria Clarke (2006) is a qualitative method to reduce text data to a small set of well-reflected themes. In the first step of the analysis all answers were searched for data items referring to the perception of mathematics. Similar items were grouped, and groups expressing closely related perceptions were combined to themes. Contradictory and too differentiated items (e.g. "addition is easy, but fractions are hard") were not coded, whereas general answers were, even if exceptions were mentioned (e.g. "maths is easy, only fractions trouble me"). If ambiguous expressions were used (such as "confusion", which may be experienced as an excitement or as a burden), their meaning was assessed by the context. In this chapter, I only focus on those themes which occur in at least every tenth questionnaire of the complete set. Apart from that, all themes which focus on specific mathematical contents were excluded, for an analysis differentiated by curriculum contents, which may be interesting indeed, would over-expand the scope of this chapter.

Especially the composition of themes necessarily requires the researcher to decide on which groups express related perceptions. Especially, themes could often be merged further or conceptualised with more differentiation. In order to give a transparent account of the analysis, the themes constructed will be presented with exemplary items. Consequently, the thematic analysis followed an inductive approach. Text items were analysed literally without consideration of any latent meanings. In the extreme case, this might mean to interpret "sickness" as a somatic symptom instead of as a metaphor for refusal. However, I argue that this approach works best to avoid alienations of the students' perceptions through the analyst's lens. Eventually, even if the student did not indeed feel sick—what we cannot know—she might still have had her reasons to express her perception in such bodily terms.

Under the assumption that students' perceptions of mathematics differ by attitude, the data set was differentiated by self-assigned general attitude towards mathematics. General attitude was usually identified by the help of the initial question; only in unclear cases the answers to other questions were used for clarification. General attitude was grouped into three dimensions:

- Positive: The student expresses a positive relationship with mathematics.
- Neutral: The student expresses a contradictory or indifferent relationship with mathematics.
- Negative: The student expresses a negative relationship with mathematics.

Constructing Themes

Following the methodological approach outlined above, the associations expressed by the students in the questionnaires were grouped and combined to the following themes (Table 11.2):

Table 11.2 Themes originating from the thematic analysis with descriptions and examples

Name of theme(s)	
Description	Exemplary excerpts
Psychosomatic comfort vs. discomfort	
The students state that mathematics causes psychological or physical comfort or discomfort respectively	Exciting, fun, relaxing/stressful, frustrating, hopeless, fear, tired, headache
Easy vs. hard comprehension	
The students state that mathematics is easy or hard to understand	Comprehensible, easy/complicated, hard
Strong vs. little interest	
The students express strong or little interest in mathematics	Interesting/uninteresting, boring
High vs. low usefulness	
The students state that mathematics is useful or not useful for their current or future life	Important, meaningful/useless, senseless, superfluous, unnecessary
Challenging effort	
The students state that mathematics requires challenging efforts	Efforts, challenge, exertive, demanding, concentration, discipline
Logical dimension[a]	
The students state that mathematics is logical, that is, it follows a certain system of thought	Logic, logical
Evaluation	
The students state that they associate mathematics with exams or marking	Marks, bad marks, exams, tests

[a]In order to avoid any distortion of the data, this question was only applied to the questions 1–6

A comparison of the frequencies with which the themes occur in the questionnaire provided an insight into the themes most prevalent. However, these frequencies do not resemble any measure for the agreement or disagreement with certain statements. For example, not mentioning the term "logical" does not mean that a student does not consider mathematics logical—she just found other issues more important to tell. The mind map (Fig. 11.1) visualises the frequencies of the occurrences of themes. The text size indicates the frequency of each theme:

These findings already draw a picture of mathematics as a subject that is perceived challenging, logical, and useful; but simultaneously uninteresting, unpleasant and hard to understand. However, the data also show that students' perceptions are far from being coherent; they diverge into completely opposite ways of perceiving mathematics. Differentiating the groups by self-ascribed general attitude towards mathematics allows for a more detailed account. Fifty-seven students express a positive, 72 students a neutral and 70 students a negative general attitude towards mathematics. Given that classification, it is possible to compare the frequencies of the occurrences of certain themes for each group (Table 11.3):

This differentiation proved successful in providing more coherence within the data subsets. For example, "strong interest" was a frequent theme among students with a positive attitude, whereas it was not among students with a negative attitude. However, the groups with neutral attitudes towards mathematics are still incoherent. Possibly, there are various essentially different ways of having a neutral attitude towards mathematics. The following considerations focus on chosen points of interest, deepening the analysis by considering individual statements and opening them for a sociopolitical interpretation.

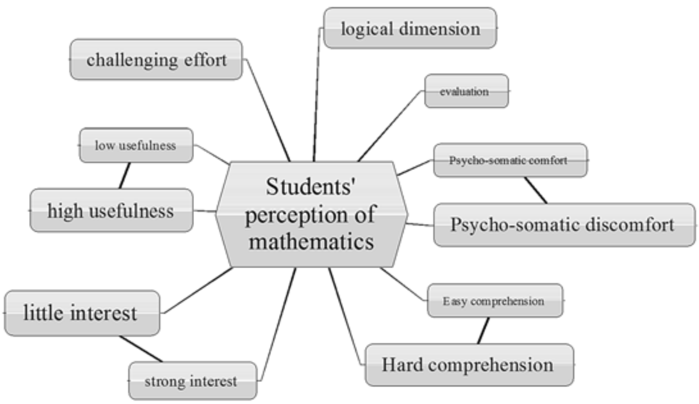

Fig. 11.1 Mind-map of themes with text size indicating frequencies among the whole set

Table 11.3 Relative occurrences of themes differentiated by general attitude towards mathematics

	+ (%)	± (%)	− (%)	Ø (%)
Psychosomatic comfort	33	6	0	12
Psychosomatic discomfort	4	29	61	33
Easy comprehension	37	7	0	13
Hard comprehension	2	31	61	33
Strong interest	42	22	0	20
Little interest	4	35	74	40
High usefulness	39	32	24	31
Low usefulness	7	18	21	16
Challenging effort	33	28	23	28
Logical dimension	47	24	20	29
Evaluation	7	11	20	13

Understanding the Themes

Mathematics as a Polarising Subject

Although many students state that they like mathematics, mathematics proves to be a *polarising subject*. While students with a positive general attitude towards mathematics frequently express psychosomatic comfort, easy comprehension and strong interest; students with a negative general attitude express psychosomatic discomfort, hard comprehension and little interest. For example, students with a positive general attitude towards mathematics state that mathematics was "interesting", "easy", "exciting", "fun" or that they would "relax" when performing mathematics. The extracts from students with a negative general attitude towards mathematics often provide more detailed information. With "boring" being the most prominent association with mathematics throughout the data set, many students and the vast majority of those with a negative attitude state that they have little interest in mathematics. Some students explain their lack of interest with mathematics being too "dry", "without emotions" or "unfriendly" and allowing "too little discussions".

Many students perceive mathematics as being "complicated" and "hard". They express psychological or physical symptoms such as "despair", "stress", "demotivation", "depression", "fear", "exhaustion", "headache" and "nausea". Apparently, feeling bad is a widespread association with mathematics: "Maths is the only subject where I panic. In the other subjects we aren't put that much pressure on. [...] In my case, maths causes anxiety and headache." Interestingly, this burden is not presented as a pathology, as a yet-to-be-cured failure of teaching mathematics, but rather as an unavoidable characteristic of mathematics. For example, asked for what she thinks when she hears the word "mathematics" a successful student states in a factual manner that "desperate students" come to her mind.

Importance of Mathematics

Many students mentioned the *importance* of mathematics, which interestingly was rarely associated with its socially selective function. Probably, mathematics is not perceived as a device for social selection more than any other subject. Some students complained about "bad marks" or "math exams", but no student considered mathematics to be more selective a subject than any other school subject. However, one student remarked that she liked mathematics for its presumed fairness of marking: "In other subjects it does not please me that assessment is left to the discretion of the teacher. In maths it is not like this."

Nevertheless, there are some students who perceive mathematics as a gatekeeper to a happy future. Mathematics was able "to determine our future" and necessary "to learn a nice profession". One student point outs that mathematics could also be a gatekeeper to economic success: "I appreciate that mathematics is useful in life and that there are many professions for which you need mathematics and in which you earn much money."

Thus, while students do not perceive mathematics as a selective subject, they express an awareness of its allocating function in society.

Apart from that, the importance of mathematics was frequently associated with the utilitarian value of mathematics in contemporary everyday life and the expected future of the students. Even students who expressed a negative general attitude towards mathematics "appreciate mathematics as it can be applied everywhere". Other students argue more abstractly that they would need mathematics somewhere in the future: "When I hear 'maths,' I know that in the future it will become important and we will need it."

In spite of that, there is also a considerable group of students who regard mathematics as being "useless". They argue that "you do not need the bigger part of what you learn there", that mathematics was "needless and not important for my future life" and that most of what was taught would soon be forgotten. It is interesting to note that both the perception of mathematics as being useful and that of mathematics as being useless can be found in all groups of self-ascribed general attitudes towards mathematics. For example, the last two excerpts quoted above came from students who expressed a positive general attitude.

Challenge and Logic

In contrast to the mutually opposed themes discussed so far, the themes *challenge* and *logic* relate to the nature of mathematics and do not include a strong polarisation. The perception of mathematics as an intellectual challenge appears frequently and more independent of the students' self-ascribed general attitude towards mathematics. The students state that mathematics required a lot of "effort", "concentration" and "self-discipline". For example, a student associates mathematics with the following animal: "An alligator, as it is a dangerous animal. Seemingly invincibly it rises up in front of you, but with much effort you maybe can defeat it." While some students perceive this challenge as an unpleasant experience, other students appreciate this experience. For example, they state that mathematics was “a nice task to tackle” or that they liked “hard exercises where you have to consider skilfully to find a solution.” Especially when mathematics is compared to other school subjects, this theme was associated with the idea of contemplation: “Mathematics differs from other subjects in that you have to contemplate a lot. Other subjects are often only learning by heart.” Again and again, students associate mathematics with “exercising” and “understanding”; and reduce other subjects to memorising. Apparently, the students perceive mathematics as an intellectual endeavour of a special kind.

In every group of self-ascribed general attitude towards mathematics a considerable number of students explained before the corresponding question that they perceived mathematics as a logical subject. This perception may help to understand the challenge described by the students. Apart from explicitly stating that mathematics was “logical”, many students allowed further insights. Some students generally stated that mathematics “stimulates cogitation”, that it “keeps the mind fit” or that it “makes people smarter”, forcing them “to switch on their brands and to contemplate a bit”. Other students associated mathematics with certain epistemological traits. They often stated that mathematics knew only right and wrong and exactly one answer to each problem. They also explained that mathematics had an “ascending order”, that it was “not leaving anything to chance” and had “a logical explanation for everything”. Apart from that, students refer to the algorithmic dimension of mathematics by stating that you have to “apply formulas”, follow “clear schemes” and that mathematical procedures have “hardly any exceptions, unlike vocabularies”. While many students cherish the logical dimensions of mathematics, there are also some students who find it repellent. These students complain that “you have to do everything that accurately”, many exercises are “only systematic and no fun” or “even a tiny mistake” results in failure. Some students complain that mathematics was too “dry” and did not involve any emotions: “I think that in maths there are no emotions. It is calculating. In stories in German tuition you can run riot and allow your fantasy free play.”

Eventually, some students experienced logic as an epistemological obstacle. For example, a student wrote that “[s]ome can think well logically, others cannot” and that she did not belong to the first group. So, in summary, many students experience mathematics as a challenge and a logical endeavour, whereas they express divergent attitudes and opportunities to engage in these dimensions.

Interpreting the Results from a Socio-critical Perspective

In this section, the three topics discussed before are interpreted from a socio-critical perspective. Central to this perspective is the question of the existence, which mathematics education leads students to and its connections to individual and societal distributions of power.

Mathematics as a Polarising Subject

The first topic discussed was that of polarised perceptions of mathematics. The perceptions of mathematics differ severely and are closely connected to the students' general attitudes towards the subject. Nearly two thirds of the students with a negative general attitude towards mathematics state that they have little interest in the subject, find it hard to understand, and experience psychosomatic discomfort in the mathematics classroom. The reporting of hard comprehension indicates that a large group of students lack the techniques of the self to successfully cope with the disciplinary techniques exercised in the mathematics classroom. Showing little interest in the subject is an alternative form of ascesis that allows distancing oneself from permanent rejection. However, when a student fails, the disciplinary techniques exercised in the mathematics classroom appear not to allow a complete withdrawal, but keep their grip on her, often leading to various forms of psychosomatic discomfort. Therefore it can be argued on the basis of the data that contemporary school mathematics is an institution that exercises disciplinary techniques, which eventually lead to a dissociation of the big group of students who are not able or willing to understand mathematics, while the able and willing experience comfort, success and develop interest in the subject. The strong polarity in the documented perceptions of mathematics indicates that the perception of mathematics is often located very close to one of the two prototypes described above, while alternative techniques for the conduct of the self have not been found in the sample. Considering that a large group of students connects mathematics with hard comprehension, little interest in it and even psychosomatic discomfort, it seems legitimate to confirm Skovsmose's (2005) assumption that the substantial lesson for these students is that "mathematics is not for them", thus possibly excluding those students from an active role in the mathematical organisation of society. Mathematics can then be understood as a complex power-knowledge, which is erected in school and used to distribute power in our contemporary society. Although such a function of mathematics education may be very important for the functionality of our society, mathematics education systematically fails to include a large group of students into the mathematical discourse.

Importance of Mathematics

The second topic discussed was that of the perceived relevance of mathematics and its selective function. Interestingly, the findings contradict research on the issue on the first glance, as students hardly connect mathematics with a gate-keeping function for future opportunities. Indeed, some students mention grading and exams or state that they consider mathematics to be a more objective tool for selection than other subjects, but only a few students connect this to the determination of their future. However, many students state that mathematics would be useful for their contemporary or future life. These statements are general, mostly referring to the omnipresence or omnirelevance of the discipline or to a vaguely conceptualised personal future. Considering the contents dealt with in the grade 9 mathematics curriculum in Germany, it is apparent that these contents may be used in professional areas but not in private life, neither in that of the student nor in that of their peers or relatives. Accordingly, no single student qualifies the claim that mathematics was useful for them by discussing the relevance of a specific content from their classroom. Therefore, it can be assumed that the perception of mathematics as being useful for the students it not based on personal experience. The perceived usefulness of mathematics may then be interpreted as a dogmatic belief, as a power-knowledge relation in the Foucauldian sense, which is being fostered in mathematics education (Dowling, 1998; Lundin, 2012) and which might be effective in providing a technique for students and teachers, with which they can make sense of their own involvement in mathematics education, eventually reproducing that myth themselves. Considering the fact that German grade 9 contents are hardly useful in non-professional life (Heymann, 1996), it might be asked whether the belief in the mundane usefulness of mathematics is actually obscuring other functions of mathematics education, especially its function as a gatekeeper that also German ninth graders are subjected to. The technique of conduct to perceive mathematics as useful would then allow students to accept and live with the rank in the social order that the selective properties of school mathematics has imposed on them, hence subverting students' opposition.

Challenge and Logic

The last topic discussed was that of challenge and logic. Here, students report on interesting experiences which might be closely connected to the nature of mathematics and might thus shed light on further social functions of mathematics education. First, many students report that mathematics requires a lot of effort, and some of them refer more precisely to concentration, self-discipline and careful contemplation. Interestingly, many students contrast this experience with the experiences made in other subjects where learning could be realised by memorising. Interpreting the reported efforts when performing techniques of the self in the mathematics classroom as processes of ascesis it can be said that the students' techniques for the conduct of the self do not suffice, but that they are constantly experiencing ascesis, developing new techniques of the self to cope with the demands in the mathematics classroom. The differences the students state between mathematics and other subjects indicate that this ascesis is unique to mathematics and therefore has a unique function in the process of the students' construction of a mathematical individuality.

Logical thinking may be understood as a conduct of the self, which can be learnt in the mathematics classroom. However, the interpretation of this theme is difficult due to different understandings of the term "logical". On the one hand, some students connect the term to cogitation and smartness in general, using a rather universal and hardly differentiated understanding of it. Indeed, the belief that mathematics is logical may again be a dogmatic belief around mathematics, which is fostered in the classroom and used to legitimate the learning and the societal application of mathematics. Yet, on the other hand, some students share thoughts on the working mechanisms of the mathematics they experienced. They refer to the rigid antagonism of true and false, to the demand to logically explain statements and to the "clarity" and regularity of mathematical procedures. These perceptions of the nature of mathematics correspond well to the socio-critical analyses provided around mathematical thinking (Kollosche, 2014) and confirm that school mathematics is indeed connected to a specific form of thinking. Eventually, the ability to think logically is perceived as creating differences between students in the mathematics classroom. Students explicitly state that some students can think logically while others cannot, and they are aware of their own position within that field. In contrast to that, no student reported that she experienced mathematics as an opportunity to actually learn how to think logically. Therefore it can be argued that mathematics education is an institution which selects students by their ability to think logically while not providing visible opportunities to develop that kind of thinking.

To give a short summary, mathematics is perceived as a discipline, which is connected with a unique kind of thought whose learning is often experienced as a challenge and a burden, which is highly selective by in- and excluding students, which is accompanied by a dogmatic form of power-knowledge, and which legitimates mathematics as being useful for the students. The usefulness of learning mathematics is hardly associated with its content knowledge but with very general skills such as learning to think and with vague ideas of its importance for the future. This importance for the future of the student is sometimes connected to the role of mathematics as a gatekeeper in that it allows access to privileged education and professions. Ultimately, mathematics education is not perceived as an institution where meaningful contents are addressed in a fashion that allows a sovereign and supportive approach for all students, contradicting the dominant power-knowledge of mathematics as being important to be learnt by all students. Instead it can be argued that mathematics education privileges and sanctions students according to whether they develop and display techniques of conduct in line with the dogmatic power-knowledge of school mathematics. The analysis illuminates how certain ways of perceiving mathematics is a substantial ingredient of these techniques.

Looking Back and Forth

This explorative study focussed on the research questions how students perceive mathematics and how students' perceptions of mathematics can be interpreted from a socio-critical perspective. I argue that the use of Foucault's theory has proved successful in understanding students' perceptions of mathematics on a basis which is not a priori normative and not addressing negative perceptions as a pathology that could be “cured”, but is open to describe and explain students’ perceptions as manifestations of techniques of the self, which might be functional for the student even if they contradict the normative discourses of what learning mathematics should be about. For example, the finding that mathematics is perceived as “important but boring” (Kislenko et al., 2007) could not only be reproduced but be understood as a part of the working mechanisms of the institution of mathematics education. I suggest that this perspective allows to better understand the sociopolitical reality of the mathematics classroom and to challenge the normative convictions, which are often held in mathematics education research, and which might hinder a coherent comprehension of the forces at work.

While this study is only an exploration, it illustrates the relevance and productiveness of the chosen approach. The further development of methodology promises more detailed data, for example, by replacing questionnaires by interviews. Eventually, separate studies could focus on the issues touched upon in this study, for example, on the experienced comfort and discomfort in the mathematics classroom or on the unique challenges of mathematics education, leading to a deeper and better substantiated understanding of students’ perceptions of mathematics; and the sociopolitical forces at work in the mathematics classroom.

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