Early Childhood Teachers' Professional Competence in Mathematics

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Chapter 6

Kindergarten educators' affective-motivational dispositions: Examining enthusiasm for fostering mathematics in kindergarten

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Introduction

A teacher's enthusiasm for teaching in general and for the subject they teach in particular is considered to be key for effective teaching (Kunter et al., 2008). Despite the importance of teachers' enthusiasm as well as teacher emotions in general, research into a broad range of teacher emotions is limited, as research often focuses on the specific emotional concerns such as teacher burnout (Frenzel, 2014). Also beyond these, however, teacher emotions are highly relevant. It is widely understood that teacher emotions are "contagious" and thus have an impact on all aspects of teaching and learning. Furthermore, teacher emotions are in a reciprocal relation to other aspects of teaching; for example, teacher enthusiasm might ignite positive emotions amongst students, which in turn lead to more positive emotions of the teacher (Frenzel, 2014). As competence is seen as a continuum ranging from dispositions to situation-specific skills to performance (Blömeke, Gustafsson, & Shavelson, 2015), the role of affective-motivational dispositions warrants more attention.

It is assumed that teacher emotions impact on teaching behaviour, for example "teachers with predominantly positive emotional experiences may be able to effectively utilise a broad range of teaching strategies" (Frenzel, 2014, p. 519). For early childhood mathematics, affective-motivational dispositions regarding the fostering of mathematics might potentially even be more relevant, as educators do not follow a curricular programme but need to seize moments in everyday activities and in play in order to foster mathematics (Link, Vogt, & Hauser, 2017a). Early childhood educators' professional competence is crucial for fostering mathematics in kindergarten (Gasteiger, 2012).

As the following review of research findings illustrates, findings about early educators' affective-motivational dispositions regarding mathematics as a subject and the teaching of mathematics are mixed. Whilst some studies report negative

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emotions with regards to the subject of mathematics amongst early educators, other studies found this to be more varied or not the case at all. On the basis of the theoretical considerations outlined, it is proposed that for early childhood educators, the enthusiasm for *fostering* mathematics, thus the affective-motivational dispositions regarding the teaching of the subject rather than the subject itself, is crucial. Research findings on affective-motivational dispositions linked to mathematics in early childhood education are discussed first. Then, the methodology and the results of our study involving 132 early educators in Germany and Switzerland are discussed. The comparison between the two countries is of interest, because the early childhood education system of the two countries differs. Swiss kindergarten is more closely linked to primary school, which might impact on the value placed on mathematics. It is the aim of the study to examine relations between emotions regarding mathematics at school, enthusiasm for mathematics as a subject, importance given to mathematics in kindergarten and educators' self-efficacy as well as the enthusiasm for fostering mathematics in order to add to the understanding of these affective-motivational dispositions as part of early educators' competence.

Theoretical background

First, the review of the research literature focuses on emotions regarding the subject of mathematics. Second, findings on teacher emotions teaching any subject are examined. Third, the enthusiasm for fostering mathematics is discussed. Fourth, a theoretical foundation for exploring the affective-motivational dispositions is provided using the expectancy-value theory. To round off the theoretical background, the similarities and differences of kindergarten in Germany and Switzerland are explained.

Early educators' emotions regarding mathematics

The debate surrounding early educators' emotions regarding mathematics ranges from the concern that many educators have negative emotions in relation to mathematics in comparison to other subjects on the one hand, to the conclusion that emotions are more positive towards the subject than previously expected on the other hand. Anders and Rossbach (2015, p. 310) argue that emotions regarding mathematics develop in school and that "mathematics is one of the subjects that produce the most ambivalent emotional attitudes".

Benz (2012) examined the emotions and beliefs regarding mathematics of 281 kindergarten educators and 308 pre-service kindergarten educators, using questionnaires as a research method. She asked participants to choose adjectives from a selection of 12 adjectives, which could be categorised as positive, neutral, or negative, to express their emotions towards mathematics as a subject. The results reveal that adjectives such as *useful* or *important* are chosen most often, followed by *challenging* and *interesting*. However, a third of the participants also considered mathematics as *confusing*.

Mathematics anxiety as a particular negative emotion could derive from negative school experience, as was found in a study with primary school teachers (Malinsky, Ross, Pannells, & McJunkin, 2006). Early childhood educators might be even more likely to have negative emotions regarding mathematics and "shy away from maths" (Afamasaga-Fuata'i & Sooaemalelagi, 2014, p. 331), as the requirements for mathematics in some countries are lower for early childhood educators than for primary teachers. Perry (2011) identifies that the negative emotions linked to a teacher's own experiences with mathematics at school can translate into a negative attitude to teaching mathematics and a lack of good strategies for mathematics teaching, "a cycle of passing on negative attitudes and strategies for mathematics teaching" (Perry, 2011, p. 8). This cycle needs to be broken.

However, other studies have found that early educators' emotions about mathematics are not as negative as often reported (Chen, McCray, Adams, & Leow, 2014). In a questionnaire study with 110 German kindergarten teachers, a positive attitude towards mathematics was revealed (Thiel, 2010). A study of 221 German kindergarten educators included a questionnaire study with scales on past emotion regarding mathematics at school, current joy in mathematics and the importance given to early mathematics (Anders & Rossbach, 2015). Negative emotions were not as strong as suspected and current joy tended slightly to the positive side. However, the emotions regarding mathematics at school are strongly related to current joy in mathematics. Current joy is also related to the perceived importance of mathematics. In addition, it is interesting to note that past emotions regarding mathematics at school appear not to be related to the importance rating. This result ties in with the study by Benz (2012), who found that educators would state the importance and usefulness of mathematics despite the prevalence of negative emotions towards the subject.

Emotions regarding mathematics appear to correlate with the individual characteristics. Across countries, a gender gap is noted with women revealing more maths anxiety (Marsh et al., 2019). Interestingly, it appears that for early educators, age and work experience are important factors. Older kindergarten teachers were more positive about mathematics than younger ones (Thiel, 2010). In a Norwegian sample of 221 full-time and part-time students for early childhood education, the older students, who largely already got work experience in a kindergarten, showed less mathematics anxiety than their younger, less-experienced, peers (Thiel & Jenßen, 2018). The authors suggest that the practice of fostering mathematics in everyday early childhood practice could help students to overcome mathematics anxieties, which probably derived from their own school experience.

A relevant but less researched field is the interplay between emotions regarding the subject and professional competences. In the above-mentioned study, Anders and Rossbach (2015) also tested the sensitivity of early educators for mathematics in the context of play by using a vignette. They found that the current joy regarding mathematics is related to higher sensitivity for opportunities

for fostering mathematics in play. With 354 participating German pre-service kindergarten educators, Jenßen, Thiel, Dunekacke and Blömeke (2020) examined the impact of anxiety and content knowledge as well as pedagogical content knowledge, conceptualised as the "skill to perceive math-related situations during play-based activities" (ibid., p. 301). Mathematics anxiety, measured using questionnaires as well as a video-based assessment, was found to have an indirect effect on the skill to perceive situations during play, which are related to mathematics. This effect was mediated by knowledge. Mathematics anxiety possibly has a large impact: a review of the findings into the direction of causal relationships between mathematics anxiety and mathematics achievement points to a possible vicious circle, whereby anxiety causes lower achievement and lower achievement causes anxiety (Carey, Hill, Devine, & Szücs, 2016).

Teacher's enthusiasm for teaching a subject

Emotions are contagious, as has been stated widely (Frenzel, 2014). Research on teachers' enthusiasm and its effects on students has been able to prove the relationship between teachers' and students' emotions. Becker, Goetz, Morger and Ranellucci (2014) found in a study in grade nine with 149 students in 44 classes that students have an accurate perception of teachers' emotions and that the teachers' emotions affect students in class. The researchers used an experience sampling method across lessons and across four subjects, whereby students were prompted by a device to report on their emotion, their teachers' momentary emotion and the teaching in class. A questionnaire study on positive emotion in mathematics lessons in grade seven and eight also found that teachers' and their students' enthusiasm for the subject are related (Frenzel, Goetz, Lüdtke, Pekrun, & Sutton, 2009). Baumert and Kunter (2006) conceptualise teachers' enthusiasm as part of motivational orientations, together with self-efficacy and self-regulation, enthusiasm representing the emotional aspect within motivational orientations. Blömeke et al. (2015) distinguish between cognitive and affective-motivational dispositions, which would include teacher emotions.

Positive emotions may also strengthen teachers' motivation. If teachers experience positive emotions in the context of teaching a subject, they are motivated to teach the subject again, and to go about teaching the subject with greater engagement, persistence and effectivity (Eccles & Wigfield, 2002 cited in Frenzel, Goetz, & Pekrun, 2008, p. 193). This could lead, for example, to more engagement: teachers might be more motivated to attend professional education, to exchange ideas with colleagues, to read about teaching the subject more widely and to prepare for the subject more intensively (Frenzel et al., 2008).

Kunter et al. (2008) distinguish between enthusiasm for a subject and enthusiasm for teaching a subject and suggest that enthusiasm for teaching a subject is more clearly related to teaching quality than enthusiasm for a subject. In a study of 323 teachers in ninth grade, it was found that teachers' enthusiasm for the subject was related to teachers' self-reported enthusiasm in class but

not to students' rating. Whether or not students rated teachers' enthusiasm or teaching quality positively was unrelated to teachers' self-reported enthusiasm for the subject.

Enthusiasm for fostering mathematics

As highlighted in Kunter et al. (2008), enthusiasm for the subject of mathematics is distinct from being enthusiastic about fostering mathematics. Whereas teachers' enthusiasm for mathematics was unrelated, teachers' enthusiasm for teaching mathematics resulted in better ratings of the instructional behaviour by the students. Similarly, a study of 200 prospective US kindergarten teachers shows that emotions towards teaching mathematics were relevant for the quality of teaching, but not the emotions regarding mathematics as a subject per se (Lee, 2005).

In kindergarten, the foundation for mathematics is laid and thus an important and lasting contribution to a child's education is made (Duncan et al., 2007), but the curricular content in itself is basic. A kindergarten teacher might experience positive emotions when supporting a child learning to count and notice the child's progress with excitement, the mere concept of counting objects more likely would not elicit the adult's excitement. Therefore, it could be assumed that the affective-motivational disposition of enthusiasm for fostering mathematics is at the centre within the framework of competence, understood as continuum between dispositions, situation-specific skills and performance as proposed by Blömeke et al. (2015).

As already mentioned, enthusiasm for teaching a subject will increase the motivation to teach the subject further. In the context of early childhood education, where the time spent with a topic is more situational and linked to children's choice as well as to the educator's initiative, positive emotions about fostering mathematics would be even more relevant than in primary school. In early childhood education, the educator's sensitivity to seize the moment in activities and in play is often considered crucial (Rossbach, 2008). A qualitative interview study with German and Swiss educators in kindergarten revealed that educators differ in how purposefully they seek out moments in play and daily activities, which can be used to foster mathematics (Link, Vogt, & Hauser, 2017a).

Expectancy and value

On the basis of expectancy-value theory, proposed for understanding achievement motivation in education in the 1980s by Eccles (Wigfield & Eccles, 2000), the enthusiasm for fostering mathematics in kindergarten would be determined by the confidence of the educator to foster mathematical learning in kindergarten (expectancy) and the subjective value the educator places on mathematics for kindergarten. The expectancy-value theory states that the expectation of succeeding and the subjective value explain a person's achievement motivation,

effort, as well as emotions such as interest. The theoretical model implied a multiplicative relation between expectancy and value, which has been modelled in a study with 2508 secondary school students (Trautwein et al., 2012).

For the enthusiasm for fostering mathematics in kindergarten, expectancy is operationalised as self-efficacy regarding fostering mathematics and the value could be expressed in the importance given to mathematics as a subject.

With regards to the expectancy to succeed, the concept of self-efficacy is useful. Self-efficacy has been widely researched in education as well as in psychology. Some aspects relating to early childhood educators are discussed as follows. Brown (2005) found that self-efficacy and importance are correlated; however, they did not predict observed instructional practice. A US study with 67 educators found "that domain-specific self-efficacy was highest for literacy, significantly lower for science, and lowest for math" (Gerde, Pierce, Lee, & Van Egeren, 2018, p. 552). Self-efficacy has unexpected implications. Whilst high self-efficacy is conducive to positive emotions and motivations and might increase the engagement for mathematics in early childhood education, there might also be too much self-efficacy. In relation to mathematics, Thiel and Jenßen (2018) discovered that students who report high self-efficacy in solving mathematical problems might actually perform less well: "In summary, our findings show that MSE [mathematical self-efficacy] has both positive and negative effects on students' achievement. Underestimating one's abilities leads to irrational anxiety, and overestimating one's abilities might cause poor preparation for the exam" (Thiel & Jenßen, 2018, p. 525). For fostering mathematics in kindergarten, we assume that the expectancy of being able to provide such fostering is strengthening educators' affective-motivational dispositions, in particular, the enthusiasm for fostering mathematics.

In order to conceptualise value, research on the value given to mathematics as a subject is discussed. As shown above, Benz (2012) found that mathematics is considered important. Similarly, in the study by Thiel (2010), mathematics as a curricular area for early childhood education remained uncontested. As Benz (2012) explains, the tradition of early childhood education in Germany emphasises less the academic subjects and more social and emotional competences in kindergarten. It is, therefore, important not only to consider the value given to mathematics as a subject but also to compare ratings of the value given to other subjects.

International variation in early childhood education

After having reviewed findings and theories on affective-motivational dispositions regarding mathematics and fostering mathematics in kindergarten, as well as discussing value and expectancy, the structural context of the two countries will be presented, as the affective-motivational dispositions as part of early educators' competence need to be interpreted in the light of the respective education systems and the understanding of early childhood education.

Both countries share an emphasis on play-based pedagogy in kindergarten and, in comparison to other European traditions, emphasise free play, fostering in the situation, and less directive instructional teaching (Rossbach & Grell, 2012). Their pedagogical traditions regarding mathematics in kindergarten are similar (Gasteiger, Brunner, & Chen, 2020).

Although the vast majority of children attend kindergarten before entering first grade of primary school, kindergarten in Germany is not an integral part of the education system. Institutions are led by the state, non-profit organisations such as churches or associations, and by private companies. In contrast, kindergarten in Switzerland is part of the public, state-led education system. Swiss kindergartens are linked to a primary school and are often located in the school buildings themselves or nearby. Kindergarten educators are called "kindergarten teachers". Attending two years of kindergarten is compulsory in Switzerland. In relation to the curricula, in both countries, mathematics is included in the curricula guiding early childhood education. For Switzerland, the kindergarten curriculum is closely aligned to the curriculum of the first and second grade of primary school.

The different kindergarten traditions in the two countries are also noticeable in the work conditions: In Germany, two adults are present and responsible for education and care for a smaller group of children (average adult–child ratio 1:8.3, Destatis, 2020, p. 7). Some of the kindergartens are structured in a so-called open setting, whereby the curricular areas are organised as different rooms providing opportunities for learning activities. Within the team of the educators of a kindergarten, there might be a certain degree of specialisation, in so much, that an educator would be responsible for a particular curricular area and design the learning activities for the whole kindergarten. In contrast, the Swiss kindergarten teachers are for the most part the only adult present with the kindergarten group (average adult–child ratio 1:18, Bundesamt für Statistik, 2020). The Swiss kindergarten teachers are more autonomous in their teaching and solely responsible for designing the learning activities in all areas of the curriculum.

The two countries have different requirements for the qualification of educators in kindergarten. In Germany, early educators mainly train at a professional school at secondary II level, only a small part of the workforce has a bachelor degree. In Switzerland, professional school at secondary II level was the qualification for kindergarten up to approximately the year 2000. From then onwards, kindergarten teachers were required to obtain a bachelor's degree, as for primary school.

Taking these similarities and differences between the two countries into account, which encompass the shared emphasis on a play-based pedagogy, the difference in structure (social pedagogy versus education system, childcare centre versus school), and in the organisation of the work (teamwork versus autonomous teacher), in qualification (professional degree versus higher education

bachelor degree), it is therefore of interest whether the affective-motivational dispositions linked to mathematics in early childhood differ between the two countries and depending on qualification.

Research questions

As has been discussed in the review of the literature, affective-motivational dispositions are likely to be relevant for early childhood mathematics, but research on these aspects is still limited. As affective-motivational dispositions should be taken into account when researching educators' professional competence, it remains unclear how these affective-motivational dispositions could be conceptualised and measured. In this study, different scales measuring variables of affective-motivational dispositions are examined. As a theoretical framework, the motivational theory of expectancy and value will be used in order to test relations between several aspects and the crucial concept of enthusiasm for fostering mathematics in kindergarten. To further explore affective-motivational dispositions, a comparison between German and Swiss kindergarten educators is carried out.

The research presented here seeks to describe the affective-motivational dispositions of educators in Germany and Switzerland, as well as seeking to analyse the relations between different aspects.

The main research question guiding this analysis is:

> How are educators' affective-motivational dispositions interrelated, such as the emotions regarding mathematics, the enthusiasm for mathematics as a subject, the value placed on mathematics and the expectancy of fostering mathematics successfully (self-efficacy) and the enthusiasm for fostering mathematics in kindergarten?

Sub-questions are:

- Are there differences between Swiss and German educators or regarding qualification?
- Are emotions about mathematics as a subject best captured with regard to school emotions (retrospectively) or with regard to current enthusiasm for mathematics as a subject?

Methods

The analysis presented here is part of the international research project on the "structure of early childhood educators' domain-specific professional competencies and their effects on the quality of mathematical instructional situations in kindergarten and on children's increase in mathematical competencies" (Moser Opitz, Vogt, Lindmeier, Heinze, & Leuchter, 2015). Within this research project, kindergarten educators filled in a questionnaire which included several scales

on aspects of affective-motivational dispositions. First, the sample is described; next, the instrument is discussed.

Sample

For the international study, kindergarten educators were recruited in Northern Germany and German-speaking Switzerland. The questionnaire on educators' beliefs and affective-motivational dispositions was completed by almost all educators (99%) at the beginning of the study. The analysis presented here is based on 64 educators in Germany and 68 educators in Switzerland, in total $N = 132$. As abbreviations for the two countries, *D* is used for Germany and *CH* for Switzerland, following the international license plate country code.

For the Swiss sample, 53% were educated at the professional school for kindergarten teachers, the qualification for kindergarten teachers up until the year 2000 and 41% have a Bachelor in pre-primary and primary education, the qualification for kindergarten teachers since 2000. Six per cent had a different qualification.

For the German sample, data about the qualification were missing from eight educators. The majority of educators in the sample, 78%, were qualified kindergarten educators, generally educated at a professional school. Ten per cent were socio-pedagogical assistants and the remaining 12% had a different qualification.

The kindergarten educators had on average 14 years of professional experience ($M = 14.07$; SD = 10.81, $n = 119$). There is a tendency of the German educators in the sample being more experienced ($M_D = 16.33$, $M_{CH} = 12.37$, $t = 1.931$, df = 90.57, $p = .057$).

Scales

In order to measure a variety of affective-motivational dispositions, five scales were selected, adapted and developed. The scales had been used in a tri-national study previously (Link, Vogt, & Hauser, 2017b) and were adapted slightly for the present binational study. In order to measure emotions related to the personal experience with mathematics at school, the scales by Anders and Rossbach (2015, p. 312) regarding positive school emotions ($\alpha = .89$) and negative school emotions ($\alpha = .88$) were consulted. After piloting, one scale on positive emotions on mathematics at school was derived, which was based on four basic emotions, namely fun, pride, anger and anxiety. For enthusiasm for mathematics as a subject, enthusiasm for fostering mathematics in kindergarten and for self-efficacy for fostering mathematics, the same Likert scale ranging from 1 to 6 was used. Enthusiasm for mathematics as a subject was adapted for kindergarten from COACTIV ($\alpha = .82$) (Baumert et al., 2008, p. 96). Table 6.1 provides the items, the response format and the reliability measure.

Questionnaires were administered as paper-and-pencil questionnaires and analysed using the statistics software SPSS. Separately, teachers were asked to provide information about their qualification and work experience.

Table 6.1 Affective-motivational dispositions: scales

Scale	*Positive emotions regarding mathematics at school*
Items	4
	I was always optimistic that I am able to follow the lessons in mathematics
	I was proud of my achievements in mathematics
	I was annoyed that mathematics was so difficult (reversed)
	In mathematics exams, I felt hopeless (reversed)
Values	1 = does not at all apply; 4 = fully applies
Cronbach's alpha	.887
Scale	**Enthusiasm for mathematics as a subject**
Items	3
	I am myself enthusiastic about mathematics
	I find mathematics exciting and I try to convey this to the children
	I don't like mathematics very much, but I still want the children to have positive experiences with mathematics in kindergarten (reversed)
Values	1 = does not at all apply; 6 = fully applies
Cronbach's alpha	.735
Item	**Importance of mathematics in kindergarten**
Items	1
	Give a personal weighting as to which areas are particularly important to you personally …. Mathematics (other items were language, natural science, music and art, sports)
Values	1 = not at all important; 6 = very important
Scale	**Self-efficacy for fostering mathematics in kindergarten**
Items	4
	I have many ideas how to encourage kindergarten children to learn mathematics
	I feel competent to support children in kindergarten in area of mathematics
	I am very well versed in fostering mathematics in kindergarten
	I feel overcharged to support children in kindergarten in mathematics (reversed)
Values	1 = does not at all apply; 6 = fully applies
Cronbach's alpha	.776
Scale	**Enthusiasm for fostering mathematics in kindergarten**
Items	4
	I have great fun fostering mathematics in kindergarten
	The initiation of mathematical learning processes in the children in my group inspires me
	I find it exciting to watch the children working on mathematical problems
	Fostering mathematics inspires me less than other educational areas of the kindergarten (reversed)
Values	1 = does not at all apply; 6 = fully applies
Cronbach's alpha	.694

Results

In order to describe the affective-motivational dispositions, the results for each of the scales are presented. Second, the correlations between these affective-motivational dispositions, as well as possible differences between German and Swiss educators, are analysed. Third, a multiple regression is performed to conceptualise enthusiasm for fostering mathematics in kindergarten, as it is expected on the basis of the literature, that enthusiasm for fostering mathematics is the most important variable amongst the affective-motivational dispositions for mathematical learning in kindergarten.

Descriptive results on emotions, enthusiasm, value and self-efficacy

The descriptive results of the different scales are discussed first.

Positive emotions regarding mathematics at school in retrospect: Educators were asked in retrospect, how they felt regarding mathematics at school. Their answers were mixed. The scale, which was recoded to express positive emotions regarding mathematics in school, shows an average value only slightly towards the positive ($M = 2.72$; SD = .857, values from 1 to 4). The minimal value of 1, not having had positive emotions at all regarding mathematics at school, has been given by nine educators (7% of the sample), the most positive value of 4, having had mainly positive emotions at school, has been chosen by 12 educators (10%). There is no difference between the two countries, nor regarding the type of qualification (professional college at secondary II level versus higher education at tertiary level).

Enthusiasm for mathematics as a subject: The items were formulated in such a way as to referring to the current general emotions regarding mathematics. It shows a large variance: while a third of the educators are less enthusiastic, two-thirds are more enthusiastic ($M = 4.10$, SD = 1.211, values from 1 to 6). Educators with a higher education degree are more enthusiastic about mathematics as a subject than educators qualified at a professional school ($M_{prof} = 3.95$, $SD_{prof} = 1.130$; $M_{HE} = 4.41$, $SD_{HE} = .968$; $t = -2.040$, df = 115, $p = .043$). Swiss educators tend to be more enthusiastic than German educators, a difference, which shows marginal significance and is related to more Swiss educators being qualified at tertiary level ($M_D = 3.93$, $M_{CH} = 4.26$; $t = -1.743$, df = 130, $p = .084$). No correlation was found relating enthusiasm with work experience, educators with more years of working in kindergarten were not more enthusiastic about the subject.

Importance of mathematics as a curricular content in kindergarten: Mathematics is considered important, but the importance indicated in comparison other curricular contents is low. All contents are regarded as important or very important. Mathematics, together with natural science,

is considered less important (M_{Math} = 5.08, SD = .647; min = 4 "rather important", max = 6 "very important", values 1–6). Most educators consider mathematics as less important than all other subjects taken together (M_{Maths} = 5.08, $M_{\text{subjects except maths}}$ = 5.39, asympt. Wilcoxon $z = -5.595$, $p < .001$). There is a tendency for Swiss educators to consider mathematics more important than German educators (M_{D} =4.98, M_{CH} = 5.18, Mann–Whitney $U = 1792.500$, $p = .095$). No difference regarding qualification is found.

Self-efficacy for fostering mathematics in kindergarten: All educators indicate a medium-to-high self-efficacy (M = 4.77, SD = .605, values 1–6). There is a tendency of Swiss educators having higher self-efficacy in comparison to German educators (M_{D} = 4.68; M_{CH} = 4.86, $t = -1.172$, df = 130, $p = .086$). There is no difference regarding qualification; however, more work experience is related to higher self-efficacy ($r = .211$, $p = .021$).

Enthusiasm for fostering children in mathematics in kindergarten is overall high, all educators are indicating values towards the positive (M = 4.82, SD = .668, min = 3.25, max = 6, values 1–6). There is no difference between Swiss and German educators, nor regarding qualification.

To summarise, educators are valuing all subjects important; however, mathematics is considered less important than other curricular areas. Enthusiasm for fostering mathematics in kindergarten is high, as well as self-efficacy for fostering mathematics. Enthusiasm about mathematics as a subject is mixed, as are emotions referring to mathematics in school. Some of the scales show a slightly more positive affective-motivational disposition amongst the Swiss educators of the sample compared to German educators.

Correlations between affective-motivational dispositions

The affective-motivational dispositions are correlated, as is plausible (Spearman correlations, Table 6.2). Strong correlations can be found between positive emotions regarding mathematics at school and enthusiasm for mathematics as a subject. Also, a factor analysis on the items suggests that these two scales could form one factor. For theoretical reasons however, as emotions regarding mathematics at school specifically refer to the past, whereas enthusiasm for mathematics as a subject is linked to the present, the scales are analysed separately.

Table 6.3 reports the correlations for each of the country sub-samples. Correlations, where German and Swiss educators showed different results, are highlighted in bold. The test used to compare correlations from independent samples is based on Eid, Gollwitzer, and Schmitt (2011).

The correlations between self-efficacy and other variables differ between Switzerland and Germany: self-efficacy is clearly more related to the other affective-motivational dispositions in the German sub-sample. Also for enthusiasm for fostering mathematics, the correlations tend to be higher in the German sub-sample than the Swiss sub-sample.

Table 6.2 Correlations

	Positive emotions regarding mathematics at school	*Enthusiasm for mathematics as a subject*	*Importance of mathematics for kindergarten*	*Self-efficacy for fostering mathematics in kindergarten*
Enthusiasm for mathematics as a subject	.647**			
Importance of mathematics for kindergarten	.204*	.375**		
Self-efficacy for fostering mathematics in kindergarten	.182*	.403**	.401**	
Enthusiasm for fostering mathematics in kindergarten	.269**	.612**	.422**	.530**

$n = 132$; *$p < .05$; **$p < .01$

Table 6.3 Spearman correlations per country

	Positive emotions regarding mathematics at school		*Enthusiasm for mathematics as a subject*		*Importance of mathematics for kindergarten*		*Self-efficacy for fostering mathematics in kindergarten*	
	D	*CH*	*D*	*CH*	*D*	*CH*	*D*	*CH*
Enthusiasm for mathematics as a subject	.627**	.692**						
Importance of mathematics for kindergarten	.254*	.170	.340**	.384**				
Self-efficacy for fostering mathematics in kindergarten	**.350****	**.063**	**540****	**.237**	**.562****	**.180**		
Enthusiasm for fostering mathematics in kindergarten	**.393****	**.165**	.646**	.552**	**524****	**288***	**.644****	**.363****

Differences between countries; significant in bold and underlined, marginally significant in bold.

CH = Switzerland; D = Germany

$n_D = 63$, $n_{CH} = 68$; *$p < .05$; **$p < .01$

Regression analysis: explaining enthusiasm for fostering mathematics in kindergarten

As has been stated before, enthusiasm for teaching a subject is more important than the enthusiasm for the subject (Kunter et al., 2008; Lee, 2005). We argued that this is especially true for early educators, as the subject content is very basic, the children's learning processes probably being more interesting and stimulating. Therefore, a regression model explaining the enthusiasm for fostering mathematics was tested. It was hypothesised that the enthusiasm for fostering mathematics in kindergarten is predicted by emotions regarding mathematics as a subject, the value given to maths as a subject and the expectancy of self-efficacy.

As for the emotions towards mathematics as a subject, two different scales were examined: positive emotions regarding mathematics as a subject at school in retrospect and enthusiasm for mathematics as a subject. As a sub-question, it is also of interest whether the general emotion about mathematics as a subject or the emotion referring to the experience at school is of more predictive value.

The two measures for emotion regarding mathematics (enthusiasm for mathematics as a subject and positive emotions regarding mathematics at school) were entered first, then the variables for value (importance of mathematics in kindergarten) and for expectancy (self-efficacy for fostering mathematics in kindergarten) were added in order to explain the dependent variable (enthusiasm for fostering mathematics). All conditions were checked carefully. Stepwise regression was calculated first, as the theoretical model assumed an order of influence. However, as results did not differ, the simple entry model is reported.

In this first model, which explains 49.6% of the variance of enthusiasm for fostering mathematics in kindergarten ($R^2 = .496$; $F_{(4.125)} = 32.801$; $p < .001$), enthusiasm for mathematics as a subject remains significant in all steps, whereas positive emotions regarding mathematics at school are no longer significant.

The final model for predicting enthusiasm for fostering mathematics therefore includes enthusiasm for mathematics as a subject, importance of mathematics as a subject in kindergarten and self-efficacy. It explains 48.9% of variance ($R^2 = .489$; $F_{(3,126)} = 42.092$; $p < .001$; $n = 130$). Enthusiasm for mathematics as a subject is the strongest predictor, followed by self-efficacy, and then the importance given to mathematics in kindergarten (Table 6.4).

In this model, the variables "country" (Germany versus Switzerland), "years of work experience" and "qualification" (higher education versus professional education) were entered, but these variables do not have any impact.

As has been found above, some correlations differ significantly between the German and Swiss sub-sample. Therefore, the final multiple regression model was also calculated for each sub-sample separately. The models differ slightly, with the German model having a higher power of prediction: For the model for the German sub-sample, 51.5% variance is explained ($R^2 = .515$; $F_{(3.59)} = 22.987$; $p < .001$; $n = 63$), for the Swiss sub-sample, 42.9% of the variance ($R^2 = .429$; $F_{(3,63)} = 17.544$; $p < .001$; $n = 67$). As Table 6.5 indicates, there are not many differences to be noted, except that for the Swiss educators, the value given to

Table 6.4 Multiple regression analysis explaining enthusiasm for fostering mathematics in kindergarten

	Non-standardised coefficients		*Standardised coefficients*		*Sign*
	B	*SE*	β	*T*	*p*
Intercept	1.223	.408		2.997	.003
Enthusiasm for mathematics as a subject	0.250	.044	0.412	5.668	<.001
Value: importance of mathematics in kindergarten	0.197	.072	0.190	2.732	.007
Expectancy: self-efficacy	0.329	.080	0.297	4.111	<.001

Table 6.5 Multiple regression analysis explaining enthusiasm for fostering mathematics in kindergarten for each sub-sample

	Non-standardised coefficients				*Standardised coefficients*		*T*		*Sign*	
	B_D	B_{CH}	SE_D	SE_{CH}	B_D	B_{CH}	T_D	T_{CH}	p_D	p_{CH}
Intercept	.985	1.549	.550	.652			1.792	2.374	.078	.021
Enthusiasm for mathematics as a subject	.213	.292	.067	.062	.352	.481	3.198	4.685	.002	<.001
Value: importance of mathematics in kindergarten	.268	.105	.103	.107	.265	.099	2.609	.981	.011	.330
Expectancy: self-efficacy	.334	.322	.137	.104	.290	.301	2.435	3.104	.018	.003

D = Germany; CH = Switzerland

mathematics as a subject area in kindergarten does not have a significant impact on the enthusiasm for fostering mathematics in kindergarten.

Discussion

Similar to the findings of previous research (Anders & Rossbach, 2015; Benz, 2012), emotions regarding mathematics at school are mixed. There is a considerable part of educators who experienced negative emotions. On the basis of other findings (Thiel & Jenßen, 2018) and the high correlation found in this sample between past and current emotions regarding the subject, it could be assumed that emotions regarding mathematics at school determine enthusiasm for mathematics as a subject to a certain extent. In the regression model, enthusiasm for mathematics is sufficient to explain the impact of the emotions regarding the subject on enthusiasm for fostering mathematics in kindergarten. For future research, it could be sufficient to ask educators generally about enthusiasm for mathematics without having to bring in the retrospective view with the four

emotions fun, pride, anxiety and anger. This could be seen as an advantage, as the explicit question about emotions at school risks upsetting participants.

There are some marginally significant differences related to the country: self-efficacy, importance given to mathematics and enthusiasm for fostering mathematics are slightly higher in Switzerland than in Germany. Differences relating to qualification are only found for the enthusiasm for mathematics, with educators with higher education degrees being more enthusiastic about the subject. It could be interpreted that for the affective-motivational dispositions regarding mathematics in kindergarten, the structural differences between the two countries come into play. As kindergarten is defined as part of compulsory schooling in Switzerland, mathematics is given a more distinct weight in the curriculum. This could be reflected in Swiss kindergarten educators rating the importance higher than German educators. Also, the difference in self-efficacy could be linked with the more team oriented approach in Germany, and the role as the sole class teacher of Swiss kindergarten teachers. German educators might share out the responsibility for curricular areas amongst the team and thus might feel less expectations of being particularly competent for mathematics. However, as a limitation, the self-efficacy scale did not focus on the beliefs to handle any problem in the future, as self-efficacy is often measured in other studies (i.e. Schwarzer & Jerusalem, 1999), but was more closely tied to the confidence for fostering mathematics. For future research, the relation between general self-efficacy and self-efficacy for fostering mathematics could be examined. Furthermore, it would be of interest to explore whether the more team oriented or the more isolated work environment of kindergarten teachers does indeed impact these affective-motivational dispositions. Comparative studies including more countries would be needed.

The final model presented above proved to explain 48.9% of the variance in the sample. Enthusiasm for fostering mathematics could be predicted by the emotions for mathematics as a subject, importance given to mathematics as measure of value and self-efficacy as a measure of expectancy. The motivational theory of expectancy and value proves to be a useful theoretical framework for investigating affective-motivational dispositions. The differences between the two countries are slight: the country does not per se explain variance in the multiple regression. However, when analysed separately, as is advised because of the significant differences in the strength of many of the correlations, it shows that for Switzerland, the importance given to mathematics does not have an impact – possibly due to the smaller variance within the Swiss sample. As Swiss educators give higher importance to mathematics than German educators, and as they vary less in their value judgement, this could also be interpreted as being related to kindergarten being part of the school system in Switzerland, but not in Germany.

Limitations of the study presented here are the dependence on self-report measures in the questionnaire. Furthermore, it would be important to link affective-motivational dispositions such as enthusiasm for fostering mathematics in kindergarten with the performance as could be measured through observation. Frenzel et al. (2008) for that reason emphasise the need of seeing emotions

on teaching as part of a cycle, leading from the emotion to teaching itself to the learning of the students and to the appraisal of achievement, i.e. the teacher being proud of students' learning. As other findings indicate (Jenßen et al., 2020; Kunter et al., 2008; Lindmeier et al., 2020), also professional knowledge, including both – content knowledge as well as pedagogical knowledge – could also be taken into account in order to understand the ways in which educators' affective-motivational dispositions influence early mathematics education.

Conclusion

Educators' affective-motivational dispositions should be included in any future research into early mathematics in kindergarten as emotions are relevant. Enthusiasm for fostering mathematics is the central variable, but is predicted by enthusiasm for the subject, as well as the expectancy of self-efficacy and the importance given to mathematics. The expectancy-value theory has also proved helpful in this analysis (Marsh et al., 2019) though the model was adapted and the multiplicative relations could not be tested (Trautwein et al., 2012).

The results of the study indicate differences between the two countries which might be linked to characteristics of the education systems. The structure of understanding kindergarten as an integral part of schooling might emphasise the importance of mathematics in kindergarten. However, as the value assigned to mathematics is significantly lower than the values assigned to other curricular areas in both countries, mathematics needs to still be brought into the fore for early childhood education teachers.

The findings underline the importance of affective-motivational dispositions in relation to fostering mathematics. It could be concluded that professional development for increasing competences for fostering mathematics in kindergarten in providing training for situation-specific skills should also address affective-motivational dispositions. Igniting enthusiasm for mathematics in kindergarten and enhancing the expectancy of self-efficacy might lead to a higher commitment for fostering mathematics in early childhood education. To achieve an improvement, initial professional education as well as professional development would benefit from not only ensuring the acquisition of cognitive dispositions and skills but also from an emphasis on affective-motivational dispositions for early mathematics, through strengthening enthusiasm for fostering mathematics in kindergarten.

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