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Teacher enthusiasm and self-efficacy, student-perceived mastery goal orientation, and student motivation in mathematics classrooms

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Abstract

The purpose of this study is to examine whether teacher enthusiasm and classroom management self-efficacy are related to classroom mastery orientation and student motivation. We used data from 803 students in grades 9 and 10 (53.3% girls) and their mathematics teachers ($N = 41$; 58.5% men). Student-perceived teacher enthusiasm was related to classroom mastery orientation as well as to intrinsic value and cost at the student level. Teacher-reported self-efficacy was related to classroom mastery orientation at the classroom level. At both the individual and the classroom level, classroom mastery orientation was related to attainment and utility value.

Keywords: teacher enthusiasm; teacher self-efficacy; mathematics classrooms; multilevel analyses

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1. Introduction

Research has shown that teachers who are enthusiastic (Kunter, Frenzel, Nagy, Baumert, & Pekrun, 2011; Patrick, Hisley, & Kempler, 2000) and who report high self-efficacy (Midgley, Feldlaufer, & Eccles, 1989a) often have highly motivated students. However, little is known about the underlying mechanisms through which teacher enthusiasm and self-efficacy relate to student motivation. Given the consistent decline in adolescents' motivation (Fredricks & Eccles, 2002; Watt, 2004), there is a need to examine how teachers who are enthusiastic and efficacious successfully motivate their students. The purpose of this study was to examine whether teacher enthusiasm and classroom management self-efficacy were related to their students' motivation through student-perceived mastery goal orientation in class. Teacher-reported enthusiasm (Carmichael, Callingham, & Watt, 2017) and self-efficacy (Wolters & Daugherty, 2007) have been shown to be positively related to mastery goal orientation in class. In line with achievement goal theory (Ames, 1992; Meece, Anderman, & Anderman, 2006; Murayama & Elliot, 2009), mastery-oriented classroom learning environments are expected to enhance the motivation of students in class. Based on these theoretical and empirical assumptions, a multilevel analytic approach was applied in this study to examine the interrelations between teacher-reported enthusiasm and self-efficacy, student-perceived mastery goal orientation, and student motivation. Thus, the relationship between mastery orientation and students' motivation in terms of individual and classroom climate effects was tested (Morin, Marsh, Nagengast, & Scalas, 2014). The study focused on mathematics because motivation in this domain is a critical filter for career choices (Ma & Johnson, 2008) and mathematics offers tools to analyze the economic, political, and social inequalities in our society (Ball, Goffney, & Bass, 2005).

1.1. Teacher enthusiasm, teacher classroom management self-efficacy, and mastery goal orientation in class

The Eccles et al. (1983) expectancy-value theory indicates that the behaviors and beliefs of socializers (for example, teachers and parents) influence the motivation of adolescents. Socializers transmit their beliefs to adolescents through their support behaviors (Eccles, Wigfield, & Schiefele, 1998). Socializers' beliefs and support behaviors are assumed to shape the adolescents' *perceptions* of their socializers' beliefs and behaviors, which in turn are related to adolescents' motivation (Eccles et al., 1998; Gniewosz & Noack, 2012). Studies have only rarely tested these theoretical assumptions in the classroom context (Author, 2015; Schiefele & Schaffner, 2015). This study therefore examined how teacher enthusiasm and teacher classroom management self-efficacy were related to students' perceptions of mathematics teachers' mastery orientation in class as well as to student motivation.

Teacher enthusiasm can be conceptualized as the enjoyment, excitement, and pleasure that teachers experience during teaching. It has been differentiated into enthusiasm for teaching and enthusiasm for the subject matter taught (Kunter et al., 2011; Kunter et al., 2013; Kunter et al., 2008). Teachers who are enthusiastic about their subjects and about teaching provide more support to their students, which in turn has a positive effect on their students' motivation (Kunter et al., 2013). Specifically, teachers who are enthusiastic in class may enhance their students' motivation by providing mastery-oriented activities. Mastery goal orientation in class is defined as a focus on students' learning and understanding (Ames, 1992; Meece et al., 2006) and enhances students' motivation (Meece et al., 2006). According to these assumptions, research has shown that mathematics teacher enthusiasm is related to students' perceptions of classroom mastery goal orientation (Carmichael et al., 2017). Studies that focused on teacher interest also showed that teachers who are interested in their subjects and in teaching enhanced students' interest through the provision of mastery goal orientation in class (Schiefele, 2017; Schiefele & Schaffner, 2015). Teacher interest and teacher enthusiasm are theoretically overlapping constructs as enthusiasm corresponds to the feeling-related component of interest (Schiefele, Streblow, & Retelsdorf, 2013). Taken together, teachers' enthusiasm is positively related to mastery orientation in class and this relationship partially explains the process through which teacher enthusiasm relates to student motivation.

Teacher self-efficacy refers to teachers' own judgments of their ability to bring about the desired outcomes of student engagement and learning, even among students who may be difficult or unmotivated (Tschannen-Moran & Woolfolk Hoy, 2001; Woolfolk Hoy & Spero, 2005). Teacher self-efficacy is positively related to student motivation (Midgley, Feldlaufer, & Eccles, 1989b). In our study, we refer to the theoretical concept of teacher self-efficacy that Tschannen-Moran and Woolfolk Hoy (2001) developed. The authors define three related aspects of teachers' senses of self-efficacy: self-efficacy for instruction, self-efficacy for classroom management, and self-efficacy for engagement. In this study, we focus on teacher classroom management self-efficacy because research has shown the importance of this facet of teacher self-efficacy for successful teaching (Dicke et al., 2014; Emmer & Hickman, 1991; Wolters & Daugherty, 2007). Teacher classroom management self-efficacy is the teacher's judgment of his or her own ability to successfully perform classroom management tasks (Pfitzner-Eden, Thiel, & Horsley, 2015). Studies have shown positive relationships between teachers' classroom management self-efficacy and classroom mastery goal orientation (Wolters & Daugherty, 2007), classroom management (Dicke et al., 2014), and positive strategies in class (i.e., increasing desirable student behavior; Emmer & Hickman, 1991). Teachers who feel able to successfully perform classroom management tasks also focus on their students' gaining knowledge and mastery in class (Wolters & Daugherty, 2007). Mastery-oriented learning environments in turn enhance students' motivation (Meece et al., 2006). Thus, mastery orientation in class may partially explain the process through which teacher classroom management self-efficacy is related to student motivation.

1.2. Mastery goal orientation in class and student motivation

Achievement goal theorists have emphasized that classroom mastery goal structure (that is, the focus on students' learning and understanding in class) is substantially related to students' adaptive academic development (Ames, 1992; Meece et al., 2006; Murayama & Elliot, 2009). Various studies have shown the positive effects of students' perceptions of classroom mastery goal structure on students' competence beliefs (Wolters, 2004), positive affect (Kaplan & Midgley, 1999; Roeser, Midgley, & Urdan, 1996), interest (Schiefele & Schaffner, 2015; Urdan, 2004), and mathematics task value (Author, 2015).

Eccles (2005) suggests that learning environments that enhance students' experiences of mastery learning might be theoretically related to students' subjective task value. Subjective task value is conceptualized as an individual's belief about the quality of a task and is differentiated into four components (Eccles, 2005): *intrinsic value* refers to an individual's expected enjoyment when engaging with the task, *utility value* refers to the individual's perception of the usefulness of the task for long-term goals, *attainment value* is defined as the individual's perceived personal importance, and *cost* is defined as the expected perceived negative consequences of engaging in a task.

According to Eccles (2005), students may perceive higher subjective task value in mastery-oriented learning environments because of the experience of personal competence and internal control. Students' subjective task value, in turn, is assumed to be related to students' career plans and activity choices (Wigfield & Eccles, 2002). Empirically, research has shown that intrinsic value (Durik, Vida, & Eccles, 2006; Nagengast et al., 2011) and attainment value (Eccles &

Harold, 1991) are related to domain-specific free time involvement, utility value is related to adolescents' task-related career plans (Harackiewicz, Rozek, Hulleman, & Hyde, 2012), and cost is negatively related to academic retention intentions (Perez, Cromley, & Kaplan, 2014).

1.3. The present study

This study tested the assumptions of the Eccles et al. (1983) expectancy-value theory in the classroom context. The model indicates that socializers' actual beliefs and support behaviors are related to students' perceptions of these behaviors, which in turn are related to students' subjective task value and activity choices. Referring to these theoretical assumptions, this study examined whether socializers' beliefs (teacher-reported enthusiasm and classroom management self-efficacy) are indirectly related to students' subjective task value and activity choices through students' perceptions of socializers' behaviors (mastery orientation in mathematics classrooms). We examined teacher enthusiasm and classroom management self-efficacy because these variables are decisive components of teachers' professional competence (Kunter et al., 2013).

Based on previous theoretical and empirical work, we hypothesized that teacher-reported enthusiasm for teaching and for mathematics (Keller, Hoy, Goetz, & Frenzel, 2015; Kunter et al., 2013) and classroom management self-efficacy (Tschannen-Moran, Hoy, & Hoy, 1998) would be positively related to student ratings of classroom mastery goal orientation at both the individual and the classroom level (Hypothesis 1).

Student-perceived mastery goal orientation was expected to be related to students' mathematics task values at both the individual and the classroom level (Hypothesis 2).

Students' mathematics task values were expected to relate to their mathematics-related activities (Durik et al., 2006; Nagengast et al., 2011) and career plans (Watt, 2006; Watt et al., 2012) at both the individual and the classroom level (Hypothesis 3).

Because previous work has shown that student and teacher characteristics are related to the constructs that we examined in this study, we took into account student gender and mathematics achievement as covariates at the student level, and we included school type, teacher gender, and teachers' years of experience as covariates at the classroom level. Mathematics is often labelled as a typically male domain (Brandell & Staberg, 2008). Accordingly, girls often report a lower interest in (Frenzel, Goetz, Pekrun, & Watt, 2010) and a higher emotional cost of engaging in mathematics tasks (Gaspard et al., 2015). Students' achievement is also related to their motivation and perceptions of teaching behaviors. Students with high achievement tend to report high mastery goal orientation in their schools (Roeser et al., 1996).

Furthermore, students' motivation and achievement differ as a function of the type of school that the students attend (Trautwein, Lüdtke, Marsh, Köller, & Baumert, 2006). In [removed for reviewing purposes], where the present study was conducted, two main types of secondary schools exist. An "integrated" secondary school provides courses for different ability levels, while a "gymnasium" offers a college-bound track (Maaz, Baumert, Neumann, Becker, & Dumont, 2013). Only recently have researchers begun to analyze the role of teacher characteristics in their enthusiasm (Kunter et al., 2011) or self-efficacy (Klassen & Chiu, 2010). The findings have indicated that teacher gender and teaching experience are not significantly related to the teachers' mathematics enthusiasm (Kunter et al., 2011; Kunter et al., 2008) and that female teachers report lower classroom management self-efficacy (Klassen & Chiu, 2010).

2. Method

2.1. Sample

Data from this study were drawn from the ongoing [removed for reviewing purposes] study that examines relationships among students' perceptions of mathematics teachers' beliefs, teachers' instructional behaviors, and student motivation. Participating schools were randomly selected, and data were assessed two months after the beginning of the 2015 school year at the end of a compulsory class by trained research assistants. The surveys took approximately 30 minutes to complete. For these analyses, we used data from 803 ninth (47.70%) and tenth graders (52.30%) (age: $M = 14.59$ years, $SD = 0.91$) and their mathematics teachers ($N = 41$; 58.5% male; years of teaching experience: $M = 21.68$, $SD = 13.90$, range: 2–43). The students (53.3% girls) were from 42 classrooms in 13 secondary schools in Berlin, Germany. Most students (67.5%) reported that they were native German speakers. Half the students attended a gymnasium school (the academic track in Germany; 51.60%). The other half attended an integrated secondary school (a type of secondary school that provides courses for different ability levels; 47.20%). Students were informed of the voluntary nature of their participation. Parental consent was obtained for those students who were younger than 14 years (Berlin Senate Administration for Education Youth and Science, 2013).

2.2. Measures

2.2.1. Teachers' self-reported enthusiasm

Teachers' enthusiasm for teaching mathematics and for the subject itself was assessed with two established scales based on Kunter et al. (2008), ranging from 1 (*does not apply at all*) to 5 (*fully applies*). Teacher enthusiasm for teaching mathematics was assessed with two items (e.g., "I really enjoy teaching mathematics in this class"). The reliability of the scale was $\alpha = .84$. Teacher enthusiasm for the subject was also assessed with two items (e.g., ''I am still enthusiastic about the subject of mathematics"). The reliability of the scale was $\alpha = .62$.

2.2.2. Teacher classroom management self-efficacy

We assessed teacher classroom management self-efficacy with a four-item scale based on Pfitzner-Eden et al. (2015), an adapted version of the Teacher's Sense of Efficacy Scale (Tschannen-Moran & Woolfolk Hoy, 2001). The scale ranged from 1 (*not at all certain [I] can* *do*) to 5 (*absolutely certain [I] can do*). The introductory wording of the items was “How certain are you that you can…?” Example items are “...get students to follow classroom rules?” and “…control disruptive behavior in the classroom?” The reliability of the scale was α = .85. The scale referred to mathematics because data were assessed in mathematics classrooms, and the written introduction to this scale in the teacher questionnaire reads as follows: “In the following, you will find a list of tasks. Please rate how convinced you are that you can successfully accomplish these tasks in mathematics class.”

2.2.3. Student-perceived teacher enthusiasm

Students’ perceptions of their mathematics teachers’ enthusiasm were assessed with a three-item scale based on Kunter et al. (2008), ranging from 1 (*does not apply at all*) to 5 (*fully applies*). An example item is “Our mathematics teacher seems to really enjoy teaching.” The reliability of the scale was α = .87.

2.2.4. Student-perceived mastery goal orientation in class

Students’ perceptions of the mastery goal orientation in their mathematics classrooms were assessed with a three-item scale based on Midgley et al. (2000), ranging from 1 (*does not apply at all*) to 5 (*fully applies*). An example item is “In our class, really understanding the material is the main goal.” The reliability of the scale was α = .68. The introduction to the scale reads as follows: “How strongly do the following statements apply to your mathematics class?”

2.2.5. Task values

Students’ mathematics task values were assessed with a nine-item scale based on Steinmayr and Spinath (2010), ranging from 1 (*does not apply at all*) to 5 (*fully applies*). Intrinsic value (e.g., “I like doing math”), utility value (e.g., “Math content will help me in my life”), and attainment value (e.g., “It is important to me to be good at math”) were assessed with three items each. Mathematics cost value was assessed with a three-item scale based on Gaspard et al.

(2015). An example item is “Doing math is exhausting to me.” The reliabilities of the scale were α = .92 for intrinsic value, α = .92 for attainment value, α = .88 for utility value, and α = .79 for cost value.

2.2.6. Leisure-time activities

Students’ mathematics-related leisure-time activities were assessed with the item “How much time do you usually spend with the following activities per week? (…) mathematics-related activities such as mathematics clubs or learning groups.” Response categories ranged from 1 (*no time at all*) to 5 (*more than 3 hours per week*).

2.2.7. Career plans

Students’ mathematics-related career plans were assessed with the item “What job would you like to have in the future?” Students’ open-ended answers were coded for mathematics-relatedness per nominated career using the Occupational Information Network (O*NET; National Center for O*NET Development, 2014) to quantify relatedness to “knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications” on a scale ranging from 0 (*not mathematics-related*) to 100 (*completely mathematics-related*).

2.3. Statistical analyses

The Mplus program version 7.0 was used for all analyses (Muthén & Muthén, 1998-2015). Because we were interested in relationships at the student and the classroom level, we aimed to test the hypothesized relationships with two-level structural equation modeling. In our study, we used data from 42 mathematics classrooms (average classroom size: 19.12). Statistical literature (Hox, Moerbeek, & van de Schoot, 2010; Maas & Hox, 2005) recommends a sample size of 30–50 classrooms for multilevel modelling. We therefore considered the sample size in our study to be sufficiently large to estimate the coefficients in the model accurately. However, to examine whether the non-significance of specific paths in our model might be a result of the complexity of the hypothesized model, we used a stepwise approach and subsequently entered the independent variables in the model. The results of the stepwise tested models are reported in Appendix A. The results of the final models that correspond to our hypothesized theoretical model are reported in the text. To assess the reliability of the aggregated student variables, intraclass correlations (ICC) were computed for all latent variables in the model (Raudenbush & Bryk, 2002). An ICC_1 value greater than .05 revealed that individual ratings are attributable to group membership (LeBreton & Senter, 2008). ICC_2 values are used to assess the accuracy of class-mean ratings and should be above .70. The ICC_1 and ICC_2 values are reported in Table 1 and show that a relatively large amount of variance in our constructs can be explained by students' membership in different classrooms. For example, 12% of the variance in student-perceived mastery orientation in class, 9% of the variance in students' attainment value, 5% of the variance in students' intrinsic value, and 13% of the variance in students' utility value was attributable to classroom membership. Students' cost value was excluded from the class-level part of the model as the variable did not have significant amounts of variance at the class level. A two-level confirmatory factor analysis was used to establish an adequate measurement model. Missing data were handled by using full-information maximum likelihood estimation. All analyses were conducted using maximum likelihood with robust standard errors and chi-square (MLR) values (Muthén & Muthén, 1998-2015). Goodness of model fit was evaluated using the following criteria (Tanaka, 1993): the Yuan-Bentler scaled χ^2 (YB χ^2; a mean-adjusted test statistic that is robust to non-normality), the Tucker and Lewis index (TLI), the comparative fit index (CFI), and the root mean square of approximation (RMSEA) with the associated confidence intervals (CIs). Additionally, standardized root mean residual (SRMR) values were reported. TLI and CFI values greater than .95 (Hu & Bentler, 1999), RMSEA values lower than .06, and SRMR values greater than or equal to .08 (Hu & Bentler, 1999) were accepted as indicators of a good model fit.

3. Results

3.1. Measurement model

Confirmatory factor analysis with six latent factors at the individual level (students' perceptions of teachers' enthusiasm and classroom mastery goal orientation; intrinsic, utility, attainment, and cost value) and seven latent factors at the between level (teacher-reported teacher enthusiasm for mathematics and for teaching; teacher-reported classroom management self-efficacy; student-reported classroom mastery goal orientation; intrinsic, utility, and attainment value) showed a good model fit when factor loadings of the teacher enthusiasm subscales at the class level were set equal: $\chi^2 = 442.60$, $df = 269$, CFI = .98, TLI = 0.98, RMSEA = .03, $SRMR_{within} = .02$, and $SRMR_{between} = .05$. The range of standardized loadings resulting from this model is presented in Table 1.

3.2. Descriptive statistics

Manifest means and standard deviations for the variables included in the model are reported in Table 1. Manifest intercorrelations are reported in Table 2 for the student level (within) and Table 3 for the classroom level (between). Girls reported lower mathematics intrinsic and utility value as well as lower mathematics teacher enthusiasm than boys and were less likely than boys to report mathematics-related career plans. Girls reported higher mathematics-related costs than boys. Students' self-reported mathematics achievement was significantly positively related to their mathematics intrinsic, attainment, and utility value as well as to mathematics-related career plans and teacher enthusiasm. Students' self-reported mathematics achievement was negatively and significantly related to mathematics cost and leisure-time activities.

3.3. Teacher enthusiasm, teacher self-efficacy, mastery goal orientation in class, and student motivation

The results of two-level structural equation modeling showed that the paths between teachers' years of experience and students' class-level mathematics-related activities and career plans were not significant. These paths were removed from the model. The coefficients in the model did not change substantially. The final model showed a good fit to the empirical data: $\chi^2 = 633.19$, $df = 386$, CFI = .97, TLI = 0.96, RMSEA = .03, $SRMR_{within} = .01$, and $SRMR_{between} = .06$. All independent variables were allowed to correlate. Standardized regression coefficients of this final model are reported in Tables 4 and 5.

3.3.1. Student level

Girls reported lower mathematics intrinsic value (β = –.17, *SE* = 0.03, *p* < .001), lower utility value (β = –.15, *SE* = 0.04, *p* < .001), and higher cost value (β = .14, *SE* = 0.04, *p* < .001) than boys. Girls also perceived lower mathematics teacher enthusiasm than boys (β = –.08, *SE* = 0.04, *p* = .037). Students who reported high achievement in mathematics reported high mathematics intrinsic value (β = .50, *SE* = 0.03, *p* < .001), high attainment value (β = .35, *SE* = 0.05, *p* < .001), and high utility value (β = .28, *SE* = 0.04, *p* < .001) but low cost (β = –.52, *SE* = 0.04, *p* < .001). They also had a low likelihood of engaging in mathematics-related activities (β = –.20, *SE* = 0.05, *p* < .001). Student-perceived mathematics achievement was positively and statistically significantly related to student-perceived mathematics teacher enthusiasm (β = .12, *SE* = 0.04, *p* = .002).

Students who perceived high mathematics teacher enthusiasm were likely to report high levels of mastery goal orientation in class (β = .32, *SE* = 0.05, *p* < .001), high intrinsic value (β = .12, *SE* = 0.04, *p* < .001), and low cost (β = –.12, *SE* = 0.04, *p* = .006). Students who reported high mastery goal orientation in class reported high mathematics utility (β = .18, *SE* = 0.04, *p* < .001) and attainment values (β = .20, *SE* = 0.04, *p* < .001). Mathematics utility value was positively and significantly associated with mathematics-related career plans ($\beta = .15$, $SE = 0.05$, $p = .003$).

Student-perceived mathematics teacher enthusiasm was indirectly related to attainment ($\beta_{ind} = .06$, $SE = 0.01$, $p < .001$, 95% CI [.04, .09]) and utility value ($\beta_{ind} = .06$, $SE = 0.02$, $p < .001$, 95% CI [.03, .09]) through student-perceived mastery goal orientation in class. Student-perceived mastery goal orientation in class was indirectly related to students' mathematics-related career plans through their utility value ($\beta_{ind} = .02$, $SE = 0.01$, $p = .01$, 95% CI [.01, .05]).

The model explained significant amounts of variance in students' mathematics-related leisure-time activities ($R^2 = .04$), career plans ($R^2 = .10$), intrinsic ($R^2 = .31$), utility value ($R^2 = .15$), attainment value ($R^2 = .18$), cost value ($R^2 = .31$), mastery goal orientation in class ($R^2 = .10$) and mathematics teacher enthusiasm ($R^2 = .02$).

3.3.2. Classroom level

Compared to the students who attended the gymnasium (academic track), students who attended the secondary school that provides courses for different ability levels reported higher mathematics utility value ($\beta = .22$, $SE = 0.11$, $p = .04$) but lower intrinsic value ($\beta = -.33$, $SE = 0.12$, $p = .006$) and were less likely to report mathematics-related career plans ($\beta = -.47$, $SE = 0.14$, $p = .001$). Students who had female teachers reported mathematics-related career plans less often than those who had male teachers ($\beta = -.43$, $SE = 0.20$, $p = .03$). Teachers' years of experience were positively related to students' mathematics intrinsic value ($\beta = .41$, $SE = 0.12$, $p < .001$) and to teacher-reported classroom management self-efficacy ($\beta = .30$, $SE = 0.14$, $p = .03$).

Teacher-reported classroom management self-efficacy was significantly and positively associated with students' class-level ratings of mastery goal orientation in class ($\beta = .48$, $SE = 0.18$, $p = .006$). Students' class-level ratings of mastery goal orientation in class were significantly and positively associated with their class-level mathematics intrinsic ($\beta = .62$, $SE =$

0.13, $p < .001$), attainment ($\beta = .81$, $SE = 0.16$, $p < .001$), and utility values ($\beta = .65$, $SE = 0.19$, $p < .001$). Students' class-level attainment value was significantly related to their average level of mathematics-related leisure-time activities ($\beta = .74$, $SE = 0.33$, $p = .02$).

Teacher-reported classroom management self-efficacy was indirectly related to students' class-level attainment value through class-level student reports of mastery goal orientation in class ($\beta_{ind} = .39$, $SE = 0.15$, $p = .01$, 95% CI [.09, .69]).

The model explained significant amounts of variance in students' average mathematics-related activities ($R^2 = .42$); career plans ($R^2 = .45$); mathematics intrinsic ($R^2 = .60$), attainment ($R^2 = .50$), and utility value ($R^2 = .43$); and mastery goal orientation in class ($R^2 = .35$).

4. Discussion

This study contributes to the literature by testing the assumptions of the Eccles et al. (1983) expectancy-value theory in the classroom context. We examined how mathematics teacher enthusiasm and classroom management self-efficacy are related to students' mathematics task values, mathematics-related leisure-time activities, and career plans via student-perceived mastery orientation in class. One strength of this study is the combination of different sources of data by reliance on teacher and student reports. Furthermore, we considered different levels of analysis by testing the hypothesized effects simultaneously at the student and classroom levels. This approach allows for examination of the ways in which teacher-reported enthusiasm and classroom management self-efficacy are reflected in students' perceptions of mastery orientation in class and student motivation.

4.1. Summary and discussion of findings

Our expectations were partly confirmed, as the findings indicated that only teacher-reported classroom management self-efficacy was significantly related to student-perceived mastery goal orientation in mathematics classrooms (Hypothesis 1). Previous research (Wolters & Daugherty,

2007) had shown that teacher-reported classroom management self-efficacy was related to teachers' own perceptions of mastery goal orientation in class. Extending these findings, our results indicated that teachers with high classroom management self-efficacy beliefs were also perceived by their students as creating mastery-oriented learning environments. For teacher education, this implies that enhancing student teachers' confidence in their ability to successfully perform classroom management tasks might help them to create classrooms in which students perceive a focus on the mastery of tasks, which is empirically related to students' adaptive academic development (Ames, 1992; Meece et al., 2006).

Our findings did not show significant relationships between *teacher-reported* enthusiasm and student-perceived mastery orientation in class. On the statistical level, the comparably low number of classrooms in the sample may explain these nonsignificant relationships. On a theoretical level, an explanation for this finding might be that cognitive (classroom management self-efficacy) and not affective (enthusiasm) teacher characteristics may be particularly decisive for students' perceptions of mastery learning environments.

However, our findings suggest that *students' perceptions* of teacher enthusiasm were significantly related to their perceptions of mastery goal orientation in class. For educational practice, this raises the question of how teachers can transmit their genuine enthusiasm to their students. Previous research showed that students' class-level perceptions of teacher enthusiasm explained the effect of teacher-reported enjoyment on students' enjoyment (Frenzel, Goetz, Lüdtke, Pekrun, & Sutton, 2009). Theoretically, this might imply that a perceived emotional climate, rather than mastery orientation in class, plays a key role in the transmission of teachers' self-reported enthusiasm to student motivation. To gain a better understanding of such emotional transmission processes, more research is needed that also investigates the longitudinal relationships between teacher and student motivation.

In this study, we expected that student-perceived mastery goal orientation in class would be significantly related to students' task values at both levels of analysis (Hypothesis 2). This assumption was only partly confirmed. At the individual and class levels, student-perceived mastery goal orientation in class was significantly related to utility and attainment value but not to intrinsic value. Furthermore, as expected, students' mathematics utility value was related to their career plans (Watt, 2006; Watt et al., 2012) (Hypothesis 3). Interestingly, we did not find a relationship between intrinsic, attainment, or cost value and students' activities or career plans. Previous studies have shown that intrinsic value is related to students' participation in mathematics courses (Watt et al., 2012) and that cost value may be especially relevant to the intention to leave jobs or courses (Perez et al., 2014). However, further research is needed to examine the relations among the single components of students' task values, their career plans, and their leisure-time activities in greater detail.

4.2. Theoretical and practical implications

The study compared the contributions of teachers' self-reported enthusiasm and classroom management self-efficacy to student-perceived mastery goal orientation in class and student motivation. Teacher classroom management self-efficacy was associated with students' class-level perceptions of mastery goal orientation in class, which in turn were related to the level of motivation in the class. In terms of educational implications, it might be useful to discuss effective ways to enhance pre-service teachers' classroom management self-efficacy in teacher education. Prior research, for example, has suggested that pre-service teachers' classroom management self-efficacy may be increased through vicarious experience and verbal persuasion (Hagen, Gutkin, Wilson, & Oats, 1998). However, it must be noted that our findings were cross-sectional and do not allow us to draw causal conclusions. Thus, it might also be fruitful to enhance teachers' ability to create learning environments that students perceive as mastery-goal oriented in class to enhance teacher classroom management self-efficacy. To gain more knowledge about the sequence of the variables in our model, it is necessary to investigate bidirectional effects between teacher-reported self-efficacy and enthusiasm and student-perceived mastery goal orientation in class.

Regarding the application of the Eccles et al. (1983) expectancy-value theory to the classroom context, our findings emphasize the relevance of differentiating between task value facets when investigating student motivation in class. Our findings suggest that a classroom climate that is characterized by students' perceptions of mastery orientation in class is related to extrinsically characterized aspects of students' task values. Utility value is similar to extrinsic motivation because it also refers to the achievement of important personal goals (Eccles, 2005). Attainment value is also extrinsically characterized because it relates to value-related valences (i.e., personal value of tasks) (Eccles, 2005; Gaspard et al., 2015).

The findings of this study deepen existing theoretical knowledge by focusing on distinct levels of analysis. According to Marsh et al. (2012), aggregated student ratings of the characteristic of the group or classroom can be interpreted as classroom climate constructs. Our findings suggest that such climate constructs might not be highly relevant to students' intrinsic value. Instead, in line with previous results (Kunter, Baumert, & Köller, 2007), our findings show that students' intrinsic value was related to their *individual* classroom experiences rather than to features of the classroom climate. For educational practice, this emphasizes the need for interest-enhancing teaching methods and engaging tasks that address the learners' individual needs; for example, by being authentic and novel and providing affirmation and choice (Renninger & Hidi, 2016).

It is important to note that this study referred to the domain of mathematics. Previous studies that investigated the relationships among teacher enthusiasm, classroom characteristics, and student motivation have often occurred in this domain (Carmichael et al., 2017; Frenzel et al., 2009; Kunter et al., 2013; Kunter et al., 2008). This might be because the decline in task values is particularly steep in mathematics (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002). However, the generalizability of those findings that refer to mathematics classrooms needs to be discussed, as teachers' classroom behaviors might differ across domains. For example, Praetorius, Vieluf, Saß, Bernholt, and Klieme (2016) showed subject-dependent variance in teachers' motivational support across the German and English language subjects.

Interestingly, our findings corroborate those of previous studies that focused on the general school context (Schiefele, 2017; Wolters & Daugherty, 2007). For instance, Wolters and Daugherty (2007) also showed significant relationships between teacher classroom management self-efficacy and mastery goal orientation in class. Schiefele (2017) also showed that mastery goal orientation in class and students' school-related motivation were interrelated. This might imply that the investigated relationships are applicable to the general context of learning in school. However, further research is needed to investigate whether the theoretical constructs or the relationships that were examined in this study generalize to other content areas.

4.3. Limitations

This study has several limitations that one must consider when interpreting its findings. One limitation is that the data are cross-sectional, and no conclusions about the causality of the relations between the studied variables can therefore be made. Because of the cross-sectional design, the study focused on unidirectional relationships, although bidirectional relationships have been suggested between socializers' supportive behaviors and adolescents' motivation (Author, 2017). A correlational study might be a start in identifying potentially linked variables, but future research also ought to investigate whether the proposed associations can be replicated with longitudinal data.

Another limitation of the study is the low reliability of some scales. Specifically, the teacher enthusiasm scale and the mastery goal orientation scale have low reliability. Those significant relationships identified despite the low reliability of the measures, however, indicate the high robustness of the findings. Furthermore, by applying the same measures of teacher enthusiasm that have been used in previous studies (Kunter et al., 2013; Kunter et al., 2008), it is possible to compare our findings with those of previous studies.

4.4. Conclusions

The findings of this study are highly relevant for educational practitioners and researchers, as they provide information about the importance of teacher classroom management self-efficacy and mastery-oriented classrooms as they relate to individual experiences and climate effects for students' mathematics motivation. This points to the need for future studies to focus on both pre-service and in-service teachers' beliefs in their ability to achieve desired outcomes of student learning. Furthermore, student teachers need to be informed of how they can implement mastery orientation, as it is positively related to students' valuing of mathematics learning.

References

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*(3), 261-271. doi:10.1037/0022-0663.84.3.261

Ball, D. L., Goffney, I. M., & Bass, H. (2005). Guest Editorial. The Role of Mathematics Instruction in Building a Socially Just and Diverse Democracy. *The Mathematics Educator, 15*(1), 2-6.

Berlin Senate Administration for Education Youth and Science. (2013). *Verfahren zur Genehmigung empirischer Studien an Berliner Schulen [Permission procedure for empirical studies in schools in Berlin]*. Retrieved from http://www.ewi-psy.fu-berlin.de/service/Genehmigung_empirischer_Untersuchungen_in_Berliner_Schulen_April_2013.pdf.

Brandell, G., & Staberg, E. M. (2008). Mathematics: A female, male or gender-neutral domain? A study of attitudes among students at secondary level. *Gender and Education, 20*(5), 495-509. doi:10.1080/09540250701805771

Carmichael, C., Callingham, R., & Watt, H. M. G. (2017). Classroom motivational environment influences on emotional and cognitive dimensions of student interest in mathematics. *ZDM Mathematics Education*, *49*(3), 449-460. doi:10.1007/s11858-016-0831-7

Dicke, T., Parker, P. D., Marsh, H. W., Kunter, M., Schmeck, A., & Leutner, D. (2014). Self-efficacy in classroom management, classroom disturbances, and emotional exhaustion: A moderated mediation analysis of teacher candidates. *Journal of Educational Psychology, 106*(2), 569-583. doi:10.1037/a0035504

Durik, A. M., Vida, M., & Eccles, J. S. (2006). Task values and ability beliefs as predictors of high school literacy choices: A developmental analysis. *Journal of Educational Psychology, 98*(2), 382-393. doi:10.1037/0022-0663.98.2.382

Eccles, J. S. (2005). Subjective task value and the Eccles et al. model of achievement-related choices. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 105-131). New York, London: Guilford.

Eccles (Parsons), J., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motivation: Psychological and sociological approaches* (pp. 75–146). San Francisco, CA: Freeman.

Eccles, J. S., & Harold, R. D. (1991). Gender differences in sport involvement: Applying the Eccles' expectancy-value model. *Journal of Applied Sport Psychology, 3*(1), 7-35. doi:10.1080/10413209108406432

Eccles, J. S., Wigfield, A., & Schiefele, U. (1998). Motivation to succeed. In N. Eisenberg (Ed.), *Handbook of child psychology* (5 ed., Vol. 3, pp. 1017-1095). New York: Wiley.

Emmer, E. T., & Hickman, J. (1991). Teacher efficacy in classroom management and discipline. *Educational and Psychological Measurement, 51*(3), 755-765. doi:10.1177/0013164491513027

Fredricks, J. A., & Eccles, J. S. (2002). Children's competence and value beliefs from childhood through adolescence: growth trajectories in two male-sex-typed domains. *Developmental Psychology, 38*(4), 519-533. doi:10.1037/0012-1649.38.4.519

Frenzel, A. C., Goetz, T., Lüdtke, O., Pekrun, R., & Sutton, R. E. (2009). Emotional transmission in the classroom: Exploring the relationship between teacher and student enjoyment. *Journal of Educational Psychology, 101*(3), 705-716. doi:10.1037/a0014695

Frenzel, A. C., Goetz, T., Pekrun, R., & Watt, H. M. G. (2010). Development of mathematics interest in adolescence: Influences of gender, family, and school context. *Journal of Research on Adolescence, 20*(2), 507-537. doi:10.1111/j.1532-7795.2010.00645.x

Gaspard, H., Dicke, A.-L., Flunger, B., Schreier, B., Häfner, I., Trautwein, U., & Nagengast, B. (2015). More value through greater differentiation: Gender differences in value beliefs about math. *Journal of Educational Psychology, 107*(3), 663-677. doi: 10.1037/edu0000003

Gniewosz, B., & Noack, P. (2012). What you see is what you get: The role of early adolescents' perceptions in the intergenerational transmission of academic values. *Contemporary Educational Psychology, 37*(1), 70-79. doi:10.1016/j.cedpsych.2011.10.002

Hagen, K. M., Gutkin, T. B., Wilson, C. P., & Oats, R. G. (1998). Using vicarious experience and verbal persuasion to enhance self-efficacy in pre-service teachers: "Priming the pump" for consultation. *School Psychology Quarterly, 13*(2), 169-178. doi:10.1037/h0088980

Harackiewicz, J. M., Rozek, C. S., Hulleman, C. S., & Hyde, J. S. (2012). Helping parents to motivate adolescents in mathematics and science: An experimental test of a utility-value intervention. *Psychological Science, 23*(8), 899-906. doi:10.1177/0956797611435530

Hox, J. J., Moerbeek, M., & van de Schoot, R. (2010). *Multilevel analysis: Techniques and applications*. New York, Hove: Routledge.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55. doi:10.1080/10705519909540118

Jacobs, J. E., Lanza, S., Osgood, D. W., Eccles, J. S., & Wigfield, A. (2002). Changes in children's self-competence and values: Gender and domain differences across grades one through twelve. *Child Development, 73*(2), 509-527. doi:10.1111/1467-8624.00421

Kaplan, A., & Midgley, C. (1999). The relationship between perceptions of the classroom goal structure and early adolescents' affect in school: The mediating role of coping strategies. *Learning and Individual Differences, 11*(2), 187-212. doi:10.1016/S1041-6080(00)80005-9

Keller, M., Hoy, A. W., Goetz, T., & Frenzel, A. C. (2015). Teacher Enthusiasm: Reviewing and Redefining a Complex Construct. *Educational Psychology Review*, *28*(4), 743-769. doi:10.1007/s10648-015-9354-y

Klassen, R. M., & Chiu, M. M. (2010). Effects on teachers' self-efficacy and job satisfaction: Teacher gender, years of experience, and job stress. *Journal of Educational Psychology, 102*(3), 741-756. doi:10.1037/a0019237

Kunter, M., Baumert, J., & Köller, O. (2007). Effective classroom management and the development of subject-related interest. *Learning and Instruction, 17*(5), 494-509. doi:10.1016/j.learninstruc.2007.09.002

Kunter, M., Frenzel, A., Nagy, G., Baumert, J., & Pekrun, R. (2011). Teacher enthusiasm: Dimensionality and context specificity. *Contemporary Educational Psychology, 36*(4), 289-301. doi:10.1016/j.cedpsych.2011.07.001

Kunter, M., Klusmann, U., Baumert, J., Richter, D., Voss, T., & Hachfeld, A. (2013). Professional competence of teachers: Effects on instructional quality and student development. *Journal of Educational Psychology, 105*(3), 805-820. doi:10.1037/a0032583

Kunter, M., Tsai, Y.-M., Klusmann, U., Brunner, M., Krauss, S., & Baumert, J. (2008). Students' and mathematics teachers' perceptions of teacher enthusiasm and instruction. *Learning and Instruction, 18*(5), 468-482. doi:10.1016/j.learninstruc.2008.06.008

LeBreton, J. M., & Senter, J. L. (2008). Answers to 20 questions about interrater reliability and interrater agreement. *Organizational Research Methods, 11*(4), 815-852. doi:10.1177/1094428106296642

Ma, X., & Johnson, W. (2008). Mathematics as the critical filter: Curricular effects on gendered career choices. In H. M. G. Watt & J. S. Eccles (Eds.), *Gender and occupational outcomes: Longitudinal assessments of individual, social, and cultural influences* (pp. 55-83). Washington, DC, US: American Psychological Association.

Maas, C. J., & Hox, J. J. (2005). Sufficient sample sizes for multilevel modeling. *Methodology, 1*(3), 86-92. doi:10.1027/1614-2241.1.3.86

Maaz, K., Baumert, J., Neumann, M., Becker, M., & Dumont, H. (2013). *Die Berliner Schulstrukturreform: Bewertung durch die beteiligten Akteure und Konsequenzen des neuen Übergangsverfahrens von der Grundschule in die weiterführenden Schulen [The Berlin School Reform: Evaluation and consequences of new transitional processes from elementary school to high school]* Münster: Waxmann

Marsh, H. W., Lüdtke, O., Nagengast, B., Trautwein, U., Morin, A. J., Abduljabbar, A. S., & Köller, O. (2012). Classroom climate and contextual effects: conceptual and methodological issues in the evaluation of group-level effects. *Educational Psychologist, 47*(2), 106-124. doi:10.1080/00461520.2012.670488

Meece, J. L., Anderman, E. M., & Anderman, L. H. (2006). Classroom goal structure, student motivation, and academic achievement. *Annual Review of Psychology, 57*, 487-503. doi:10.1146/annurev.psych.56.091103.070258

Midgley, C., Feldlaufer, H., & Eccles, J. S. (1989a). Change in teacher efficacy and student self- and task-related beliefs in mathematics during the transition to junior high school. *Journal of Educational Psychology, 81*(2), 247-258. doi:10.1037/0022-0663.81.2.247

Midgley, C., Feldlaufer, H., & Eccles, J. S. (1989b). Student/teacher relations and attitudes toward mathematics before and after the transition to junior high school. *Child Development, 60*(4), 981-992. doi:10.2307/1131038

Midgley, C., Maehr, M. L., Hruda, L. Z., Anderman, E., Anderman, L. H., Freeman, K. E., ... Middleton, M. J. (2000). *Manual for the patterns of adaptive learning scales*. Ann Arbor, Michigan: University of Michigan.

Morin, A. J., Marsh, H. W., Nagengast, B., & Scalas, L. F. (2014). Doubly latent multilevel analyses of classroom climate: An illustration. *The Journal of Experimental Education, 82*(2), 143-167. doi:10.1080/00220973.2013.769412

Murayama, K., & Elliot, A. J. (2009). The joint influence of personal achievement goals and classroom goal structures on achievement-relevant outcomes. *Journal of Educational Psychology, 101*(2), 432-447. doi:10.1037/a0014221

Muthén, L., & Muthén, B. (1998-2015). *Mplus user's guide*. Los Angeles, CA: Muthen & Muthen.

Nagengast, B., Marsh, H. W., Scalas, L. F., Xu, M. K., Hau, K.-T., & Trautwein, U. (2011). Who took the “×” out of expectancy-value theory? A psychological mystery, a substantive-methodological synergy, and a cross-national generalization. *Psychological Science, 22*(8), 1058-1066. doi:10.1177/0956797611415540

National Center for O*NET Development. (2014). *O*NET OnLine*. Retrieved July 17, 2017, from http://www.onetonline.org/.

Patrick, B. C., Hisley, J., & Kempler, T. (2000). “What's everybody so excited about?”: The effects of teacher enthusiasm on student intrinsic motivation and vitality. *The Journal of Experimental Education, 68*(3), 217-236. doi:10.1080/00220970009600093

Perez, T., Cromley, J. G., & Kaplan, A. (2014). The role of identity development, values, and costs in college STEM retention. *Journal of Educational Psychology, 106*(1), 315-329. doi:10.1037/a0034027

Pfitzner-Eden, F., Thiel, F., & Horsley, J. (2015). An adapted measure of teacher self-efficacy for preservice teachers: Exploring its validity across two countries. *Zeitschrift für Pädagogische Psychologie, 28*(3), 83-92. doi:10.1024/1010-0652/a000125

Praetorius, A.-K., Vieluf, S., Saß, S., Bernholt, A., & Klieme, E. (2016). The same in German as in English? Investigating the subject-specificity of teaching quality. *Zeitschrift für Erziehungswissenschaft, 19*(1), 191-209.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear modeling. Applications and data analysis methods.* (2nd ed.). Thousands Oaks: Sage.

Renninger, A. K., & Hidi, S. (2016). *The Power of Interest for Motivation and Engagement*. New York: Routledge.

Roeser, R. W., Midgley, C., & Urdan, T. C. (1996). Perceptions of the school psychological environment and early adolescents' psychological and behavioral functioning in school: The mediating role of goals and belonging. *Journal of Educational Psychology, 88*(3), 408-422. doi:10.1037/0022-0663.88.3.408

Schiefele, U. (2017). Classroom management and mastery-oriented instruction as mediators of the effects of teacher motivation on student motivation. *Teaching and Teacher Education, 64*, 115-126. doi:10.1016/j.tate.2017.02.004

Schiefele, U., & Schaffner, E. (2015). Teacher interests, mastery goals, and self-efficacy as predictors of instructional practices and student motivation. *Contemporary Educational Psychology, 42*, 159-171. doi:10.1016/j.cedpsych.2015.06.005

Schiefele, U., Streblow, L., & Retelsdorf, J. (2013). Dimensions of teacher interest and their relations to occupational well-being and instructional practices. *Journal for Educational Research Online, 5*(1), 7-37.

Steinmayr, R., & Spinath, B. (2010). Konstruktion und erste Validierung einer Skala zur Erfassung subjektiver schulischer Werte (SESSW) [Construction and validation of a scale for the assessment of subjective task values (SESSW)]. *Diagnostica, 56*(4), 195-211.

Tanaka, J. S. (1993). Multifaceted conceptions of fit in structural equation models. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 10-39). Newbury Park, CA: Sage.

Trautwein, U., Lüdtke, O., Marsh, H. W., Köller, O., & Baumert, J. (2006). Tracking, grading, and student motivation: Using group composition and status to predict self-concept and interest in ninth-grade mathematics. *Journal of Educational Psychology, 98*(4), 788-806. doi:10.1037/0022-0663.98.4.788

Tschannen-Moran, M., Hoy, A. W., & Hoy, W. K. (1998). Teacher efficacy: Its meaning and measure. *Review of Educational Research, 68*(2), 202-248. doi:10.3102/00346543068002202

Tschannen-Moran, M., & Woolfolk Hoy, A. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education, 17*(7), 783-805. doi:10.1016/S0742-051X(01)00036-1

Urdan, T. (2004). Using Multiple Methods to Assess Students' Perceptions of Classroom Goal Structures. *European Psychologist, 9*(4), 222-231. doi:10.1027/1016-9040.9.4.222.

Watt, H. M. G. (2004). Development of adolescents' self-perceptions, values, and task perceptions according to gender and domain in 7th-through 11th-grade Australian students. *Child Development, 75*(5), 1556-1574. doi:10.1111/j.1467-8624.2004.00757.x

Watt, H. M. G. (2006). The role of motivation in gendered educational and occupational trajectories related to maths. *Educational Research and Evaluation, 12*(4), 305-322. doi:10.1080/13803610600765562

Watt, H. M. G., Shapka, J. D., Morris, Z. A., Durik, A. M., Keating, D. P., & Eccles, J. S. (2012). Gendered motivational processes affecting high school mathematics participation, educational aspirations, and career plans: A comparison of samples from

Australia, Canada, and the United States. *Developmental Psychology, 48*(6), 1594-1611. doi:10.1037/a0027838

Wigfield, A., & Eccles, J. S. (2002). The development of competence beliefs, expectancies for success, and achievement values from childhood through adolescence. In A. Wigfield & J. S. Eccles (Eds.), *Development of achievement motivation* (pp. 91-120). San Diego, CA: Academic Press.

Wolters, C. A. (2004). Advancing achievement goal theory: Using goal structures and goal orientations to predict students' motivation, cognition, and achievement. *Journal of Educational Psychology, 96*(2), 236-250. doi:10.1037/0022-0663.96.2.236

Wolters, C. A., & Daugherty, S. G. (2007). Goal structures and teachers' sense of efficacy: Their relation and association to teaching experience and academic level. *Journal of Educational Psychology, 99*(1), 181-193. doi:10.1037/0022-0663.99.1.181

Woolfolk Hoy, A., & Spero, R. B. (2005). Changes in teacher efficacy during the early years of teaching: A comparison of four measures. *Teaching and Teacher Education, 21*(4), 343-356. doi:10.1016/j.tate.2005.01.007

Tables and Figures.

Table 1

Descriptive Statistics: Standardized Factor Loadings, Means, Standard Deviations, and Intraclass Correlations of the Latent Variables

Student-reported latent variables	Range	λ min.-max. $_{Level1}$	λ min.-max. $_{Level2}$	M_{Level1}	$SD_{Level\ 1}$	$M_{Level\ 2}$	$SD_{Level\ 2}$	ICC_1	ICC_2
Teacher enthusiasm	1-5	.73 - .89		3.50	1.07				
Mastery orientation in class	1-5	.43 - .78	.65 - .90	3.64	0.85	3.64	0.86	.12	.73
Intrinsic	1-5	.80 - .94	.83 - .97	3.01	1.12	3.01	0.34	.05	.49
Attainment	1-5	.88 - .90	.90 - .96	3.59	1.04	3.60	0.37	.09	.64
Utility	1-5	.81 - .89	.90 - .95	3.28	1.07	3.28	0.44	.13	.75
Cost	1-5	.66 - .79		2.70	1.04			.04$^{n.s.}$	.43$^{n.s.}$
Career plans	1-100			51.61	16.87	51.40	5.72	.05	
Activities	1-5			1.24	0.66	1.24	0.19	.03	
Teacher-reported latent variables									
Teacher self-efficacy	1-5		.64 - .86	3.79	0.65				
Teacher enthusiasm (teaching)	1-5		.82 - .88	4.35	0.52				
Teacher enthusiasm (mathematics)	1-5		.58 - .76	3.78	0.74				

Note. N = 803, M = mean, SD = Standard deviation, ICC_1 and ICC_2 = Intraclass correlation. Standardized factor loadings = λ minimum to maximum. n.s. = nonsignificant.

Table 2

Manifest Intercorrelations between Student, Classroom and Teacher Variables at the Student Level

	1	2	3	4	5	6	7	8	9
1) Girls									
2) Achievement	.05								
3) Intrinsic	–.14***	.50***							
4) Attainment	–.05	.29***	.57***						
5) Utility	–.16***	.17***	.52***	.61***					
6) Cost	.12***	–.47***	–.77***	–.46***	–.43***				
7) Mastery orientation in class	–.03	–.01	.15**	.29***	.27***	–.07			
8) Teacher enthusiasm	–.08*	.11*	.21***	.19***	.19***	–.17***	.38***		
9) Activities	–.04	–.12***	.05	.10**	.04	–.03	.06	–.01	
10) Career plans	–.11**	.18***	.27***	.19***	.22***	–.25***	.10*	.08	.01

Note. *p < .05;** p < .01; *** p < .001.

Table 3

Manifest Intercorrelations between Student, Classroom and Teacher Variables at the Classroom Level

	1	2	3	4	5	6	7	8	9	10	11
1) Integrated secondary school											
2) Teacher years of experience	.27										
3) Teacher gender	.28*	.17									
4) Intrinsic value	–.31*	.28	–.06								
5) Attainment value	–.08	–.02	.04	.72***							
6) Utility value	.22	.02	.38**	.42*	.77***						
7) Mastery orientation in class	–.14	.11	.11	.58***	.67***	.45**					
8) Teacher self-efficacy	–.17	.21	–.14	.18	.18	–.10	.48***				
9) Teacher enthusiasm to teach	–.01	.08	–.05	.03	.05	.01	.27	.27			
10) Teacher enthusiasm math	–.06	–.40*	–.35	.04	.06	.01	–.03	–.24	.08		
11) Activities	.01	–.05	.18	.19	.44***	.43***	.19	–.20	.10	–.17	
12) Career plans	–.50***	–.18	–.36**	.37***	.34**	.13	.29*	.17	.21	.02	.06

Note. *$p < .05$;** $p < .01$; *** $p < .001$. Teacher enthusiasm math = Teacher-reported enthusiasm for mathematics, Activities = Mathematics-related leisure time activities, Career = Mathematics-related career plans.

Table 4

Standardized Regression Coefficients: Student Level

	Tenth		Mastery		Int		Att		Uti		Cost		Activities		Career	
Girls	–.08*	(0.04)	–.04	(0.04)	–.17***	(0.03)	–.05	(0.04)	–.15***	(0.04)	.14***	(0.04)	–.01	(0.03)	–.09	(0.05)
Achiev	.12**	(0.04)	–.03	(0.04)	.50***	(0.03)	.35***	(0.05)	.28***	(0.04)	–.52***	(0.04)	–.20***	(0.05)	.03	(0.05)
Tenth			.32***	(0.05)	.12**	(0.04)	.06	(0.04)	.06	(0.04)	–.12**	(0.04)	–.07	(0.07)	.01	(0.04)
Mastery					.04	(0.04)	.20***	(0.04)	.18***	(0.04)	.03	(0.03)	.05	(0.05)	.02	(0.04)
Int													.07	(0.09)	.07	(0.08)
Att													.09	(0.05)	–.03	(0.07)
Uti													–.07	(0.06)	.15**	(0.05)
Cost													–.07	(0.07)	–.11	(0.08)

Note. N = 803. **p* < .05;** *p* < .01; *** *p* < .001. Achiev = Mathematics achievement, Tenth = Teacher enthusiasm, Mastery = Mastery orientation in class, Int = Intrinsic value, Att = Attainment, Uti = Utility, Cost = Cost value, Activities = Mathematics-related leisure time activities, Career = Mathematics-related career plans.

Table 5

Standardized Regression Coefficients: Classroom Level

	TT	TM	TS	Mastery	Int	Uti	Att	Activities	Career
School	–.02 (0.18)	.14 (0.26)	–.21 (0.17)	–.14 (0.16)	–.33** (0.12)	.22* (0.11)	.04 (0.12)	–.09 (0.18)	–.47*** (0.14)
Ty	.10 (0.22)	–.37 (0.23)	.30* (0.14)	.07 (0.19)	.41*** (0.12)	–.07 (0.13)	–.06 (0.16)	–	–
Tf	–.06 (0.18)	–.32 (0.18)	–.13 (0.18)	.27 (0.16)	–.09 (0.14)	.22 (0.17)	–.08 (0.16)	.01 (0.16)	–.43* (0.20)
TT				.14 (0.14)	–.13 (0.17)	–.07 (0.15)	–.11 (0.18)	.21 (0.19)	.19 (0.16)
TM				.19 (0.31)	.13 (0.21)	.01 (0.22)	–.02 (0.26)	–.32 (0.28)	–.16 (0.24)
TS				.48** (0.18)	–.21 (0.17)	–.30 (0.20)	–.17 (0.21)	–.43 (0.28)	–.08 (0.22)
Mastery					.62*** (0.13)	.65*** (0.19)	.81*** (0.16)	–.01 (0.28)	.09 (0.25)
Int								–.27 (0.24)	.02 (0.21)
Att								.74* (0.33)	–.01 (0.34)
Uti								–.05 (0.29)	.35 (0.31)

Note. $N = 803$. $*p < .05$; $**\ p < .01$; $***\ p < .001$. School = Integrated secondary school, Ty = Teachers' years of experience, Tf = Female teacher, TT = Teacher-reported enthusiasm for teaching, TM = Teacher-reported enthusiasm for mathematics, TS = Teacher-reported self-efficacy, Mastery = Mastery orientation in class, Int = Intrinsic value, Att = Attainment, Uti = Utility, Cost = Cost value, Activities = Mathematics-related leisure time activities, Career = Mathematics-related career plans.

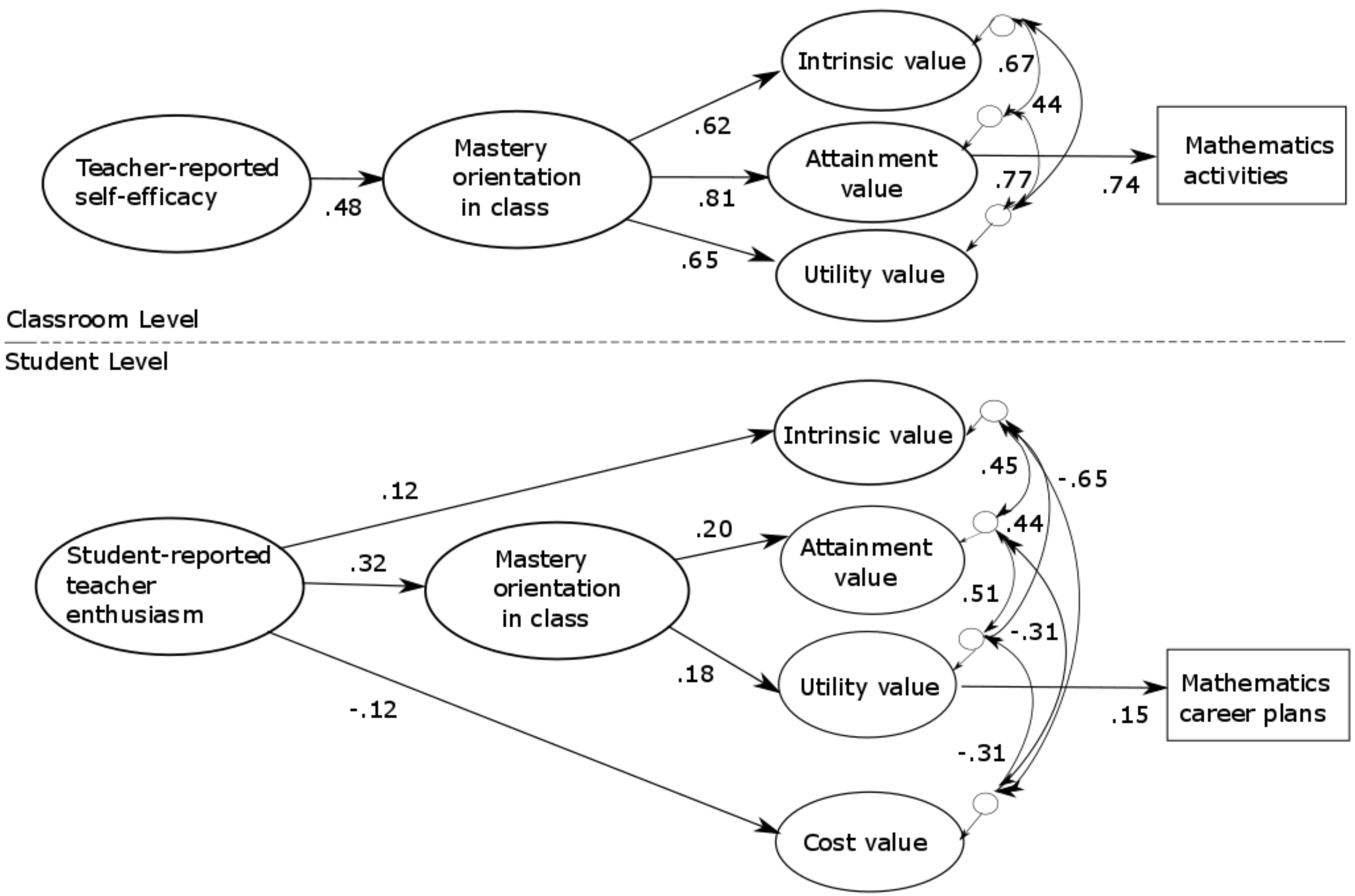

Figure 1. Empirical multilevel structural equation model for the examined relations. Only significant ($p < .05$) standardized coefficients are depicted.

Appendices

Appendix A

Results of the Stepwise Conducted Structural Equation Model 1

Student Level								
	Tenth				Activities		Career	
Girls	–.08*	(0.04)			–.05	(0.03)	–.14***	(0.04)
Achiev	.12**	(0.04)			–.10***	(0.03)	.14***	(0.05)
Tenth					–.06	(0.06)	.01	(0.03)
Classroom Level								
	TT		TM		Activities		Career	
School	–.10	(0.13)	.14	(0.25)	–.01	(0.16)	–.40**	(0.15)
Ty	–.01	(0.14)	–.35	(0.30)	–.02	(0.21)	–.01	(0.15)
Tf	–.05	(0.10)	–.26	(0.24)	.27	(0.17)	–.21	(0.14)
TT					–.04	(0.14)	.02	(0.10)
TM					.17	(0.27)	.02	(0.19)

Note. N = 803. *p < .05; ** p < .01; *** p < .001. Achiev = Mathematics achievement, Tenth = Student-reported teacher enthusiasm, School = Integrated secondary school, Ty = Teachers' years of experience, Tf = Female teacher, TT = Teacher-reported enthusiasm for teaching, TM = Teacher-reported enthusiasm for mathematics, Activities = Mathematics-related leisure time activities, Career = Mathematics-related career plans.

Results of the Stepwise Conducted Structural Equation Model 2

Student Level						
		Tenth			Activities	Career
Girls		–.08* (0.04)			–.05 (0.03)	–.14*** (0.04)
Achiev		.12** (0.04)			–.10*** (0.03)	.14** (0.05)
Tenth					–.06 (0.06)	.07 (0.05)
Classroom Level						
	TT	TM	TS		Activities	Career
School	–.01 (0.18)	.04 (0.22)	–.11 (0.20)		–.01 (0.16)	–.39*** (0.14)
Ty	–	–	–		–.07 (0.16)	–.05 (0.15)
Tf	–.07 (0.19)	–.38 (0.20)	–.01 (0.19)		.13 (0.15)	–.24 (0.15)
TT					.12 (0.20)	.17 (0.16)
TM					–.20 (0.31)	–.10 (0.20)
TS					–.27 (0.22)	–.01 (0.17)

Note. $N = 803$. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. Achiev = Mathematics achievement, Tenth = Student-reported teacher enthusiasm, School = Integrated secondary school, Ty = Teachers' years of experience, Tf = Female teacher, TT = Teacher-reported enthusiasm for teaching, TM = Teacher-reported enthusiasm for mathematics, TS = Teacher-reported classroom management self-efficacy, Activities = Mathematics-related leisure time activities, Career = Mathematics-related career plans.

Results of the Stepwise Conducted Structural Equation Model 3

Student Level

	Tenth	Mastery	Activities	Career
Girls	–.07 (0.04)	–.05 (0.04)	–.04 (0.03)	–.15*** (0.04)
Achiev	.12** (0.04)	–.04 (0.04)	–.10** (0.03)	.15** (0.05)
Tenth		.32*** (0.05)	–.08 (0.07)	.04 (0.05)
Mastery			.06 (0.05)	.05 (0.04)

Classroom Level

	TT	TM	TS	Mastery	Activities	Career
School	.03 (0.16)	.01 (0.21)	–.10 (0.19)	–.08 (0.17)	.02 (0.18)	–.38** (0.14)
Ty	–	–	–	.07 (0.17)	–.09 (0.15)	–.06 (0.16)
Tf	–.04 (0.19)	–.37 (0.20)	–.09 (0.19)	.33* (0.17)	–.02 (0.19)	–.34* (0.17)
TT				.08 (0.14)	.15 (0.21)	.17 (0.17)
TM				.38 (0.30)	–.40 (0.33)	–.24 (0.25)
TS				.52** (0.17)	–.55 (0.27)	–.19 (0.22)
Mastery					.38* (0.18)	.24 (0.20)

Note. N = 803. *p < .05;** p < .01; *** p < .001. Achiev = Mathematics achievement, Tenth = Student-reported teacher enthusiasm, School = Integrated secondary school, Ty = Teacher years of experience, Tf = Female teacher, TT = Teacher-reported enthusiasm for teaching, TM = Teacher-reported enthusiasm for mathematics, TS = Teacher-reported self-efficacy, Mastery = Student-perceived mastery goal orientation in class, Activities = Mathematics-related leisure time activities, Career = Mathematics-related career plans.