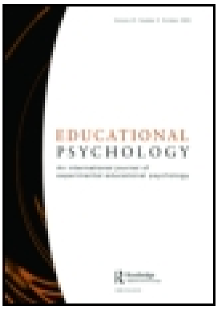

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The aim of the study was to investigate the relationships between elementary students' reported use of self-regulatory strategies in mathematics and their motivational and affective determinants. Participants of the study were 344 fifth- and sixth-grade Greek students. Students were asked to complete self-reported measures regarding the strategies they use to self-regulate mathematics learning, their achievement goals in relation to mathematics, their self-efficacy concerning mathematics learning and achievement, the value they attribute to mathematics as a subject domain and their enjoyment of mathematics learning. Structural equation modelling confirmed a mediation model, that is, students' mathematics self-efficacy, value beliefs about mathematics and enjoyment mediated the effects of achievement goals on reported strategy use. Results are discussed in terms of implications for elementary students' self-regulated learning skills.

Keywords: self-regulatory strategies; achievement goals; self-efficacy; value; enjoyment; elementary school mathematics

Introduction

In today's classrooms, there is a tendency for redistribution of responsibility of learning between the teacher and the students. Self-regulated learning (SRL) is a notion that emphasises the active and agentic role of the learner (Boekaerts, Pintrich, & Zeidner, 2000; Efklides, 2011). Research on self-regulation from a socio-cognitive perspective has focused on the individual's capacity to monitor and modify behaviour, cognition, affect and environment, in order to achieve a goal (Efklides, Niemivirta, & Yamauchi, 2002; Zimmerman & Schunk, 2001). Research on SRL has revealed that, in comparison with poor self-regulated learners, good self-regulators set more realistic learning goals, select more effective learning strategies, monitor and better evaluate their understanding and progress towards goals and are more highly motivated to learn and invest effort (Schunk & Zimmerman, 2008; Zimmerman, 2011). It is posited that the above behavioural attributes can determine students' academic outcomes (Boekaerts & Corno, 2005; Efklides, 2011).

Within the SRL tradition from a socio-cognitive perspective, the importance of students' strategic behaviour that facilitates active, independent, self-regulated

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learning is stressed more than before (Alexander, Graham, & Harris, 1998; Weinstein, Husman, & Dierking, 2000). Self-regulated learners have a repertoire of cognitive, metacognitive and motivational regulation strategies they appropriately apply to tackle the day-to-day challenges of cognitive tasks (Dermitzaki, Leondari, & Goudas, 2009; Sperling, Howard, Miller, & Murphy, 2002; Weinstein, Acee, & Jung, 2011). Cognitive strategies (i.e. rehearsal, elaboration and organisation strategies) and metacognitive strategies (i.e. planning of learning, self-monitoring) are examples of such skills that can be activated before, during and after learning efforts (Alexander et al., 1998; Berger & Karabenick, 2011; Weinstein et al., 2000). Research has shown that the use of cognitive and metacognitive skills and strategies is related to higher quality of learning and to academic performance in a variety of academic fields (Pressley & Hilden, 2006).

Numerous studies have shown significant associations between students' use of adaptive learning strategies with their motivation and affect. Students' achievement goals, academic self-efficacy, the value students attribute to a subject domain and students' emotions, such as their enjoyment of an activity, are reported as important determinants of strategic learning (Artino & Stephens, 2008; Pekrun, Goetz, Titz, & Perry, 2002a; Schunk & Zimmerman, 2006; Vrugt & Oort, 2008; Wolters, 2004). However, the pattern of relationships between these determinants of self-regulatory strategy use requires further investigation. In addition, in most of the studies which examined the above relations, the participants were junior high school or older students.

In this study, we examined elementary school students' reports about the self-regulatory strategies they use during mathematics learning and problem solving. The relationships between reported strategy use and students' achievement goals, their mathematics self-efficacy, the value they attribute to mathematics and enjoyment of mathematics learning were investigated. The focus was on cognitive strategies for memorising, elaborating and organising the learning material and on metacognitive strategies for planning, self-monitoring and reflecting on cognitive outcomes. Investigating such relationships relatively early in students' educational courses may provide additional information on the associations between students' individual attributes and self-regulatory processes. Recently, elementary school students' strategic behaviours during problem solving in the mathematical domain have attracted great interest (Annevirta & Vauras, 2006; Dermitzaki et al., 2009; Kramarski, Weiss, & Kololshi-Minsker, 2009; Labuhn, Zimmerman, & Hasselhom, 2010; Perels, Dignath, & Schmitz, 2009). The present study focused on school mathematics for two reasons. First, it is a core subject in school learning and curriculum. Second, as previous studies show, mathematics is a learning domain frequently associated with dysfunctional emotional reactions, such as increased stress and fear both in teachers (Haylock, 2001) and in students (Jones, 2001). Therefore, further examination of the psychological processes activated during mathematics learning might have important implications for students' adaptive learning and mathematics achievement.

Motivational and affective determinants of students' self-regulatory strategy use

The relation between students' self-regulation and academic achievement has been investigated in conjunction with students' motivational and affective variables. Previous studies show that individual motivational and affective characteristics influence students' learning behaviour which, in turn, affects academic attainments (Boekaerts et al., 2000; Schunk & Zimmerman, 2008). Specifically, previous research has documented the predictive power of students' achievement goals for strategy use in school learning (Vrugt & Oort, 2008; Wolters, 2004; Wolters, Yu, & Pintrich, 1996). Two major goal orientations have been investigated more frequently in the educational context. *Learning* or *mastery goals* orient the student towards learning and understanding, developing new skills and a focus on self-improvement using self-referenced standards. *Performance goals* represent a concern with demonstrating high ability, obtaining recognition of high ability, attempting to surpass others, protecting self-worth and a focus on comparative standards relative to others (Ames, 1992; Elliot & Church, 1997; Harackiewicz, Barron, & Elliot, 1998). Theorists have described performance goals in terms of *performance-approach* (an orientation to demonstrating ability) and *performance-avoidance* (an orientation to avoiding the demonstration of lack of ability) components.

The adoption of mastery goals has been associated with adaptive strategy use, such as deep-level cognitive and metacognitive strategy use for the regulation of learning (Middleton & Midgley, 1997; Vrugt & Oort, 2008; Wolters, 2004). For example, previous studies show that students' organisation, elaboration and critical thinking were positively correlated with the adoption of mastery goals (e.g. Elliot & McGregor, 1999; Liem, Lau, & Nie, 2008). Other studies also show that students' metacognitive strategy use, such as planning, monitoring and regulatory strategies, was associated with mastery goal orientation (Al-Harthy & Was, 2010; Vrugt & Oort, 2008; Wolters, 2004).

Regarding the association of performance goals with patterns of learning behaviours, many studies have found that performance-approach goals are unrelated to deep processing (Midgley, Kaplan, & Middleton, 2001). However, there are also studies showing that students' performance-approach goals may not be maladaptive in terms of motivation, affect and strategy use, as suggested by the normative view (Pintrich, 2000), but that they could be positively associated with students' cognitive, metacognitive, motivational and resource management strategies (e.g. Kadivar, Dasta, Jvadi, & Farzad, 2010; Liem et al., 2008; Pintrich, 2000; Vrugt & Oort, 2008). Wolters et al. (1996) found a positive association between performance-approach goals and strategy use in mathematics, English and social studies. Similarly, Bouffard, Boisvert, Vezeau, and Larouche (1995) report a positive relation between performance goals and metacognitive strategy use for boys.

More research is needed to further clarify the relations between students' achievement goals and self-regulatory strategy use. Most previous studies examining the relations between achievement goals and learning strategies focused on adolescent and college students (e.g. Howell & Watson, 2007; Sungur, 2007; Weinstein et al., 2011; Wolters, 2004). Moreover, there is some evidence regarding the relations between achievement goals and self-regulated learning strategies in elementary school. For example, Patrick, Ryan, and Kaplan (2007) found that mastery goals were strongly related to self-regulation strategies used by fifth-grade students. Additionally, Seo and Kim (2001) found that, in elementary school students, both mastery and performance-approach goals related positively to metacognitive strategies as well as to mathematics achievement. However, further research with a focus on younger students' mathematics learning is needed in order to understand better the above relations at earlier stages of development.

Another construct associated with students' self-regulation is academic self-efficacy (Bandura, 1993; Zimmerman & Schunk, 2008). Wigfield and Eccles (2001) note that a variety of models of self-regulation include competence or efficacy beliefs as crucial determinants of self-regulation. It has been proposed that self-efficacy is positively related to the use of self-regulatory strategies during all three phases of self-regulated learning, that is, forethought, performance and self-evaluation based on reflection (Schunk & Ertmer, 2000; Zimmerman, Bonner, & Kovach, 1996). It has been also shown that students who believe that they are capable of performing academic tasks tend to use more cognitive and metacognitive strategies for achieving learning objectives in the classroom and they are more successful in school activities than those who doubt their competence (Linnenbrink & Pintrich, 2003; Schunk & Ertmer, 2000; Zimmerman & Schunk, 2008). This also holds true for the domain of mathematics (Berger & Karabenick, 2011).

Several researchers (Pintrich & Zusho, 2002; Zimmerman, 2000) maintain that strategy use is an effortful and time consuming activity; therefore, students who value a task or domain will be more likely to employ strategies to increase the likelihood of success, such as cognitive and metacognitive strategies requiring more concentration, effort and self-reflection and, hence, higher levels of motivation. Previous research has pointed out that task value was a good predictor of both cognitive and regulatory strategy use by students. Seventh- and eighth-grade students who valued and were interested in the content of the subject area were more likely to report using deeper processing strategies and more self-regulatory strategies (Pintrich, Roeser, & De Groot, 1994; Wolters & Pintrich, 1998). Similarly, in relation to mathematics, recent findings suggest that the value students attribute to this subject was positively correlated with cognitive strategy use (i.e. rehearsal, organisation and evaluation strategies) and self-regulation (Berger & Karabenick, 2011).

Furthermore, research and theory suggest that emotions experienced in academic settings can have a profound and long-term influence on students' self-regulation and achievement (e.g. Boekaerts, 2007; Linnenbrink, 2006; Pekrun, 2006). Pekrun et al. (2002a, 2002b) found that students' positive emotions, such as enjoyment, were substantially associated with deeper cognitive processing (elaboration and organisation), critical thinking and metacognitive monitoring strategies. Other studies with a focus on mathematics have also shown that students' reported enjoyment of mathematics learning is associated with self-regulation of learning and with strategy use (e.g. Goetz, Hall, Frenzel, & Pekrun, 2006). Ahmed, van der Werf, Kuyper, and Minnaert (2013) showed that changes in positive emotions of seventh graders, such as enjoyment and pride, were systematically associated with changes in self-regulatory strategies and achievement in mathematics. For example, a decrease in enjoyment was associated with a decrease in self-regulated learning strategies.

Relations between motivational and affective determinants of self-regulatory strategy use

Previous theory and research (e.g. the expectancy-value theory, Wigfield & Eccles, 2001) posits that the achievement goals students hold in learning can influence academic self-efficacy and other aspects of the self in academic settings, students' task value, appraisals of a learning situation and affective reactions (e.g. Ames, 1992; Dermitzaki & Efklides, 2003; Pintrich & Zusho, 2002; Wolters, 2004). There has been considerable consistency regarding the relation of a mastery goal orientation and adaptive patterns of cognition, motivation and affect. Over the years, it has been shown that mastery goals predict academic self-efficacy, students' task value and reported enjoyment of learning activities (Bong, 2001; Spinath & Steinmayr, 2012; Wolters et al., 1996).

As regards performance-approach goals, they have been found positively correlated (Bong, 2001; Harackiewicz et al., 1998), weakly correlated or uncorrelated (Midgley et al., 2001; Pintrich, Smith, Garcia, & McKeachie, 1993) to academic self-efficacy and to task value. Moreover, no relationship was found between students' performance goals and reported feelings of enjoyment of academic activities in previous literature (Barron & Harackiewicz, 2001; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000; Middleton & Midgley, 1997). Various studies have consistently reported that mastery goals were positive predictors of task enjoyment and interest, whereas performance-approach goals were not (Harackiewicz et al., 2000; Spinath & Steinmayr, 2012). In general, the literature review shows weaker relationships of performance goals with academic self-efficacy and value beliefs about mathematics, in comparison with mastery goals (Barron & Harackiewicz, 2001; Friedel, Cortina, Turner, & Midgley, 2007).

The present study

The aim of this study was to investigate the relationships between elementary students' reported use of self-regulatory strategies in relation to mathematics and motivational and affective determinants. In the present study, students' mastery and performance-approach goals in mathematics, mathematics self-efficacy, the value attributed to mathematics and students' enjoyment of mathematics learning were addressed.

As described in the previous sections, the above-mentioned variables are reported to be directly associated with strategy use. Moreover, the presented literature showed that students' achievement goals can affect mathematics self-efficacy, task value beliefs and enjoyment of learning. Therefore, it seems plausible to assume that achievement goals, especially mastery goals, might exert indirect influences on students' self-regulatory strategy use through their effects on mathematics self-efficacy, on the value attributed to a subject domain and on reported enjoyment.

Based on the literature review presented above, the hypotheses of the study are stated as follows. Students' reported use of self-regulatory strategies in mathematics could be affected by the adoption of mastery goals when dealing with mathematics (Hypothesis 1a), by students' mathematics self-efficacy (Hypothesis 1b), by the value they attribute to mathematics (Hypothesis 1c) and by their reported enjoyment of mathematics learning (Hypothesis 1d). Regarding the direct relation between reported strategy use and the adoption of performance goal orientation no prediction could be formulated because of the inconsistent findings of the previous studies. We also expected that both achievement goals could influence students' mathematics self-efficacy beliefs (Hypothesis 2a), the value they attribute to mathematics (Hypothesis 2b) and that mastery goals could affect students' enjoyment of dealing with mathematics (Hypothesis 2c). Based on previous findings, we expected no relationship between performance goals and reported feelings of enjoyment (Hypothesis 2d), as shown in previous literature (Barron & Harackiewicz, 2001; Middleton & Midgley, 1997). We additionally hypothesised that mathematics self-efficacy, the value attributed to mathematics and the reported enjoyment of mathematics learning could mediate the effects of students' achievement goals on reported strategy use (Hypothesis 3).

Method

Participants

The participants were 344 Greek elementary school students. The students were almost equally distributed to the fifth and the sixth grade (173 fifth graders and 171 sixth graders). In Greece, elementary school covers a period of six years, and students in the fifth and sixth grade are 11 and 12 years old, respectively. Concerning the gender of the participants, 181 were males (52.6%) and 163 were females (47.4%). The data were gathered from seven randomly selected elementary state schools of a medium sized Greek city. Students were from medium socio-economic status families according to parental occupation.

Instruments

Self-regulatory strategies in mathematics learning

This questionnaire consists of 11 items and it was developed by Dermitzaki and Efklides (2003). The scale assesses the cognitive and metacognitive strategies that students report using to self-regulate learning and problem solving in mathematics. Answers were given on a five-point scale from 1-'I never do it' to 5-'I always do it'. Principal component factor analysis using oblimin rotation suggested 2 factors with eigenvalue > 1 explaining 43.49% of the variance. The first factor was named strategies for *Memorisation and Deep Comprehension* (3 items, $\alpha = .63$, e.g. 'After I read carefully the problem to be solved in mathematics, I verbalise it in order to understand what the problem asks for'), and it comprised mainly strategies for memorising, elaborating and organising the learning material. The second factor was named strategies for *Enhancing Metacognition and Reflection* and it included strategies for planning, self-monitoring, regulating learning and problem solving, and reflecting on cognitive outcomes (8 items, $\alpha = .75$, e.g. 'During dealing with the task-at-hand, I stop and check the solution process', 'I try to choose the most appropriate among several possible solutions', 'Once I solve a problem in mathematics, I ask myself how well I solved it'.).

Achievement goals in mathematics

The items of this scale were developed for the purposes of the present study after a pilot study conducted with 125 students. This pilot study was designed in order to investigate fifth- and sixth-grade students' learning priorities in mathematics within the Greek educational system. The participants of the pilot study were invited by means of an open-ended question to reflect on 'What is more important (for you as a student) with regard to mathematics learning'. The students could give as many reasons as they wanted. Content analysis showed that students' answers reflected the conceptual distinction between mastery goals and performance-approach goals. This finding is in agreement with the idea that the conceptual differentiation of the two constructs takes place between 10 and 12 years of age (Stipek & MacIver, 1989). Based on the most frequent answers, a scale with five items was finally developed. The stem for each item was 'Regarding mathematics, …'. Three statements referred to mastery goals ($\alpha = .54$, '… to acquire knowledge and skills and be at ease with operations and with solving problems is …', '… to learn to think methodically, in an organised way and critically is …', '… to be happy to learn mathematics and to solve problems is …'). Two statements referred to performance-approach goals ($\alpha = .52$, '… to display top performance and get the best grades is …', '… to have a chance to display my abilities is …'). Answers were given on a five-point scale from 1-'Not at all important to me' to 5-'Most important to me'.

In order to test the factorial structure of the data, confirmatory factor analysis has been performed using the EQS (structural equation modelling (SEM) software) version 6.1 for Windows statistical programme (Bentler, 1993). The model tested included the five items explained by two latent factors, that is, mastery goals and performance goals. The fit of this model was very good ($\chi^2_{(3,\ N=344)} = 8.015$, $p = .044$, Bentler-Bonnet normative fit index (BBNFI) = .992, Bentler-Bonnet non-normative fit index (BBNNFI) = 1.010, comparative fit index (CFI) = 1.000, root mean square error of approximation (RMSEA) = .001). The two subscales had a moderate correlation ($r = .45$) indicating that they are relatively independent constructs. The low alpha of the two scales may be due to the small number of items and to the young age of the participants. Furthermore, we collapsed the 5 items in one scale and examined the pattern of relationships with the other variables of the study. Results were similar with the pattern of relationships when employing the two subscales separately. Therefore, we opted for retaining the model with the two subscales.

Self-efficacy regarding mathematics learning

This questionnaire was developed by Dermitzaki and Efklides (2001, 2003) and assesses students' reported self-efficacy in learning mathematics with 5 items (5 items, $\alpha = .72$, e.g. 'I believe that this year I will get a very good grade in mathematics'). Answers are given on a five-point scale from 1-'Not at all true for me' to 5-'Totally true for me'.

Value of mathematics

The conceptualisation of the value of mathematics as a learning domain was similar to the attainment value, one component of the task value theory outlined by Wigfield and Eccles (2001) and it was defined as the personal importance of doing well in mathematics. Three items assessed students' value beliefs about the importance of mathematics as a school subject. These items originated from a scale by Ames (1983) but they have been adapted in order to fit the purposes of this study ($\alpha = .63$). An example item is as follows: 'In comparison with the rest school subjects, mathematics is …' Answers were given on a five-point scale from 1-'Not at all important' to 5-'Highly important'.

Enjoyment of mathematics learning

This scale was based on the work of Price and Mueller (1981) for adults and it was adapted for the purposes of this study. It includes 3 items assessing students' enjoyment of mathematics learning ($\alpha = .80$, e.g. 'I get real enjoyment when dealing with mathematics'). Answers were given on a five-point scale from 1-'I totally disagree' to 5-'I totally agree'.

The scales developed for the purposes of this study were previously tested in a pilot study conducted with 125 students. On the basis of these results, we improved the scales and made some minor changes regarding the wording of some sentences.

Procedure

Before distributing the questionnaires, the Headmasters' and teachers' consent had been ensured. The survey took place during the springtime. The students completed the scales voluntarily during mathematics class and the completion lasted approximately 15–20 min. The teacher was present during questionnaire completion. The researcher distributed the questionnaires, she was reading aloud each sentence and waited for all the students to write down their answers. She finally collected the completed scales.

Analyses of the data

Pearson r correlation coefficients between the scales of the study were calculated. In addition, SEM analysis has been performed on the data in order to investigate the network of relations between the variables of the study. SEM was applied using the EQS (SEM Software) version 6.1 for Windows statistical programme (Bentler, 1993). The parameters of the model were estimated using the maximum likelihood method (Hu & Bentler, 1999). The maximum likelihood estimation method yields estimates of regression coefficients, residual variances and covariances, as well as a chi-square measure of overall goodness of fit and a RMSEA. The goodness of fit of the estimated model was evaluated using the following indicators: χ^2 test, BBNFI, BBNNFI, CFI and RMSEA. A model provides a good fit with the data when p-value associated with the χ^2 test is non-significant ($p > .05$). The CFI is a normed-fit index that evaluates the adequacy of the model tested in relation to the baseline model and varies from 0 to 1. For BBNFI, BBNNFI and CFI, values greater than .90 typically reflect acceptable fits and values greater than .95 reflect excellent fits of the model to the data (Marsh, Balla, & Hau, 1996). The RMSEA is a measure

Table 1. Descriptive statistics and Pearson r correlation coefficients among the variables of the study.

Variables	*M*	SD	1	2	3	4	5	6	7
1. Strategies for memorisation and deep comprehension	4.13	.76							
2. Strategies for enhancing metacognition and reflection	3.88	.65	.55**						
3. Mathematics self-efficacy	4.16	.62	.42**	.52**	–				
4. Value of mathematics	4.33	.63	.41**	.49**	.49**	–			
5. Enjoyment of mathematics learning	3.79	.89	.40**	.55**	.54**	.51**	–		
6. Mastery goals	4.16	.64	.33**	.46**	.48**	.55**	.50**	–	
7. Performance goals	4.26	.72	.32**	.40**	.40**	.41**	.29**	.45**	–

Note: $N = 344$, $^{**}p < .01$.

of the approximation error of the model. Values less than .05 indicate an excellent fit (Hu & Bentler, 1999; Steiger, 1990).

Results

Table 1 presents the descriptive statistics (means and standard deviations) and the Pearson's r correlation coefficients among the variables of the study.

Table 1 shows that the reported use of strategies for Enhancing Metacognition and Reflection correlated with the motivational and affective variables of the study from $r = .40$ to $r = .55$ ($p < .01$) and strategies for Memorisation and Deep Comprehension from $r = .32$ to $r = .42$ ($p < .01$). Both factors of self-regulatory strategy use correlated with students' reported enjoyment of mathematics learning and with mathematics self-efficacy from $r = .40$ to $r = .55$ ($p < .01$). Students' self-efficacy regarding mathematics learning and their reported enjoyment shared a relatively strong correlation ($r = .54$, $p < .01$).

Furthermore, SEM analysis has been performed on the data in order to investigate the network of relations between the variables of the study. Figure 1 presents the results of SEM conducted. The model tested was based on previous findings claiming that students' self-regulatory behaviour depends on individual factors such as their achievement goals, mathematics self-efficacy, the value students attribute to mathematics as a learning domain and feelings of enjoyment of mathematics learning. In particular, following the hypotheses of the study, we tested a mediation model where self-efficacy expectations, value beliefs about mathematics and enjoyment of mathematics learning should mediate the effects of students' achievement goals on their reported use of self-regulatory strategies. Mastery but not performance goals were specified to affect the reported enjoyment of mathematics learning, according to previous findings. The model tested is depicted in Figure 1 presenting the standardised values.

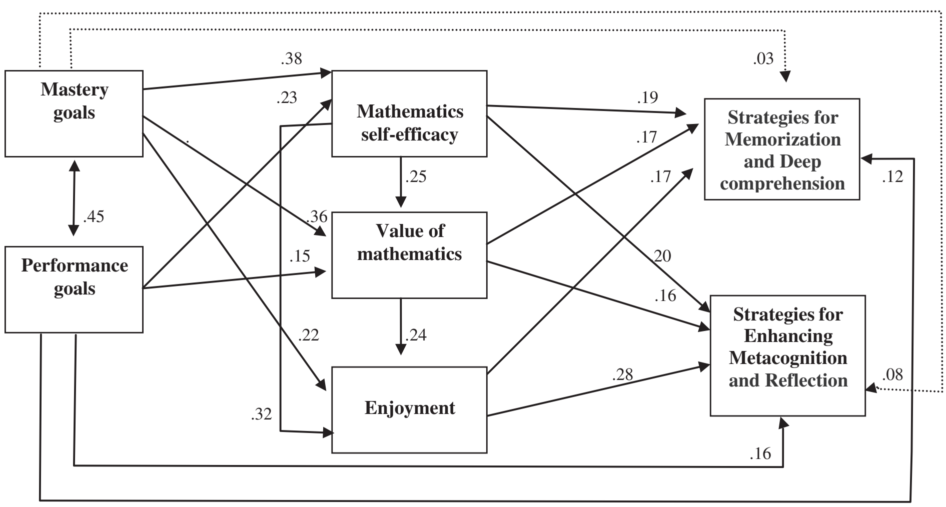

Figure 1. Structural equation modelling analysis among the variables of the study (standardised values).
Error covariance: strategies for memorisation & deep comprehension – strategies for enhancing metacognition = .45.
Note: The relationships denoted with dotted lines are not significant.

The fit indices of the model tested were as follows: $\chi^2_{(1,\ N=344)} = 1.031$, $p = .309$, BBNFI = .999, BBNNFI = 1.000, CFI = 1.000, RMSEA = .009, and they show an excellent fit of this model. As reported in the Method section, a model provides a good fit with the data when *p*-value associated with the χ^2 test is non-significant ($p > .05$), when the CFI value is greater than .95 (Marsh et al., 1996), and when the RMSEA value is less than .08–.05 (Hu & Bentler, 1999; Steiger, 1990). As depicted in Figure 1, both groups of the reported strategy use in mathematics were directly influenced by students' self-efficacy regarding mathematics, the enjoyment they report of dealing with mathematics and the value they attribute to mathematics as a subject domain. An interesting link between students' enjoyment of mathematics learning and reported use of Strategies for Enhancing Metacognition and Reflection was found. Regarding achievement goals, performance goals had significant, though weak, direct effects on students' reported use of self-regulatory strategies for mathematics learning. Moreover, performance goals had significant indirect effects on both groups of strategy use (.10 on cognitive strategies and .11 on metacognitive strategies, $p < .05$) as calculated by EQS (standardised values). Mastery goals exerted influences on reported self-regulation mainly indirectly, through their effects on mathematics self-efficacy, value of mathematics and feeling of enjoyment of mathematics learning. The magnitude of these significant indirect effects was .23 on cognitive strategies and .27 on metacognitive strategies ($p < .05$, standardised values). The total effects of mastery goals on cognitive and on metacognitive strategy use were .23 and .34, respectively, while the total effects of performance goals on cognitive and on metacognitive strategy use were .22 and .27, respectively. The total effects of mastery goals appear to be somewhat stronger than the total effects of performance goals.

Discussion

The aim of this study was to examine in fifth- and sixth-grade students the motivational and affective determinants of reported use of self-regulatory strategies in relation to mathematics learning. Students' achievement goals in mathematics, their mathematics self-efficacy, the value attributed to mathematics and their enjoyment of mathematics learning were examined in relation to self-regulatory strategy use. Pearson *r* correlation coefficients and SEM analysis showed that, with reference to mathematics, students' reported strategy use was differentially associated with the examined individual motivational and affective factors both directly and indirectly.

In particular, students' reports of self-regulatory strategy use in mathematics were directly and positively associated with their self-efficacy regarding mathematics, the value they attribute to mathematics as a school subject and the reported enjoyment of mathematics learning confirming hypotheses 1b, 1c and 1d and corroborating previous findings (e.g. Berger & Karabenick, 2011; Goetz et al., 2006; Pintrich & Zusho, 2002; Zimmerman et al., 1996). In the SEM model tested, an interesting link was noticed between students' enjoyment of mathematics learning and reported strategy use for Enhancing Metacognition and Reflection. This finding is in line with the view that achievement emotions, and particularly positive emotions such as students' enjoyment of a task or domain, are systematically associated with self-regulation of learning (e.g. Ahmed et al., 2013; Goetz et al., 2006; Pekrun, 2006).

Regarding the hypothesised associations of students' achievement goals in mathematics with their reported strategy use, overall, weak direct and mainly indirect effects of students' achievement goals on reported strategy use were found. Specifically, hypothesis 1a on the expected direct association of students' mastery goals with their reported strategy use was not confirmed, as the specified direct links were statistically non-significant. Some previous studies have also failed to find strong correlations between students' mastery goals and their use of cognitive strategies, either surface-level (e.g. Vrugt & Oort, 2008) or deep-level strategies (e.g. Al-Harthy & Was, 2010). However, in our study, students' mastery goals exerted significant indirect effects on both categories of reported strategy use via their effects on mathematics self-efficacy, the value attributed to mathematics and their enjoyment of mathematics learning.

Performance goals had direct associations with both groups of students' reported use of self-regulatory strategies. Their links were statistically significant, although they were weak. In addition, performance goals exerted significant indirect effects on both groups of reported strategy use via their effects on mathematics self-efficacy and on value of mathematics as a subject domain. These effects appeared to be weaker in comparison with the indirect effects on strategy use exerted by mastery goals. These findings are in line with past studies reporting that, not only mastery goals, but also performance-approach goals can directly and positively affect students' cognitive and metacognitive strategies (e.g. Kadivar et al., 2010; Liem et al., 2008; Pintrich, 2000; Vrugt & Oort, 2008).

As reported above, both mastery and performance goals had positive direct effects on students' mathematics self-efficacy and on the value they attribute to mathematics confirming, thus hypotheses 2a and 2b. In literature, it is well documented that students' mastery goals are associated with academic self-efficacy and task value (e.g. Bong, 2001; Pintrich & Zusho, 2002; Spinath & Steinmayr, 2012; Wolters, 2004). Some previous studies also report that performance-approach goals can be positively associated with higher academic self-efficacy (Bong, 2001; Harackiewicz et al., 1998) and with the value attributed to a subject domain, though more weakly in comparison with mastery goals (Bong, 2001; Midgley et al., 2001; Pintrich et al., 1993). Regarding students' reported enjoyment of mathematics learning, it was affected only by mastery goals and not by performance goals confirming hypotheses 2c and 2d. Studies with reference to mathematics have shown that students' performance-approach goals demonstrated no relationship with students' enjoyment of mathematics learning (Barron & Harackiewicz, 2001; Middleton & Midgley, 1997) in contrast to mastery goals (Harackiewicz et al., 2000; Spinath & Steinmayr, 2012).

In addition, the present study confirmed previous findings that positive ability beliefs in a given domain and individual's control and value appraisals are important prerequisites for experiencing intrinsic motivation towards this domain and positive emotions, such as enjoyment of this domain (Bong, 2001; Falco, Crethar, & Bauman, 2008; Pekrun, 2006; Wigfield & Eccles, 2001).

To conclude, our findings support the mediation hypothesis (hypothesis 3) stating that mathematics self-efficacy, the value attributed to mathematics and reported enjoyment of mathematics learning should mediate the effects of students' achievement goals on reported strategy use. It appears that students' positive self-efficacy, value beliefs and enjoyment of mathematics are necessary for mastery goals to have a positive effect on strategy use with reference to mathematics. This study also showed that, at the end of elementary school, the connexions between students' self-regulatory behaviours and individual motivational and affective determinants have already emerged. Studying such relationships at earlier stages of development gains more and more interest in literature (Aunola, Leskinen, & Nurmi, 2006; Dermitzaki et al., 2009; Kramarski et al., 2009; Labuhn et al., 2010). Further studies with younger students are needed in order to shed more light on these complex associations.

A limitation of this study is that the constructs were measured via self-reports and that this shared variance could inflate the coefficients. Although self-reports are a direct way to measure internal states, caution is suggested in establishing causal inferences. Longitudinal and experimental studies with the use of more objective methods that are not based only on self-reports, such as observational methods, students' recording of actual use of strategies in the classroom, and checklists of school practices would allow us to better clarify the relationships among the variables under examination and should add important information for educators and teachers. It is also important to note that readers should be cautious with the generalisation of the results to different grades and school subjects. The relationships between the variables examined in this study have been investigated with reference to mathematics domain and they do not necessarily hold in other domains as well. Finally, the results of this study should be interpreted with reference to the specific cultural context. Future research could try to replicate these results in other cultural contexts as well.

Conclusive comments on the relations examined cannot be made, as further improvement of research tools is needed. For example, the groups of items assessing achievement goals have only reached weak alpha values. Further studies employing instruments with robust psychometric properties are needed in order to replicate the interplay of the constructs examined.

Implications for learning

The present study showed that students' reported strategy use with reference to mathematics was differently related to their motivation and affect. Our findings suggest that elementary school students' enjoyment of mathematics learning, their positive expectations for success in mathematics and the value they attribute to mathematics should be fostered in order to promote strategic learning in mathematics. Moreover, emphasis on learning, mastery and understanding, but not on beating others, can also foster students' enjoyment of learning. Students' enjoyment of learning is, in turn, associated not only with self-regulatory strategy use but also with students' interest, motivation, reported current and future engagement (e.g. Ainley & Ainley, 2011; Pekrun et al., 2002b), learning retention and lower dropout rates (e.g. Lee & Choi, 2013). Future research should replicate these findings through multiple methods and in various ages and cultural contexts.

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