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## Towards conceptualising failure in mathematics as an autobiographical experience

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### ABSTRACT

Studies have shown that failure experiences play a role in pre-service teachers' development. Given that autobiographical experiences are a foundation of learning and that failure is a wide-spread experience, particularly in mathematics, we need further insight into what kind of experience failure actually is. This paper draws on 59 pre-service teachers' written experiences of failure in order to map them out and provide insight into what counts as failure from the perspective of the future teachers of mathematics, that is, pre-service mathematics and pre-service elementary school teachers. The findings, alongside the earlier research on negative experiences, form a basis for conceptualising failure in mathematics as an autobiographical experience and distinguishing it from a negative experience. A theoretical insight into the nature of failure is gained; the failure experiences seem to be less relational than anticipated. The paper also discusses the relevance of failure experiences for teacher education.

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Autobiographical experiences; failure; mathematics; pre-service teachers; teacher education

## Introduction

It has been noted that 'gaining awareness of our life history is, then, an important first step in personal and professional development' (Bukor 2015, 311). This suggests that autobiographical experiences and the memories formed based on those experiences are an important factor in learning to teach and in developing teacher identities (Miller and Shifflet 2016; Bukor 2015; Haught, Nardi, and Walls 2015; Izadinia 2013). Moreover, some studies have demonstrated that personal experiences and memories might have a greater impact on becoming a teacher than coursework in initial teacher education (Miller and Shifflet 2016; Ruohotie-Lyhty and Kaikkonen 2009). There is also evidence that personal and professional experiences continue to shape teacher identity once teachers reach the in-service phase, therefore impacting teachers' continuing professional development (Bukor 2015).

Given that 'experiences are the cornerstones of learning' (Carmi and Tamir 2020, 9), it is essential to investigate various experiences encountered by pre-service teachers, including failure in order to help them in their development. Elsewhere, we have shown that

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failure experiences shape not only how pre-service teachers understand their own failure and resilience (Lutovac 2019; Lutovac and Kaasila [Forthcoming](#)) but also the impact failure has on identity development in terms of the kind of teachers they want to become in the future (Lutovac 2020). The latter includes how they understand their students' failures and the relational and instructional strategies they plan to employ in their future teaching practices (Lutovac 2020; Lutovac and Flores 2021). Therefore, we know that failure experiences shape future teachers' identities, but we do not know what kind of experiences future teachers come to understand as failure. With the premise that we know little about pre-service teachers' autobiographical experiences of failure and about failure as a phenomenon per se, this study builds on and extends the previous research by examining what kind of experience failure actually is.

Maths failure experiences are of particular interest here as there is 'wide-spread phenomena of failure in mathematics' (Reusser 2000, 11/17). Compared to other school subjects, negative learning experiences are most often reported in mathematics (Haight, Nardi, and Walls 2015). Additionally, some teachers who eventually teach mathematics, such as elementary school teachers, have had their share of prior negative experiences, including maths anxiety (García González and Martínez Sierra 2020; Bekdemir 2010), which have powerfully impacted their relationships with the subject and their teaching. Given that teacher–student relationships characterise teaching as a relational profession (Bauml 2009), pre-service teachers need a broad understanding of how individuals see failure in order to be able to employ this knowledge in their relationships and interactions with students.

In this paper, we examine pre-service mathematics and pre-service elementary school teachers' written memories of failure in mathematics in order to map out what kind of experiences count as failure from their perspective. We purposively chose these two cohorts of pre-service teachers, not to compare and contrast their experiences, but rather to better understand failure experiences of future teachers who will be qualified to teach mathematics in schools at different educational levels. Moreover, based on our extensive work regarding pre-service teachers' negative experiences with mathematics and the ways these affect their beliefs, emotions and teacher identity development, we initially thought of failure as a negative experience on the extreme end of the spectrum or a 'very negative experience'. However, our recent studies into failure (Lutovac 2019, 2020; Lutovac and Kaasila [Forthcoming](#)) brought to our attention some distinguishing aspects of the two constructs. This observation warrants further research support, which this paper provides by specifically analysing what the experiences of failure are with a sample of two cohorts of pre-service teachers in the same subject-context in order to delineate the nature of failure experience and conceptualise the phenomenon. The research question guiding this study was: *What kind of autobiographical experiences do pre-service teachers label as failure in mathematics and what do these experiences reveal about the nature of failure?*

## **Negative autobiographical experiences of school time and teacher development**

The autobiographical perspective in teacher education (a focus on pre-service teachers' prior experiences as central to teacher development) (Bullough 1997) has contributed to

discussions on teacher beliefs, teacher socialisation and teacher identity. For example, it has been established that teacher socialisation begins well before the initial teacher education and stretches beyond formal educational settings (Pajares 1992; Timmerman 2009). In the process of teacher development, early educational experiences, positive or negative, all significantly shape individuals' self-efficacy beliefs, their motives to become teachers and their choice of the teaching profession, as well as their teaching self-efficacy (Phelps 2010; Pajares 1992; Thomson and Palermo 2014; Fokkens-Bruinsma and Canrinus 2014). Teacher role models, as part of personal experience, not only shape future teachers' beliefs about teaching and learning but also how teachers teach throughout their entire careers (Timmerman 2009). Moreover, the centrality of school-time experiences and personal histories in teacher education has been greatly attributed to their power to shape pre-service teachers' identities – who they were, who they are and who they want to become (Izadinia 2013; Furlong 2013; Miller and Shifflet 2016).

In the context of becoming a mathematics teacher, negative autobiographical experiences, in particular, have been under scrutiny for a long time due to their power to weaken one's self-esteem and evoke negative emotions, especially mathematics anxiety in many pre- and in-service elementary school teachers (García González and Martínez Sierra 2020; Bekdemir 2010; McCulloch et al. 2013). As a result, pre-service teachers develop a negative view of the subject and a negative self-view as learners of the subject, which may integrate into their views of themselves as teachers of mathematics and their teaching self-efficacy (Wilson and Thornton 2008; Phelps 2010; Kaasila, Hannula, and Laine 2012; Drake 2006; see for review Ramirez, Shaw, and Maloney 2018). Similar findings portraying pre-service teachers' difficult relationships with mathematics and 'non-mathematical' identities developed as a result of negative learning experiences, including feelings of being victims of teachers' attitudes, have been recounted in the studies by Lutovac and Kaasila (2011, 2012, 2014; see also Kaasila, Hannula, and Laine 2012).

What these and prior studies revealed about the nature of negative experience is that they often revolve around teachers and their 'wrong doings' (Towers et al. 2017; Hobden and Mitchell 2011; Lutovac and Kaasila 2014; Machalow, Goldsmith-Markey, and Remillard 2020) and tend to be portrayed via particularly strong and negative language (Drake 2006). For example, Hobden and Mitchell (2011) suggested that pre-service teachers' stories of their complicated experiences with school mathematics portray teachers as lacking knowledge, empathy and professionalism, all of which pre-service teachers felt dissatisfied with. Moreover, when pre-service teachers who report to have had negative experiences with mathematics reflected on their future-oriented teacher identities, they expressed that as teachers they will do anything in their power to assure that they do not repeat the mistakes of their teachers so that their pupils can experience mathematics more positively (Lutovac and Kaasila 2012, 2014). Drake's (2006) study on in-service elementary school teachers, however, showed that despite the fact that some teachers' negative experiences encompassed all of their educational lives, as a result of a turning point, the teachers were able to begin to see themselves and their relationship with mathematics in a more positive light (see also McCulloch et al. 2013).

Supporting a similar idea, research has argued that autobiographical experiences should be understood as a resource in initial teacher education (see also Meijer et al. 2014). Revisiting negative experiences, particularly via narratives has become a key component of mathematics teacher education pedagogies, involving reflective and

critical examination of prior experiences via narrative and biographical approaches (Lutovac and Kaasila 2011, 2020; Di Martino and Zan 2010; Hobden and Mitchell 2011; Machalow, Goldsmith-Markey, and Remillard 2020; see also McCulloch et al. 2013). The opportunities given to pre-service teachers to deal with their past experiences have been shown to positively impact their emotions, self-efficacy beliefs and confidence regarding the subject and consequently, shift their learner and/or teacher identities (Palmer 2009; Wilson and Thornton 2008; Namukasa, Gadanidis, and Cordy 2009; Lutovac and Kaasila 2011, 2014, 2020). However, in order to use the autobiographical experiences in a manner that will best serve pre-service teachers' current and future needs, we need to acknowledge and examine a broad range of autobiographical experiences and the ways these link to pre-service teachers' development. We argue that we need to understand a wide range of experiences commonly categorised as either positive or negative and assume their impact may differ.

### **Towards understanding failure in mathematics as an autobiographical experience**

Educational research has typically discussed failure around academic achievement and motivation and has viewed it as a normative and a negative phenomenon with a detrimental impact on learning (Eskreis-Winkler and Fishbach 2019). Some research has also brought to attention the importance of productive failure (Kapur 2014) and the benefits of a teaching approach that allows for temporary failure (Alfi, Assor, and Katz 2004). Little, however, has been done to address failure as a personal experience from the times at school or during a teaching practicum (Danyluk et al. 2020; Martins, Costa, and Onofre 2015). As researchers interested in exploring pre-service teachers' negative experiences with mathematics, we observed a complexity to failure that tends to be insufficiently acknowledged in research and in practice. Let us examine the following pre-service teachers' accounts (from Lutovac 2014):

I got a lot of failing grades and had to take repeat exams. The first year was really a painful period. I usually had the desire to just pass ... (Ines)

"And then my maths grade went down; I think I got six or seven [on the scale 1–10] on the tests. I had negative feelings because of the failure ... (Ulla),"

While the outcome in the above examples was similar, Ines and Ulla did not identify themselves as mathematically able (see also Lutovac and Kaasila 2011, 2014); there is an underlying difference in what Ines and Ulla labelled as failure. While Ines received failing grades and had to take repeat exams, Ulla viewed her undesirable performance as a failure. This led us to further explore failure as an autobiographical experience in the project on 'Narrated Failures', which seeks to provide a better understanding of how future teachers of mathematics understand the phenomena of failure.

In our recent studies on failure, we identified five categories of definitions of failure held by pre-service elementary school teachers (Lutovac and Kaasila *Forthcoming*), 1) failure as underperformance and underachievement, 2) failure as subjective, dependent on each individual, 3) failure as not achieving one's own goals or expectations, 4) failure as one's own inadequacy, that is, not feeling good enough, anxious, frustrated, worried and disappointed and 5) failure as a learning opportunity. In a study by Lutovac (2019),

analysis of two pre-service mathematics teachers' stories revealed that, while they have had mostly positive experiences with mathematics and saw the subject in a positive light, their experiences were not free of failure. Their narratives, however, displayed the ways in which they rejected failure and did not allow it to affect how they saw themselves mathematically. In another study (Lutovac 2020), various possible teacher selves pre-service elementary school and mathematics teachers formed as a result of their failure experiences were identified, such as possible selves focused on 'teacher traits and actions', on 'student strategies' and on 'teacher self-development'. The two cohorts of students projected very similar possible selves, which demonstrated that their identity development as teachers was similar.

Based on these studies, we formed the assumption that there might be a distinction between negative experiences and failure, and that failure may not necessarily be a negative experience on the extreme end of the spectrum. For example, for pre-service teachers who self-report to have had many negative experiences with mathematics, such as our earlier examples of Ines and Ulla, failure can be a negative experience (see also Lutovac and Kaasila 2011, 2012, 2014), but Lutovac (2019) observed that for other pre-service teachers, that seems not to be the case. These observations alongside the idea that interpretation of performance as failure may undermine one's satisfaction and self-efficacy beliefs (Zeldin and Pajares 2000), but also, as Bandura (1994) observed, achievements do not necessarily correspond to how pre-service teachers see their own abilities and do not always reflect whether they feel they have succeeded or failed, which suggests that different failure experiences require different kinds of support. Understanding failure, therefore, the kind of experience it is and its distinction with negative experience can help us provide more targeted support for teacher development in pre-service teacher education.

## Method

### *Data collection*

The data for this study were collected as part of 'Narrated Failures' project (Academy of Finland), which seeks to cross-examine the failure experiences of pre-service elementary school and pre-service mathematics teachers in order to contribute to a better understanding of their development as teachers. The study was conducted in one Finnish university teacher education programme. Sixty-seven pre-service teachers participated by providing written narratives about their failure experiences. Twenty-two of these narratives pertained to pre-service mathematics teachers in their third year of study and at the beginning of their pedagogical studies at the teacher education department. These students were previously engaged in studies at their own respective departments. Forty-five narratives were collected from pre-service elementary school teachers who were enrolled in their first year of study. Both cohorts of pre-service teachers were asked to produce an account prompted by the following instructions: *'Tell about your experiences of failure (in your main subject)'* and *'Choose 1–3 meaningful episodes from your past in relation to mathematics (from primary school until today) that you labelled as failures'*.

The writings were produced as a part of the coursework for both the purpose of data collection for the project and for pedagogical purposes. Pedagogically, the task's aim was

to stimulate the reflection upon pre-service teachers' own experiences and the ways these have shaped their identities as learners and as teachers. We followed the ethics protocol of the Finnish National Board of Ethics in research. Per their guidelines, this study did not require institutional review board approval; however, all pre-service teachers were informed about the use of their writings for research purposes. In addition, while all had to produce the writing as a course task, they could choose whether or not they wanted to give consent for the use of the writing as research material. Pre-service teachers were also informed that their participation (or lack of participation) would bear no impact on their success in the courses. While most pre-service teachers did give consent, others declined to participate in the study and their wishes were respected.

### ***Analysis of narratives***

The narrative approach was applied in this study and in particular, categorical analysis of narratives was used as an analytical technique (Lieblich, Tuval-Mashiach, and Zilber 1998). We first read through all the writings and extracted specific memories of failure experiences for each participant. Often, pre-service teachers reported on a single memory of failure experience. In the case of two memories, we considered both, which is also reflected in the count (see [Tables 1 and 2](#)). The next step involved a careful reading of these experiences to which we assigned codes. These codes were not pre-determined, rather they emerged from the readings of the data. However, since we analysed the same data set for the purposes of another study with a different focus (Lutovac 2020), we were, at the time of analysis, well familiar with the content of the data set, and we knew the kind of experiences we might identify in it. This prior knowledge of the data, as well as other findings from our research on failure (Lutovac 2019; Lutovac and Kaasila [Forthcoming](#); Lutovac and Flores 2021), were not used as an explicit deductive element informing the categories; however, these may have tacitly impacted the categorisation and our interpretations of the findings. For example, our prior research demonstrated that pre-service teachers associate failure with underperformance and underachievement, which also meant that this could appear as a category of failure experience in this study.

We also decided to code the entire data set at once; this means that in this step of the analysis, we did not differ between pre-service mathematics teachers' and pre-service elementary school teachers' memories. The next step involved a careful examination of codes through which the categories of experiences emerged. In this step, we decided to separate the data set into the two parts – one that pertained to pre-service mathematics teachers and one that pertained to pre-service elementary school teachers. We continued the analysis process for each data set separately.

Among 22 pre-service mathematics teachers, four did not write about a specific experience of failure. The remaining 18 were analysed further, and we identified 22 failure experiences, which means that four participants reported on two experiences. The analysis of this data set yielded six categories of failure experiences. We then analysed 45 pre-service elementary school teachers' narratives, among which, four did not write about any specific failure experience. This left us with 41 narratives to be analysed, and we identified 44 failure experiences, which means that three pre-service elementary school teachers reported two experiences. In this data set, we identified eight categories of failure experiences. The process of data analysis was iterative. For example, for the

purposes of choosing sample quotations for this paper, we revisited and probed our categorisation. As our findings emerged, we went back to the data to assure that our interpretations and claims were suitable. In the results section, we present the categories identified according to the two cohorts and provide an example quotation for each category.

## Results

In this section, we first address pre-service mathematics teachers' experiences of failure and then pre-service elementary school teachers' experiences. These will serve as a basis for further discussion on the nature of failure.

### *Pre-service mathematics teachers' experiences of maths failure*

Pre-service mathematics teachers reported on six categories of experiences (Table 1). Most of these experiences occurred during university studies, and a minority during secondary or upper-secondary schooling.

The most common experiences labelled as failure were those of failing exams and having to take repeat exams, as well as barely passing exams despite the effort invested in studying. As one participant said:

When I started university, I couldn't believe that math was not like it had been in upper-secondary school. With a difficult workload, I got a grade 1 [on the scale 1–5], and sometimes I couldn't even get through the courses. In the spring of the first year, I was pretty sure I would never graduate as a math teacher. I was really disappointed. The second year, I made friends at university. I no longer did the tasks alone, but with a group of friends. I got through the courses easier and got better grades on the exams. After the failure, success felt better, and I became excited about studying again. I feel that mathematics is so demanding at university that I need more effective ways of learning than learning alone. (PsMT#17)

Four failure experiences related to errors in tasks or in problem-solving in non-assessment related situations were identified. In the following example, a pre-service teacher tells about continuous failing at the university understood as an inability to solve various tasks, mostly due to misunderstanding the given instructions.

As a university student, I am constantly failing in my subject. Failure in tasks can both frustrate and empower. Occasionally, there is a small mistake in the calculation, and it is nice when you have noticed the failure yourself and it is possible to fix the mistake. Sometimes, the failure is noticed only after the exams, and this is very annoying. Many times, if I make a mistake in the

**Table 1.** Pre-service mathematics teachers' experiences of maths failure.

Autobiographical experiences of failure	*N = 22
Barely passing or repeating exams at university	11
Solving the tasks or problems incorrectly in university studies	4
Obtaining a lower than expected grade and dissatisfaction with one's own performance in upper-secondary school	2
Performance tension and anxiety during school time	2
Learning difficulties in advanced mathematics courses in upper-secondary school	2
Lacking motivation in university studies	1

\*N represents the number of failure experiences identified, not the number of participants.



exam, I know that I need to repeat and focus more on the topic next time in order to understand it properly. (PsMT#6)

The following categories of failure experiences were less frequent. For example, two experiences of failure belonged to the category 'obtaining lower than expected grade'. One participant said:

One example of my own failure is upper-secondary school mathematics vector calculation course. In that course I used to get only tens and then I got 7 [on the scale 1–10]. In retrospect, it is ridiculous that I was annoyed by the result, but then it even scared me, and it didn't feel good. However, I knew I had understood the content. At that time, I couldn't handle that result properly, and I skipped some classes and learning vectors in general. Only later I realised that the failure on the test does not tell you whether you are able or not. Nowadays, I understand that a test is just a test. It does not tell the whole truth about the student's skills. (PsMT#11)

Two experiences of failure were about performance anxiety in school. For example, this participant said:

All of [my experiences of failure] were related to my long-standing tendency to be tense when performing. Every time during the examinations, I could get so nervous that I was completely confused in my words. The teacher may have come up with an idea that I have not practiced enough, even though it was really a matter of fear, when my mind completely forgot what I was talking about. (PsMT#2)

Two failure experiences were linked to having difficulties in advanced maths in upper secondary school. For example, one participant said:

In upper-secondary school, I tried long [advanced] math, which I had already failed miserably in the first course. I wanted to switch to short [basic] math because I simply didn't understand anything. My teacher still pressured me to continue for a long time, which I agreed to do for one more course. This course, in turn, was eye-opening, to say the least. Mathematics suddenly became my favourite subject, in which I wanted to become an equally good teacher. Turning the experience of failure into a success is many times the most effective way to learn and be motivated by. (PsMT#3)

This pre-service teacher reported a lack of motivation to study as a failure experience.

I've generally responded to schooling casually, without unnecessary stress and without requiring excessive perfection from myself. When I got to university, my first year went pretty well and seemed to continue in the normal pattern. For some reason, however, as my second year began, my motivation for studying completely ceased, and this new momentum continued until my fifth year. Then I finally decided to wake up from my dormancy and realised that if I didn't start to study, I wouldn't get my degree. (PsMT#10)

### ***Pre-service elementary school teachers' experiences of maths failure***

Pre-service elementary teachers reported eight different categories of failure experiences (Table 2). These experiences occurred throughout various levels of schooling, that is, from elementary school to upper-secondary school. We did not identify, however, any failure experiences with mathematics from studies at university with this group of pre-service teachers.

**Table 2.** Pre-service elementary school teachers' experiences of maths failure.

Autobiographical experiences of failure	*N = 44
Poor performance on the tests and low grades	15
Learning difficulties in advanced mathematics courses in upper-secondary school	7
Obtaining a lower than expected grade	6
Learning difficulties from early years of schooling	5
Learning difficulties due to a specific reason (e.g., competitive, time-restricted environment)	5
Obtaining less than the highest grade (striving for perfection)	3
Errors in doing maths in an out-of-school context	2
Unfair treatment and grading	1

\*N represents the number of failure experiences identified, not the number of participants.

Fifteen failure experiences were about poor and/or insufficient performance on exams and receiving low grades. For instance, this participant said:

I was not used to studying math or struggling with learning math. I was used to being good at it with no or very little effort. After just a few lessons, our teacher gave us a surprise test. I knew right away that I was not going to do well, since I had not studied the content of the two previous lessons. I was graded a 6– [on the scale 1–10]. The worst grade I had ever gotten before that was a 9–. The first emotion that I experienced was a feeling of panic. This completely shattered my image of myself as the perfect student. When I think about this now, it is easy to say that it was probably necessary to have that false assumption about myself revealed. I was so caught up with my identity as a ‘talented student’ that I often decided not to invest effort to study or learn difficult things. After this experience, I started to really put a lot of effort into studying and learning math. I decided to never have this feeling of failure again. (PsET#21)

Seven failure experiences were linked to learning difficulties in advanced mathematics in upper-secondary school. In the following example, a pre-service teacher narrates her struggle in an advanced maths course due to lack of invested effort and the emotional toll that came with it when deciding whether or not to change advanced courses for basic courses. The story is also a good example of how a student can internalise failure and begin to identify with it.

In upper-secondary school, I ended up taking advanced math courses. The failure was due to myself and the fact that I did far too little. I was used to the fact that mathematics was fairly easy and mostly problem-free. Although I knew that I did not study sufficiently, I felt that I just sucked at math. I knew I should have switched to basic math, but I didn’t want to give up. I wanted to continue and persevere through the courses. And so, I did. I chose this as a failure because I had never experienced such a great and long-term failure in mathematics. ... This seemed to create a so-called snowball effect where emotions just swelled. Then the bad performances increased the feeling that I was bad at math. And when enough similar experiences accumulated, it was impossible to get positive attitude towards one’s mathematical skills. (PsET#11)

Six failure experiences concerned obtaining lower than expected grades in mathematics. For example, this participant said:

This event takes place in the sixth grade of elementary school and was the final math exam of the spring and the semester. We had discussed with my teacher that my mathematics grade may lower if I didn’t get at least 8 [on the scale 1–10] on the final exam. I remember practicing a lot for the exam, and I was really excited by the upcoming exam. I didn’t want my grade to drop. In the end, however, I got 7 on the exam, and I was really disappointed. ... I felt I had

failed completely. I was really disappointed with myself, and I remember thinking that I was just not good at math, so it was useless to even try. (PsET#17)

Learning difficulties in mathematics in the early years of schooling were labelled as failure experience five times. As one participant said:

I had my first failure experience in the third grade. I needed extra support with learning because my grades in math were below average. I think the feeling of failure came from staying behind with my performance compared to the other children in the class and the expectations towards myself, my parents and my teachers. Furthermore, it was really frustrating not to understand what the teacher explained, and I was often too shy and felt stupid to ask if he/she could explain it again. (PsET#3)

Pre-service teachers also wrote about maths failure in terms of learning difficulties due to a specific reason, such as a particularly difficult content or ways of learning (e.g., mental calculations), competitive and time-restricted environments, learning after a long absence from school, poor reading skills and so on. We identified five such experiences. The following narrative also displays how for some students, failure also had a motivating power, pushing them to persevere and had increased their desire to learn.

I remember some failures from elementary school concerning verbal tasks that I couldn't figure out by myself. I remember thinking that I lacked ability, abstract thinking and verbal understanding of assignments. I remember thinking that I did not understand this yet, but due to my failures, my interest in learning increased. And the anxiety of not knowing and seeing my classmates succeeding, pushed my passion furthermore. (PsET#18)

Three experiences were related to strivings for perfection where anything less than perfect performance and achievement was labelled as failure. The following example illustrates how a pre-service teacher interpreted obtaining a very high (but not the highest) grade as failure.

The first [experience of failure] was in 5th grade when I got my first 10– [on the scale 1–10] on the test. Before that, I had always gotten a clean 10 on all the tests. This time was a huge disappointment. It felt as if everyone had seen it. The emotions were strong, and I remember not telling anyone about my grade. In hindsight, the frustration is laughable, but the experience was meaningful because at that time I learned concretely that disappointment belongs to life and does not crash the world. Only over the years have I realised that my math skills had not deteriorated despite what the grades said. (PsET#24)

In two narratives, the experiences that pre-service teachers labelled as maths failure occurred in an out-of-school context. The following example illustrates a real-world experience of miscalculating a sum while shopping as failure.

Once I went to the store to buy a new game that I had been wanting for a long time. I had saved money for it, and now it was suitably discounted so my money would be enough for it. In my mind, I calculated the new price of the product by subtracting 20%. However, I was disappointed at the checkout: I had miscalculated the new price and my money wasn't enough. So, I had to do a lot of homework to get some more money to buy the game. (PsET#33)

Only one pre-service elementary school teacher described a failure experience linked to unfair grading, assigning the blame to the teacher.

My experience relates to the assessment in upper-secondary school. Me and the boy in the same course did a lot of calculations together during the course. In this course, as in other courses, the final course grade consisted of the score on the exam, as well as participation. In the course exam, I got a grade of 9– and my friend 8.5 [on the scale 1–10]. My final course grade was 8 and my male friend's was 9. Today, I still feel that the treatment was unfair, as we did the tasks together and the same amount of work. . . . On the other hand, I remember I was also thinking that maybe the teacher was able to see further and knew that I was less talented in mathematics, so that's why such a difference in assessment. . . . (PsET#14)

## Discussion

In this study, we systematically examined what kind of experiences were narrated as failure by two cohorts of pre-service teachers who will teach mathematics. In the following discussion, we purposively entwine our findings with the research on negative experiences in mathematics and knowledge gained from our recent studies into failure experiences to argue for the distinction between failure and negative experience. In so doing, we conceptualise failure experience in hopes of best supporting pre-service teachers' development in initial teacher education.

### *What kind of experiences count as failure?*

We identified different types of experiences that pre-service teachers labelled as failure. Notably, experiences of underperformance and underachievement were the most common types among both cohorts, positioning failure in the context of assessment. In the case of pre-service mathematics teachers, these experiences ranged from barely passing and/or repeating exams, obtaining lower than expected grades and dissatisfaction with one's own performance to performance tension and anxiety. In case of pre-service elementary school teachers, poor performance on the tests and low grades, obtaining lower than expected grades, obtaining less than the highest grade (striving for perfection) and being treated and graded unfairly were all identified as failure. It is important to highlight that both cohorts considered a failure receiving a lower than expected grade, which further supports the view that failure needs not be actual, but is a matter of personal interpretation (Bandura 1994).

A variety of learning situations or difficulties were also considered failures. For example, pre-service mathematics teachers labelled as failure a lack of motivation, solving the tasks or problems incorrectly and learning difficulties in advanced mathematics courses. Similarly, pre-service elementary school teachers labelled as failure various learning difficulties, such as in early years of schooling, in advanced mathematics courses and due to a specific reason. Also, maths-related errors in out-of-school contexts were identified as failure experiences. These identified failure experiences resemble elsewhere reported negative experiences in terms of what kind of incidents these are. For example, difficulties in understanding the mathematical content, not succeeding in the evaluative circumstances, experiences of perfectionism and accompanied dissatisfaction or maths anxiety have all been recounted in research on negative experiences with school mathematics (e.g., Wilson and Thornton 2008; Kaasila, Hannula, and Laine 2012; Drake 2006; Di Martino and Zan 2010; McCulloch et al. 2013; Bekdemir 2010; Hobden and Mitchell 2011).

However, we also observed some key differences between the failure and negative experiences, which we discuss next.

### ***The nature of failure and its distinction from negative experience***

We think of experiences as more or less relational, or in other words, as intra- or inter-personal. A fundamental difference we observed between the experiences labelled as negative and the narrated failure experiences identified in this study is that the latter are far less relational in terms of social relations, that is, they do not highlight teacher-student or student-student relations.

Negative experiences with mathematics tend to be portrayed, especially by the pre-service elementary school teachers, as something external, that is done to them by others (e.g., a scoffing and unfair teacher, classmates laughing at their mistakes), and as something they have little control over (Machalow, Goldsmith-Markey, and Remillard 2020; Di Martino and Zan 2010). These experiences are oftentimes essentially about teachers who were blamed for those experiences (Towers et al. 2017; Hobden and Mitchell 2011; Lutovac and Kaasila 2014). In contrast to this view, in failure experiences, we observed internal locus of control (Weiner 1985), which means that most, if not all, pre-service teachers in this study attributed the causes of their failure to themselves. They held themselves accountable for their own failures and assigned blame to their own study habits, motivation or the lack thereof (e.g., PsMT#10, PsET#21). These failure experiences also portrayed the idea that pre-service teachers have control over the causes of their failure. For example, they would report failing because they had not studied hard enough and hence, the solution to avoid future failure was to study more. We identified only one narrative out of 59 (see PsET#14), labelling a teacher's unfair assessment as failure, thus portraying failure as an inter-personal experience. Therefore, arguably, while negative experiences tend to arise from and are attributed to social relations, failure is more an intra-personal experience.

However, failure is not devoid of relations. Rather, most of the pre-service teachers' failure experiences portrayed the relation between a pre-service teacher and a subject or a subject knowledge (i.e. mathematics). Failure seems to arise from a relation between the knower and what is to be known and how pre-service teachers interpret this relation. Inter-personal relations show up as a context in the experience of failure (e.g. PsMT#17, PsET#3). For example, few pre-service teachers spoke about wanting to make teachers proud or alternatively, disappointing them with their failure. Occasionally, fearing a teacher's disapproval was mentioned; however, teachers were not seen as the causes of failure; neither were they portrayed as contributing factors.

In terms of emotions and emotional intensity, the narratives of failure experiences do not appear to be as emotion-laden as those of negative school-time experiences with mathematics. As opposed to social emotions, such as anger, anxiety and shame, which tend to take prominence in the narratives of negative experience, the emotions identified in the failure narratives were for the most part frustration and disappointment (e.g. PsMT#6, PsMT#17, PsET#3, PsET#17, PsET#24, PsET#33). Embarrassment occasionally appeared in the examined narratives; however, shame as particularly social emotion (García González and Martínez Sierra 2020) was rarely mentioned, which supports the observation that the examined failure experiences were, indeed, intra-personal. Moreover,

social emotions are often referred to as self-conscious emotions due to their ability to affect a pre-service teacher's sense of self. Despite the fact that these emotions were not as prominent here, in some narratives we observed that the experiences of failure had indeed been a source of self-threat (Alfi, Assor, and Katz 2004), undermined pre-service elementary school teachers' self-efficacy beliefs and their self-confidence, reinforced a belief about a 'natural' talent in mathematics and provided for them the opportunities to begin identifying with failure (e.g., PsET#11, PsET#17; see also Lutovac and Kaasila *Forthcoming*).

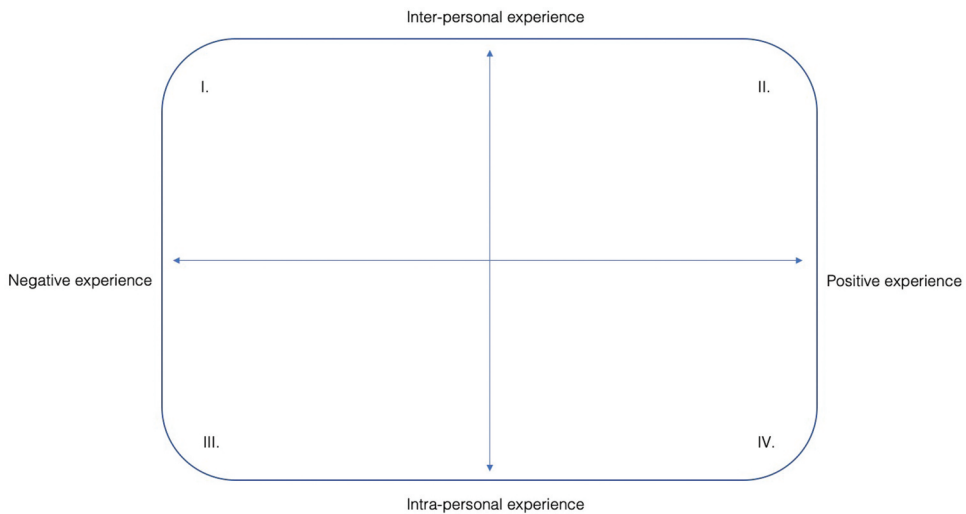
With respect to the duration of the experience, the narratives of failure experiences in our study revealed that these were temporary incidents when something went wrong or in a manner that was undesirable or unexpected for a pre-service teacher (e.g. PsMT#11, PsET#17). On the contrary, negative experiences have often been portrayed as repeatedly experiencing something that is unpleasant. However, when failure is experienced repeatedly and forms an overall negative experience with mathematics, we observed elsewhere that it appears to integrate itself into pre-service teachers' mathematics-related identity, that is, how they see themselves as learners and also future teachers of mathematics (Lutovac and Kaasila 2014).

### ***Conceptualising failure and the role of relationality***

The findings in this study reveal important knowledge about the nature of failure experiences from the pre-service teachers' subjective viewpoint. Pre-service teachers seem to normalise failure, seeing it as something inevitable, and not necessarily very negative or extreme. Many pre-service teachers labelled ordinary experiences of learning mathematics as failure. For example, failure could be a single error/mistake. Failure can therefore be conceptualised as an ordinary experience rather than an extreme one, and highly associated with real or perceived underperformance and underachievement.

Moreover, it appears that pre-service teachers experience failure through a positive or a negative experience. They might feel successful despite an overall negative educational experience or feel that they have failed despite an overall positive experience (see *Figure 1*). For many pre-service teachers in this study, failure would be positioned in Quadrant III, as a negative experience, but for some, particularly pre-service mathematics teachers, it could be positioned in Quadrant IV, as a part of a rather positive experience with mathematics. This positioning then involves the 'events that reflect the vast middle ground between outright perfection and abject failure' (Covington 1992, 178), and what Holt (1964) termed 'nonsuccess'. Failure is essentially, as many pre-service teachers reported, a matter of personal definition and personal goals and expectations (Lutovac 2019; Lutovac and Kaasila *Forthcoming*; see also Bandura 1994), and while it may range from negative to positive, it was, for the most part, portrayed as an intra-personal experience, positioned below the x-axis (see *Figure 1*). Relationality, arguably, is the key in this positioning as pre-service teachers narrated internal causes for their failure (assigning blame to themselves) and have felt they have the power to control it.

Arguably, the nature of failure experiences we discussed here may be distinct from the negative experience in the aspects such as relationality (including locus of control and controllability), emotional intensity and duration, but needs not be limited to these. Overall, what we deduce from the prior research and literature is that negative



**Figure 1.** The nature of failure experience.

experiences with mathematics tend to be portrayed as repeated and uncontrollable, while failure experiences, as seen here, are rather temporary and controllable (Alfi, Assor, and Katz 2004). That said, we wish to note that failure experiences and related emotions are also context-dependent (Zhang and Cross 2011). Perhaps in some other cultural as well as subject-specific contexts, the nature of the failure experience might be different, which calls for further investigation.

## Conclusion

We believe that explicitly addressing failure experiences via reflection and discussion is needed in teacher education (Lutovac and Kaasila *Forthcoming*; Lutovac and Flores 2021) as it will bare influence on pre-service teachers' thinking and actions in their future practices (Lutovac 2020). Regarding mathematics teacher education, pre-service teachers need to become aware that various experiences can count as failure, depending on the individuals and their interpretations (see also Lutovac 2019). This is important if they are to understand failure beyond normative – as an autobiographical experience and apply this notion in their classrooms. Moreover, it has been shown that people are more likely to learn from vicarious failure experiences than personal ones as the former are detached from the self and thus less likely to be self-threatening (Eskreis-Winkler and Fishbach 2019).

Therefore, arguably, the narratives of autobiographical failure experiences produced by the pre-service teachers in our study can be used as material for the purposes of pedagogical bibliotherapy (Lutovac and Kaasila 2011, 2020; Wilson and Thornton 2008). Pedagogical bibliotherapy is a reflective tool that uses reading material to provide pre-service teachers with the opportunities to identify with characters, their trajectories and provides them with vicarious experience and learning. This process can promote pre-service teachers' development by assisting them in addressing their possible affective barriers to teaching, as well as giving them opportunities to reflect on their pedagogical knowledge

and practices (Lutovac and Kaasila 2020). Moreover, pre-service teachers' written narratives of failure experiences have been found to stimulate the discussion on other important topics regarding teacher development and teachers' work (Lutovac and Flores 2021), which makes them a fruitful tool to be implemented in initial teacher education.

Additionally, provided that the experiences of failure were predominantly linked to underperformance and underachievement in assessment situations, arguably, the essential aspect of assessment know-how includes various ways in which students can interpret the assessment and address these interpretations of assessment as well as its affective side. Given the long-lasting impact of failure experiences for some, it seems relevant to discuss the failure with pupils during their formative school years and perhaps impact students' engagement with mathematics.

This study, hence, importantly contributes to the theoretical understanding of failure as an autobiographical experience. By addressing what kind of experiences pre-service teachers labelled as failure, we gained a previously missing piece of insight into the pre-service teachers' trajectories, that is, from failure experiences to the ways they understand and define failure and to the role failure plays in pre-service teachers' development (Lutovac 2019, 2020; Lutovac and Kaasila *Forthcoming*). Although stretching beyond the scope of this paper, it is important to acknowledge that what counts as a failure experience and the meaning of this experience can be different depending on the time and perspective. For example, when pre-service teachers reflect on failure, do they think like the students they once were or like the pre-service teachers they currently are? Or perhaps they think like teachers and take the perspective of their future students (Flores 2020; Lutovac and Flores 2021). This dynamic nature of failure as part of various perspective taking in initial teacher education needs further address as it has the potential to further advance our understanding of the failure phenomenon and the ways to support pre-service teachers' development.

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