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# “You have to know that! Shame on you!” Pre-service primary teachers’ shame experiences in mathematics during teacher education

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*Empirical studies have shown that shame is a significant emotion, influencing pre-service teachers' competence and identity development in mathematics. In our study, 84 pre-service teachers with a Bachelor degree participated, and 37 of them reported shame experiences in mathematics. Based on a qualitative content analysis, these 37 reports from pre-service primary teachers in Germany were scrutinised regarding their experiences of shame in undergraduate mathematics courses. Characteristics such as person(s) involved, mathematical content domains, and teaching-learning formats, found in a former study, were examined. Furthermore, aspects triggering low control, such as low mathematical understanding, and high value, for example social exposure, were revealed as additional characteristics of shame-inducing situations. The paper concludes by discussing ways for mathematics teacher educators to deal with pre-service teachers' shame experiences.*

*Keywords: Pre-service teachers, teacher education, emotions, mathematics.*

## Introduction

Shame is an activating emotion that is experienced by individuals as extremely unpleasant and is affectively associated with feelings of shyness, embarrassment, insufficiency, and humiliation (Velotti et al., 2017). Studies revealed that pre-service primary teachers (PSTs) report shame more often in mathematics than in other subjects, even in related ones such as physical education (Jenßen et al., 2021). Mathematics is perceived as emotionally challenging in learning and achievement situations by many individuals, and thus may be experienced as uncomfortable by PSTs, too (Jackson, 2008). This finding might imply challenges, particularly for the learning of mathematics. In this respect, Goldin (2014), highlighted the relevance of the hierarchical structure of mathematical topics, the possible frustration related to comprehensive mathematical problem-solving processes, and, at least in traditional learning settings, the strong dichotomisation between correct and incorrect solutions, thus leading to experiences of success and failure. Additionally, Goldin (2014) stressed the role of dysfunctional beliefs about mathematics (e.g., mathematical competence means general intelligence, mathematics is a male domain, or mathematical competence is an innate ability) that can nurture shame experiences, for example, in the case of persistent poor performances.

PSTs' shame in mathematics shows a variety of negative consequences: First, it is associated with lower achievement in mathematics (Jenßen, 2021). Second, according to the study by Panagi (2013), shame in mathematics functions as an identity-shaping emotion for PSTs and thus goes beyond the effects on knowledge acquisition during teacher education in terms of its significance. Third, shame is associated with the choice of subjects at university, in that PSTs avoid mathematics as a subject of study by specifically choosing other subject combinations (Jenßen et al., 2022). Fourth, shame has also negative effects on their intention to teach mathematics later at school (Jenßen et al., 2023). Both aspects are especially problematic because PSTs are most likely to have to teach mathematics later on at school.

## Theoretical Background: Experiencing Shame during Teacher Education

PSTs tend to see themselves as learners rather than teachers during their undergraduate studies (Chen, 2017). Thus, Weiner's (1986) attribution theory and Pekrun's (2006) control-value theory serve as theoretical foundations to conceptualise the development and effects of shame during teacher education. According to attribution theory, shame is experienced when poor performance is attributed to one's own lack of ability, for example, PSTs' subjectively perceived lack of understanding in mathematics (Jenßen, 2021). Such attributions can be a starting point of a vicious circle in the experience of shame in mathematics (Heyd-Metzuyanim, 2015). Furthermore, it can be conditioned by social processes, so-called *upward comparisons* (Festinger, 1954), in which students compare their own performance with the performance of fellow students who, according to their subjective perception, are better than they are (Jenßen, 2021). Qualitative studies revealed that PSTs actually identify their own low mathematics content knowledge (MCK) as a major source of their shame in mathematics, which they in turn attribute to the low amount of mathematics learning opportunities during their teacher education (Bibby, 2002).

The control-value theory (Pekrun, 2006) emphasises value as another factor that can condition the development of shame in addition to such an internal and stable attribution in the case of failure (understood here as lack of *control*). According to Pekrun (2006), *value* may relate to mathematical achievement (e.g., importance of a broad and deep knowledge of mathematics and thus good grades) or to the domain of mathematics (e.g., importance of mathematics knowledge for the profession of a mathematics teacher). In addition, there is also the social value, i.e., the individually perceived value that fellow students or society ascribe to mathematics. Studies have shown that PSTs in Germany have low MCK due to the low amount of mathematics-specific learning opportunities during their teacher education programs, and low entry requirements (Blömeke et al., 2012). Studies also emphasised the significance of MCK for PSTs' acquisition of pedagogical content knowledge (Agathangelou & Charalambous, 2021), which emphasises the individual value of mathematics for PSTs. Moreover, it can be assumed that PSTs perceive the societal importance of their own MCK when international comparison studies such as TIMSS consistently report the low mathematics achievement of primary school students in Germany (e.g., Schwippert et al. 2019). At the same time the societal norm is internalised that primary teachers should have high MCK so that they can better support their students' mathematics competence development.

Studies regarding shame in mathematics classes at school have shown that three main aspects can describe shame-inducing situations (Jenßen et al., 2022): One of the main characteristics is the *person involved*, which is usually the teacher because of his or her hostile behavior. Furthermore, *instructional methods* play a significant role. Instructional methods that promote social exposure, for example, calculating at the blackboard, are more often associated with shame experiences than other instructional settings. Furthermore, the study of Jenßen et al. (2022) could show that shame is experienced especially in *mathematical content domains* that trigger a strong dichotomisation of correct and incorrect solutions. Which situations are associated with the experience of shame by PSTs at university has not yet been investigated. Moreover, identifying control- and value-related aspects of shame-inducing situations can provide important information for the concrete design of learning environments in PSTs' mathematics education at the university.

## Research Questions

The present study is dedicated to contribute characteristics of shame-inducing situations during PSTs' bachelor studies in mathematics. Especially in the bachelor's program, PSTs participate in mathematics courses in which their own learning of mathematics is in the centre.

The design of the present study follows qualitative studies describing situations of emotionally challenging situations that PSTs made during their school years (for anxiety: Bekdemir 2010; for shame: Jenßen, et al. 2022). These studies primarily postulated the following categories as grids to describe these emotionally uncomfortable situations: *person(s) involved*, *mathematical content domains*, and *teaching learning formats* (as adaption of the term *instructional methods* to the context of teacher education). Following the approach by Bekdemir (2010), PSTs were asked to specify their *most* shameful experience during their university studies with respect to the three aforementioned categories. Drawing on the category system derived to classify PSTs' shame experiences during their schooldays, we aim at specifying these three categories for shame experiences during mathematics education at university. Furthermore, we were interested in exploring whether PSTs mention aspects related to shame experience in mathematics that can be classified as low control or/and high value aspects, following Weiner's (1986) attribution theory and Pekrun's (2006) control-value theory. Particularly, we pursued the following research questions:

**RQ1:** How can PSTs' shame-inducing situations experienced during their university mathematics education be specified with respect to *person(s) involved*, *mathematical content domains*, and *instructional methods*?

**RQ2:** What low control and high value aspects characterise PSTs' shame-inducing situations experienced during their university mathematics education?

## Methods

### Sample and Procedure

In the present study, 84 PSTs, involved in the master's program of their teacher education, participated ( $M = 9.30$  semesters,  $SD = 1.6$ ;  $Min = 8$ ;  $Max = 16$ ) and reported on their experiences from their completed bachelor's program (42 ECTS out of 60 for the whole study program in mathematics; 14 ECTS for arithmetic, 10 ECTS for geometry, 7 ECTS for stochastics, and 11 ECTS for didactics of mathematics in general). The mean age of the sample was  $M = 30.48$  years ( $SD = 7.35$ ). The majority of participants indicated female as their gender (90%; 10% male; no person indicated *diverse* or *other*). Finally, 37 PSTs reported shame experiences and were included in the qualitative study.

Data were collected online. The survey on shameful experiences was introduced by a definition of the emotion *shame* to ensure a uniform understanding, adopted from the study by Jenßen et al. (2022). Furthermore, the participants were asked whether they had experienced shameful situations in the bachelor's program of their teacher education. This included both shame experiences as a directly affected person, and from an observing perspective. The presence of at least one shame experience was recorded in a dichotomous manner (yes vs. no). If participants indicated *yes*, they were asked to describe the most shameful situation they had experienced or observed. This procedure was chosen following similar studies by Bekdemir (2010) and Jenßen et al. (2022). Participants were also asked

to describe this situation in as much detail as possible, specifically by addressing *person(s) involved*, *mathematical content domains*, and *teaching-learning formats*.

## Data Analysis

Each PST's open response was treated as unit of analysis when analyzing the data. Thereby, a qualitative content analysis, combining a deductive with an inductive approach was applied. That is, we first coded the three main categories (*person(s) involved*, *mathematical content domains*, *teaching-learning formats*) identified in a former study as characterising PSTs' shame-inducing experiences at school. Also, we checked the data for the two categories of low control and high value aspects (Pekrun, 2006; Weiner, 1986). Subcategories were then coded inductively through identifying patterns and themes that were reported recurrently in the open responses. The subcategories served to differentiate and characterize the shameful situations in more detail. Inter-rater reliabilities (Cohen's kappa) ranged from 0.73 to 1.00.

## Results

In sum, 37 of the 84 participants (44%) stated that they had experienced a shameful situation as a shamed person themselves (41%), or as an observer (3%). Regarding RQ1, the categories *person(s) involved*, *mathematical content domains* and *teaching-learning format* also served for classifying PSTs' shameful situations at university. In the following, we clarify for the three categories the mentioned specifics, their occurrences in percentages, and provide exemplarily excerpts from the data.

Similar to the teacher in the study by Jenßen et al. (2022), the *mathematics teacher educator*, plays a significant role as a person involved (43%). The subsequent statements outline situations in which the teacher educator's behaviour was deemed causal for a shame-inducing experience:

A fellow student asked a question that was considered ridiculous. This was announced by the lecturer in front of the whole exercise group and the question was not answered. Other students wanted to answer the question and help her, but this support was forbidden by the mathematics teacher educator who wanted the student to answer it by her own. (P16)

Almost as often, *no other persons* took part in the shame-inducing situations (38%). *Fellow students* were named as involved persons in about one in five situations (19%). The following example exemplifies how such an involvement looked like: "It was a group activity, one fellow student asked a mathematics question that was probably redundant to many, and another fellow student started to laugh." (P9)

With regard to the *mathematical content domains*, it is striking that in the majority of the described shame situations *no concrete mathematical content domain* was named (57%), although the study participants were explicitly asked to do so. When a mathematical content was mentioned, it was mostly in the area of *arithmetic* (27%; further sub-categories were *geometry* (8%), *didactics of mathematics in general* (5%), and *stochastics* (3%)).

In terms of *teaching-learning formats* the *lecture* was the most dominant format for shame experiences of PSTs in mathematics (27%). Furthermore, *seminars* (16%), *exercise groups* (16%),

*examinations* (8%) and *post-exam reviews* (8%) were named as specific formats. Shame experiences in exercise groups were, for instance, described as follows: “I often felt ashamed when I didn't come up with solutions as quickly as other fellow students, for example in exercise groups.” (P18)

However, the frequency distribution shows that similar to content, *no specific format* does seem to play a significant role in many situations (24%).

In regard to RQ2, we pursued an inductive approach to reveal aspects related to perceived *low control* and *high value*, describing the shameful situations. For these two main categories we gained the following subcategories, ranked according to their occurrences:

**Table 1: Frequencies of aspects related to low control and high value**

Low control aspects	High value aspects
own lack of mathematical understanding (30%)	public exposure (24%)
negative communication (24%)	own mistakes made (14%)
non-transparency of performance requirements (8%)	poor grading in mathematics received (11%)
memories of school days (5%)	social upward comparison (11%)
	getting laughed at (8%)
	doubts towards teaching profession (5%)

As aspects related to low control, most frequently the participants mentioned the subjectively perceived *own lack of mathematical understanding* (30%). This was described either for concrete tasks or rather globally for complex mathematical contents. The following example exemplifies, what the category entails: “When I didn't directly understand some simple task. The typical “standing on the hose” is particularly unpleasant when it comes to math problems on an elementary school level.” (P27)

As another aspect related to low control, the PSTs reported situations in which persons showed a negative communication style towards the PSTs, for example, hostile, pejorative, or lack-of-ability-focusing communication: “Narratives were used in discussions, which made people feel stupid (“That's obvious...that's easy... you have to know that”).” (P47)

As most frequent aspects which were coded as relation to high value, *public exposure*, *social upward comparisons*, *own mistakes made*, and *poor grading in mathematics received* have been found in the data. The first two aspects emphasise underlying social values. The latter two aspects, in particular, can be associated with high achievement values. The following statement refers explicitly to a poor grade and makes clear that this is a subjective judgment: “I had received a grade in an exam that was not satisfactory to me.” (P2)

*Getting laughed at* was named less frequently and might represent a specific case of public exposure. Furthermore, PSTs named also *doubts towards teaching profession*, for example:

Existing doubts about whether it is careless to become a primary school teacher of mathematics, among other things, with so little understanding/knowledge of mathematics. So rather extreme self-doubt throughout all math courses. (P35)

All categories – person(s involved), teaching-learning format, mathematical content domain, aspects related to low control, and aspects related to high value – serve to describe the shameful situations of PSTs. The category system refers on the one hand to the multifactoriality of these situations and on the other hand to the heterogeneity that can result from the combinations of the single subcategories.

## **Discussion and Conclusions**

The present study considers mathematics teacher education as a context with learning and achievement situations, possessing also a social dimension, for example, when it comes to presentations, discussions, and exams, where one's own identity is challenged in terms of, for example, doubts that may arise about one's competence for the teaching profession. Our qualitative analyses show that the experience of shame in concrete situations can be conditioned by a variety of factors, which can interact with each other in a complex way.

In sum, our results show that mathematical content domains seem to be less relevant. They are reported less dominantly compared to shame situations from school (cf. Jenßen et al., 2022), which raises the question of how mathematics-specific the experienced shame situations were. This is surprising, because PSTs received all courses related to MCK relevant for primary school during their bachelor's program. Predominantly, arithmetic was mentioned in relation to PSTs' shame experiences, but this might be explained either by its relevance (lasting one year, first year of the bachelor's studies) or a more prevalent dichotomisation of correct vs. incorrect solutions (Goldin, 2014) than, for example, in mathematics didactics in general. However, it could also be that specific content domains were rarely mentioned because - in line with the nature of shame - the person experiences mathematics globally as a shameful field.

Other characteristics of shame-inducing situations can be interpreted in terms of the control-value theory (Pekrun, 2006). We were able to categorise aspects specifically related to low control, such as the *own lack of mathematical understanding* or *memories of school days*, to name but a few. Unpleasant memories of school days may be perceived as triggering and intrusive and thus as less controllable. Furthermore, we were able to relate some subcategories to high values. That is, poor grades and mistakes made may be in conflict with a high subjective value of mathematics achievement, whereas social upward comparisons, public exposure, and getting laughed at represent underlying social values.

Before drawing conclusions, we would like to point out some limitations of our study. First, our sample is not representative, especially in that sense as PSTs with higher levels of shame might not participated in our study as they already had left the bachelor's programs. Second, the term *most shameful situation* is not objective as shame is bound to be a subjectively perceived emotion and situations which are described as *shameful* may vary between PSTs.

Overall, the results indicate that mathematics teacher educators - similar to mathematics school teachers (Jenßen et al., 2022) - play a significant role when it comes to shame experiences of PSTs at

university. Thus, the reduction of hostile or negative communication on the part of the educators, which implies a global internal attribution in case of deficits, seems to be relevant and a possible starting point to avoid shaming. At this point, reference can be made to programs on reattribution training for educators (Perry et al., 2010) or to the importance of social support by educators for the well-being and performance of students (Aldridge et al., 2013). Given that shame disrupts self-regulatory learning processes, and thus has negative effects on motivation and performance (Husman & Turner, 2008), another starting point for teacher educators might be to regularly demonstrate long-term goals of competence and identity development to minimize such negative effects of shame (ibid.). Another possibility could be to not only name objectively existing deficits such as a low MCK globally, but to specify them as concretely as possible and to name corresponding opportunities for the acquisition of competencies or the activation of resources. In this respect, sound MCK can also be considered as shame-preventive. Finally, given that shame can also be caused by the behaviour of fellow students, it makes also sense to establish a functional error culture in mathematics teacher education.

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