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Self-regulatory teaching in mathematics: relations to teachers' motivation, affect and professional commitment

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Abstract The purpose of this study was to examine the relationships between teachers' reports on self-regulatory strategy use in mathematics instruction and individual motivational and affective factors. Two hundred and ninety-two Greek primary school teachers responded to two questionnaires assessing (a) the strategies they use themselves to plan, monitor and evaluate mathematics instruction and (b) the strategies they use to activate and enhance students' self-regulated learning in mathematics. Path analysis showed that teachers' self-regulation strategies both for their own teaching and for enhancing students' self-regulation in mathematics were predicted by their self-efficacy beliefs in teaching mathematics, the value they attribute to mathematics and their emotional commitment to their profession. Teachers' enjoyment of mathematics teaching did not directly predict their reported use of self-regulatory instructional strategies. The implications of the study are related to the development of teachers' training programmes in self-regulated instruction.

Keywords Teachers' self-regulation · Strategic teaching · Teaching self-efficacy · Value of mathematics · Enjoyment of teaching · Professional commitment

Introduction

Research on self-regulation has focused on the individual's capacity to monitor and modify behaviour, cognition and affect and, sometimes, the individual's environment, in order to achieve a goal (Efklides et al. 2002). Zimmerman (2000) stated that self-regulated individuals use a variety of self-regulatory strategies, that is, active processes that involve agency

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and purpose. Strategic action to effectively monitor and regulate behaviour and problem solving processes is considered as an essential component of self-regulated individual and it is critical in educational settings (Alexander et al. 1998; Efklides 2011; Weinstein et al. 2000). Self-regulation and strategic action in education have been mainly investigated with reference to students, although these constructs certainly can be expected to have several implications in relation to teachers and teaching. Thus, there is a growing interest on teachers' self-regulatory processes that support instruction and facilitate students' self-regulated learning (Capa-Aydin et al. 2009; Davis and Gray 2007; De Corte et al. 2011; Delfino et al. 2010; Kramarski and Revach 2009; Tonks and Taboada 2011). It has been claimed that teachers need to use various strategies to self-regulate their instruction in order to maximise their teaching effectiveness and to facilitate students' academic learning and achievement (Andreassen and Braten 2011; Dignath and Buttner 2008; Stoeger and Ziegler 2011; Tonks and Taboada 2011). Teachers' self-regulation can be viewed as active processes through which teachers direct and maintain their metacognition, motivation and strategies for effective instruction (see also Hartman 2001; Manning and Payne 1996).

The present study aimed at examining the relationships between the self-regulatory strategies and practices that elementary school teachers report using with regard to mathematics teaching and individual motivational and affective factors. Examining such relationships may lead to better understanding of why teachers spontaneously employ specific self-regulatory strategies and practices with regard to instruction and which factors might be critical in enacting such strategies. Mathematics was chosen as the cognitive context needed in order to investigate the above relationships because it is a subject that holds a prominent position in the primary school curriculum. Therefore, mathematics is appropriate for exploring teachers' beliefs regarding the strategies they employ during its teaching. As Tobias and Everson (2000, p. 185) noted "the computation and problem solving in mathematics involve more procedural knowledge than does, for example, vocabulary learning". Finally, mathematics has been chosen because it is associated with individuals' affective reactions such as increased anxiety and fear either in teachers (Haylock 2001) or in students (Jones 2001). Therefore, it is worthwhile to further explore the above relationships with regard to mathematics instruction.

Self-regulatory instructional strategies

According to Zimmerman (2000), self-regulatory processes fall into three cyclical phases, that is, forethought, performance or volitional control and self-reflection. Forethought refers to influential processes that precede efforts to act, such as strategic planning. The second phase, performance or volitional control, involves processes that occur during the person's efforts and affect attention and action, such as attention focusing and self-observation. The third phase, self-reflection, involves processes that occur after performance and influence a person's response to that experience, such as self-evaluation. Strategic action during learning or teaching may fall into this three phase's model. Accordingly, teachers need to prepare their teaching, that is, to set the teaching goals, to plan their actions and to organise instruction and teaching material. At the second phase, during instruction, teachers have to monitor students' understanding, identifying and resolving misconceptions but they also have to monitor their own instructional efforts and activities. Finally, after the instruction, teachers need to evaluate the effectiveness of their instruction and the teaching strategies employed, to reflect on them but also to evaluate their students' understanding and progress.

Extending Hartman's (2001) theoretical distinction between teaching with metacognition and teaching for metacognition, one could assume a similar distinction between teaching

with self-regulation and teaching *for* self-regulation as a broader construct that includes metacognitive processes. Teaching *with* self-regulation means that teachers need to self-regulate their instruction before, during and after conducting lessons in order to enhance the effectiveness of their teaching. Research has shown that effective teachers conduct lessons with advance planning of their teaching, they monitor their instruction and they take time for reflection, self-evaluation and revision of their teaching practices (Hartman 2001; Kramarski and Revach 2009; Porter and Brophy 1998).

Teachers should also give students the tools they need to keep up with learning demands themselves. Teaching *for* self-regulation means that teachers activate or provide instruction on effective strategies in order to get the students able to plan their learning activities, to monitor the learning process and to evaluate themselves after dealing with a task. Through self-regulatory strategies, students are empowered to take control of their own learning, allowing their performance to match their potential. Pressley and Hilden (2006) reported that the most striking academic effects have been obtained when students are taught using a repertoire of strategies in a self-regulated fashion (see also Alexander et al. 1998; Fuchs et al. 2003).

To conclude, both teaching with and teaching for self-regulation are needed in order to improve instructional quality and classroom communication, and facilitate teachers' and students' effective performance outcomes. In this study, two different categories of teachers' strategic activity were investigated, i.e., strategies for teachers' self-regulation and strategies for enhancing students' self-regulation, which presumably correspond to the distinction above. These two groups of strategies were examined in conjunction with important motivational and affective constructs that are associated with self-regulation and strategic activity in educational environments. These associations are described in the following section.

Motivational and affective determinants of teachers' self-regulatory strategies

Research showed that motivational and affective factors, such as the students'/teachers' self-efficacy beliefs, the value they attribute to a domain, the feelings of enjoyment when dealing with a task and the emotional commitment to a job, can be predictors of the person's strategic behaviour towards learning/instruction.

Self-efficacy beliefs Zimmerman (2000) proposed that self-regulated individuals not only use a variety of self-regulatory strategies but they also believe they can perform efficaciously. Moreover, Wigfield and Eccles (2001) noted that a variety of models of self-regulation include competence or efficacy beliefs as crucial influences on self-regulation. Positive self-efficacy is believed to activate self-regulation processes during all the three phases of self-regulation, that is, forethought, performance and self-evaluation based on reflection (Schunk and Ertmer 2000). In the school context, teachers' self-efficacy is teachers' belief in their ability to organise and execute the courses of action required to successfully accomplish a teaching task in a particular context (Bandura 1986; Tschannen-Moran et al. 1998). It has been proposed that teachers' self-efficacy beliefs play a very important role in the educational process (Knoblauch and Woolfolk Hoy 2008). Teachers' self-efficacy beliefs can function with a circular way, that is, higher teacher self-efficacy beliefs appear to lead to higher motivation, greater effort, resilience and persistence, which usually results in improved instruction (Tschannen-Moran et al. 1998; Yost 2002).

Recent studies have shown that teaching self-efficacy beliefs were significantly correlated with teacher self-regulation (Capa-Aydin, et al. 2009; Ghonsooly and Ghanizadeh 2011). A consistent relationship between teacher efficacy beliefs and classroom instructional

strategies has been indicated (e.g. Wertheim and Leyser 2002; Swars 2005). Researchers have claimed that teachers holding positive self-efficacy beliefs regarding their teaching abilities are more likely to use strategies for achieving their own objectives and for supporting their students' learning. Positive teaching self-efficacy beliefs are associated with greater levels of teachers' planning and organisation, with spending more time on student learning and with supporting students in their goals (Allinder 1994; Bandura 1993; Zimmerman 2000). Teachers with positive self-efficacy beliefs tend to employ instructional strategies that favour academic self-directedness and open-ended problem solving (Mulholland and Wallace 2001). Furthermore, it has been reported that teachers with higher levels of self-efficacy beliefs are more likely to learn and use new approaches and strategies for teaching, set attainable goals, use management techniques that enhance student autonomy and persist in face of student failure (Hami et al. 1996; Ross 1998). To conclude, positive teaching self-efficacy beliefs activate effective, self-regulatory strategic approach of instruction.

Value of mathematics Moreover, the present study examined the relationship between the value that teachers attribute to mathematics teaching and their reported use of self-regulatory strategies with regard to mathematics teaching. In this study, the conception of value was similar to the attainment value, one component of task value theory outlined by Eccles et al. (1983) that was defined as the personal importance of doing well on a task, in our case, in mathematics instruction. Previous research, conducted mainly with students, has pointed out that task value was a good predictor of both cognitive and regulatory strategy use (e.g. Wolters and Pintrich 1998). 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 et al. 1994). With regard to teachers, studies have reported links between pre-service teachers' value for learning strategy instruction and their own degree of strategy use and self-regulation (Bembenutty 2007; Hamman 1998) and between task value and reported self-regulation strategies (Arsal 2010). Therefore, based on previous literature, it seems reasonable to assume that teachers' value beliefs regarding teaching should affect their use of self-regulatory instructional strategies.

Enjoyment of mathematics Furthermore, this study investigated the relationships between teachers' feelings of enjoyment regarding mathematics instruction and their reported use of self-regulatory strategies in mathematics. To find a work enjoyable often means that the work itself captures our attention and willingness to be involved and engages us in activities that are challenging enough and they reward us with satisfaction and pleasure as they unfold (Pekrun et al. 2002; Schallert et al. 2004). Enjoyable work is a reward in its own, not dependent on extrinsic incentives. In the past, it has been reported that learners' positive emotions such as enjoyment facilitate the adoption of flexible strategies for learning and self-regulation (Pekrun et al. 2002). Teachers' feelings of enjoyment might also play a crucial role in their instructional effectiveness, as it is often assumed that "happier teachers are better teachers" (Hean and Garrett 2001). It has been shown that teachers' enjoyment and enthusiasm for teaching mathematics directly affected their instructional behaviours regarding mathematics, such as using monitoring and students' cognitive autonomy support (Kunter, et al. 2008). Moreover, past studies have reported that teachers with positive attitudes and affect, such as liking, enjoyment and enthusiasm for the teaching of mathematics, might incorporate instructional methods and representations that encourage student independence (Karp 1991).

Professional commitment Finally, teachers' emotional commitment to their profession has been also examined in the present study as expressed by statements of pride and enthusiasm

for being a teacher and by the importance attributed to their profession. Professional commitment has been found to be a significant predictor of teaching achievements and of teacher reported burnout (Louis 1998; Tsui and Cheng 1999). Previous studies have reported links between teachers' commitment to their profession and teaching practices (Bernhardt 2012). It has been shown that teachers highly engaged in their profession provided higher level of cognitive activation in mathematics lessons, their instruction and the tasks set were more cognitively demanding and they provided more student personal support, as rated by their students (Klusmann et al. 2008). That is, engaged teachers had the most favourable ratings in instructional performance that predicted the quality of their instruction in mathematics. Moreover, as depicted in previous paragraphs, teachers' beliefs, attitudes and positive affect towards teaching directly influence their instructional behaviours and teaching effectiveness and they impact on how well teachers take on any new initiative (Hean and Garrett 2001; Helmer et al. 2011).

Relations between determinants of self-regulatory strategy use Regarding the relationships between determinants of teachers' use of self-regulatory strategies, according to both the Eccles et al. model (1983) and Bandura's (1986) self-efficacy theory, competence-related self-perceptions can influence the development of task value. It has been demonstrated that, particularly in the achievement domain, children who believe to be less competent in many activities tend to value less those activities (Anderman et al. 2001; Chatzistamatiou et al. 2013; Wigfield and Eccles 2000; Wigfield et al. 1997). Based on respective theory and results regarding students, we assumed that the same relationship will hold for teachers.

Furthermore, a number of studies have shown that teachers' beliefs of personal confidence and efficacy are associated with greater enjoyment of teaching, reported enthusiasm, job satisfaction and job commitment (Klassen and Chiu 2010; Skaalvik and Skaalvik 2007; Tschannen-Moran and Woolfolk Hoy 2001). Teachers high in self-efficacy beliefs appear to be more enthusiastic about teaching, they experience higher levels of job satisfaction and are more likely to stay in teaching (Caprara et al. 2003). In addition, it has been illustrated that teachers' strong beliefs about their own competence at work fostered enjoying experiences over time (Salanova et al. 2006). It is theoretically plausible that teachers who feel self-efficacious tend also to get more pleasure from their teaching role and to feel more committed to their profession.

Finally, a relationship between the value individuals attach to various tasks and the kinds of affective experiences they have with these tasks has also been pointed out in the past (Eccles et al. 1983; Pekrun 2006). Individuals tend to engage in tasks that they positively value. This engagement in turn may lead to feelings of enjoyment.

The present study

In the present study, two different categories of self-regulatory strategy use regarding mathematics instruction were examined via reports of elementary school teachers. The participant teachers were asked to respond on the following: (a) how frequently they use themselves a series of self-regulatory strategies and practices in order to prepare, implement and reflect on mathematics instruction, that is, teaching with self-regulation. These strategic activities will be henceforth called strategies for teachers' self-regulation (STSR); (b) how frequently they enact strategies and practices that promote and enhance their students' self-regulated learning, that is, teaching for self-regulation. These strategic activities will be

henceforth called strategies for enhancing students' self-regulation (SSSR). The contribution of the present study lies in focusing on the relationships between both teaching with self-regulation and teaching for students' self-regulation and important individual determinants, such as self-efficacy beliefs in teaching mathematics, the value teachers attribute to mathematics as a knowledge domain, their reported enjoyment of dealing with mathematics instruction and emotional commitment to their profession.

Specifically, the aim of the study was to examine the relationships between teachers' reports for self-regulatory strategy use regarding mathematics instruction and the following correlates: their self-efficacy beliefs in teaching mathematics, the value they attribute to mathematics as a knowledge domain, their reported enjoyment of dealing with mathematics instruction and emotional commitment to their profession. Although teaching self-efficacy beliefs have been associated with strategic teaching, their relationship with the above-mentioned two distinct categories of self-regulatory teaching has not been thoroughly investigated. Further, there is limited evidence on the relationship of the two categories of self-regulatory teaching strategies with the rest of the examined motivational and affective determinants, that is, the value teachers attribute to mathematics teaching, the feelings of enjoyment with regard to mathematics instruction and teachers' emotional commitment to their profession.

Following research evidence presented above, the hypotheses of the study were stated as follows. The teachers' reported use of both groups of self-regulatory strategies should be predicted by their self-efficacy beliefs in mathematics teaching (hypothesis 1), by the value they attribute to mathematics (hypothesis 2), by the reported enjoyment of mathematics instruction (hypothesis 3) and by teachers' emotional commitment to their profession (hypothesis 4). It was not possible to state hypotheses for the two different groups of strategic action separately because of lack of relevant data.

Method

Participants

Participants were 292 elementary school teachers from 90 different state schools located at three medium-sized towns in Greece. The teachers were teaching mathematics in all the six grades of the elementary school and they were about equally distributed along the six grades. In Greece, there are "general" teachers in the elementary school teaching the core subjects of the curriculum (i.e. Greek Language, Mathematics, Physics, etc.). Concerning the gender of the participant teachers, 56.8 % were females (166 teachers) and 43.2 % were males (126 teachers). Their teaching experience ranged from 1 to 34 years (M=13.28) and their mean age was 42 years.

Instruments

Strategies for teachers' self-regulation In order to assess the self-regulatory strategies that elementary school teachers report using to prepare, implement and evaluate the instruction of mathematics, a new scale was developed by the authors based on the work of Hartman (2001) and Mevarech and Kramarski (1997). The questionnaire's internal consistency and structural validity were previously tested in a pilot study. In total, there were 11 items. The participants reported the frequency of employing each strategy described on a Likert-type answer scale from 1 = never to 5 = always.

Regarding the structure of the questionnaire, principal component factor analysis using oblimin rotation revealed two factors with eigenvalue >1 explaining 41.45 % of the variance. The first factor (seven items, Cronbach's α=.73) was named Planning Mathematics Instruction and Evaluating Goals and it reflected the phase of class preparation before teaching (e.g. "During planning mathematics instruction, I clearly state to myself the objectives of teaching mathematics, e.g. what students need to have learnt at the end of the lesson or which skills they need to practice.") as well as if the teaching goals have been accomplished (e.g. "After maths instruction, I evaluate students' knowledge and skills"). The second factor was named Monitoring Instruction and Reflecting (four items, Cronbach's α=.60) and it mainly included practices that teachers use to monitor the course of their instruction in order to be effective (e.g. "I monitor myself during maths instruction pointing out my strengths and weaknesses as a teacher") as well as enactment of further self-reflection with reference to their teaching.

Strategies for students' self-regulation Enactment of strategies to enhance students' self-regulated learning in mathematics was assessed by means of a 13-item questionnaire developed for the purposes of the present study and based on the work of Hartman (2001) and Mevarech and Kramarski (1997). The questionnaire's internal consistency and structural validity were previously tested in a pilot study (authors 2009). Teachers were asked to report on a Likert-type scale, from 1 = never to 5 = always, how frequently they employ the specific strategies during mathematics teaching in order to activate and enhance their students' self-regulated learning. Principal component factor analysis using oblimin rotation suggested three factors with eigenvalue >1 explaining 52.50 % of the variance. The first factor was named Deep Understanding of the task and Forethought (four items, Cronbach's α=.67, e.g. "I ask students to plan their steps of action in order to attain a goal in maths, e.g. in order to learn a concept in maths or to solve a problem"). The second factor was called Encouraging Metacognition and Reflecting (five items, Cronbach's α=.76, e.g. "After finishing studying, I encourage students to consider if they have learnt what they wanted to learn"). Finally, the third factor was called Solution Evaluation (four items, Cronbach's α=.65, e.g. "I ask students to check the correctness of their answers or the solution produced for a mathematical problem").

Self-efficacy beliefs in teaching mathematics This scale was also developed for the purposes of this study in order to assess teaching self-efficacy beliefs with regard to mathematics. The items were based on the work of Bandura (1986), Woolfolk and Hoy (1993) and Tschannen-Moran and Woolfolk Hoy (2001). In total, there were nine items (Cronbach's α=.87) with a focus on mathematics. Answers were given on a Likert-type scale from 1 = I strongly disagree to 5 = I strongly agree. An example item is: "I believe I can accurately estimate students' comprehension of what I have taught in mathematics." Principal component factor analysis using oblimin rotation revealed one factor explaining 48.61 % of the variance.

Value of mathematics Three items were used to assess teachers' beliefs about the importance of mathematics as a school subject (Cronbach's α=.73). These items were adapted from Ames (1983). Answers were given on a Likert-type scale from 1 = not at all important to 5 = totally important. An example item is: "In comparison to the various school subjects, mathematics is…."

Teachers' enjoyment of teaching mathematics The participant teachers were asked to report their liking and enjoyment of mathematics teaching. The scale was originally based on Price and Mueller (1981) and the statements were adapted with a focus on mathematics teaching.

There were three items (Cronbach's α=.93). Answers were given on a Likert-type scale from 1 = I strongly disagree to 5 = I strongly agree. An example item is: "I enjoy teaching mathematics."

Teachers' professional commitment To investigate teachers' emotional commitment to their profession, the three positively stated items of the scale "Emotional commitment" from the Professional Commitment Questionnaire of (Meyer et al. 1993) were employed (three items, Cronbach's α=.61, e.g. "I am proud of being a teacher", "I am enthusiastic with my job as a teacher", "Teaching is important to my self-image"). Teachers were asked to report on a Likert-type scale, from 1 = I strongly disagree to 5 = I strongly agree, how committed they are to their profession.

Procedure

The participant teachers were approached during school intervals after the consent of the director of each school had been ensured. They completed the questionnaires during school intervals or at home. The return rate of completed questionnaires that were filled in at home was about 85 %. For the purposes of the study, a license was granted by the Greek Ministry of Education.

Results

The descriptive statistics (means and standard deviations) and Pearson's *r* correlation coefficients among the variables of the study are presented in Table 1.

Table 1 shows moderate to weak correlations, though statistically significant, between teachers' reported use of self-regulatory strategies and the motivational and affective variables examined. Inspection of correlation coefficients reveals that reported employment of strategies for teachers' self-regulation was more closely associated to teachers' motivation and affect in comparison to strategies for enhancing students' self-regulation. More specifically, the first factor of the STSR, that is, employment of strategies for planning instruction and evaluating attainment of teaching goals, was significantly and positively related to teachers' self-efficacy beliefs, value attributed to mathematics, reported enjoyment of mathematics teaching and commitment to teaching profession ($.27<r<.45$). Furthermore, teaching self-efficacy beliefs correlated stronger with both groups of the reported use of self-regulatory strategies in comparison to the rest motivational and affective variables. Finally, teachers' reported enjoyment of teaching mathematics has been significantly and positively correlated to their teaching self-efficacy beliefs (r=.44) and to the value teachers attribute to mathematics (r=.39).

Path analysis was performed on the data in order to test the network of relationships between the variables of the study. In the model tested, two latent first-order factors were assumed. One factor represented teachers' self-regulatory teaching (STSR) and it accounted for the variance of two composite mean scores reflecting the factors emerged from the exploratory factor analysis of the STSR. The second latent factor represented strategies for the development of students' self-regulated learning (SSSR) and it accounted for the variance of three composite mean scores reflecting the factors emerged from the exploratory factor analysis of the SSSR. These two latent factors were the dependent variables based on previous literature showing that teachers' strategic teaching and support of students' self-regulated learning might be dependent on teaching self-efficacy beliefs, the value teachers

Table 1 Descriptive statistics and Pearson's *r* correlation coefficients among the variables of the study

	Mean	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Planning Instruction and Evaluating Goals (STSR)	4.53	.38	–								
2. Monitoring Instruction and Reflecting (STSR)	4.14	.55	.48**	–							
3. Deep Task Understanding and Forethought (SSSR)	4.20	.57	.46**	.40**	–						
4. Encouraging Metacognition and Reflecting (SSSR)	3.70	.67	.37**	.43**	.47**	–					
5. Solution Evaluation (SSSR)	4.20	.55	.44**	.39**	.45**	.48**	–				
6. Teaching self-efficacy	3.95	.51	.45**	.28**	.32**	.36**	.28**	–			
7. Value of mathematics teaching	4.46	.51	.28**	.25**	.25**	.21**	.21**	.29**	–		
8. Enjoyment of mathematics teaching	4.23	.72	.30**	.18**	.21**	.21**	.19**	.44**	.39**	–	
9. Professional commitment	4.35	.66	.27**	.25**	.17**	.20**	.14*	.26**	.21**	.12*	–

STSR strategies for teachers' self-regulation, *SSSR* strategies for students' self-regulation

*$p<.05$; **$p<.01$

attribute to a learning domain, the enjoyment they experience with regard to instruction and the commitment to their profession (Fig. 1).

Path analysis was conducted using the EQS (Structural Equation Modeling Software) Version 6.1 for Windows statistical program (Bentler 1993) and the maximum likelihood method (Hu and Bentler 1999). Figure 1 presents the results of path analysis conducted between the variables of the study. The fit indices of the model tested were $x^2_{(15)}=20.561$, $p=.151$, BBNFI=.968, BBNNFI=.978, CFI=.991, SRMR=.024, and RMSEA=.036, and they show a very good fit of this model. In Fig. 1, it is depicted that both categories of the reported strategy use were directly predicted by the teachers' self-efficacy beliefs, their emotional commitment to their profession as well as the value they attribute to mathematics as a subject domain. Self-efficacy beliefs in teaching mathematics explained the larger part of the variance of the dependent variables. Teachers' enjoyment of mathematics teaching was not significantly associated to their reported employment of self-regulatory teaching strategies.

Discussion

This study examined teachers' reported teaching with self-regulation (STSR) and for enhancing students' self-regulation (SSSR) with reference to elementary school mathematics. The aim was to examine the relationships between these two categories of self-regulatory

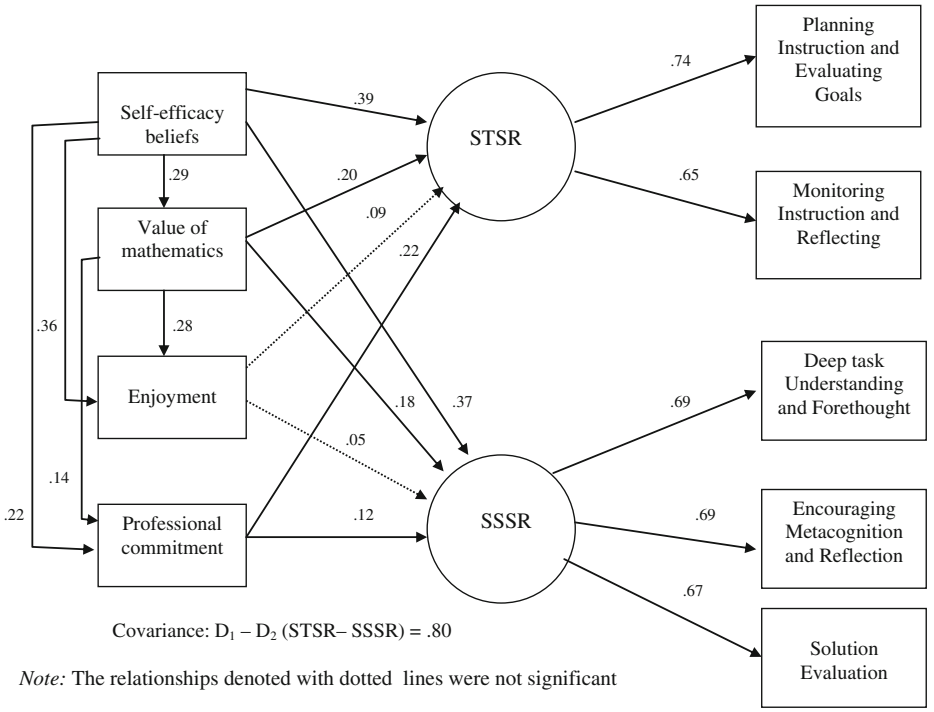

Fig. 1 Path analysis among the variables of the study (standardised values)

strategies and teachers' individual motivational and affective correlates. Path analysis showed that teachers' motivational beliefs, affect and professional commitment directly predicted their use of self-regulatory instructional strategies in mathematics. Specifically, path analysis confirmed hypotheses 1, 2 and 4 stating that teachers' reported use of both groups of self-regulatory strategies should be predicted by their self-efficacy beliefs in mathematics teaching (hypothesis 1), by the value they attribute to mathematics (hypothesis 2) and by teachers' emotional commitment to their profession (hypothesis 4).

All in all, the findings are in line with past research. Regarding teaching self-efficacy beliefs, many studies have shown that teachers confident in their teaching abilities are more likely to use strategies for achieving teaching objectives (Bandura 1993), to use effective instructional practices, to try out various strategies that help them set realistic goals, to self-regulate instruction and to persist in their attainments (Capa-Aydin et al. 2009; Ghonsooly and Ghanizadeh 2011; Mulholland and Wallace 2001; Wertheim and Leyser 2002; Swars 2005). Moreover, teachers confident in their instructional abilities are more likely to use inquiry and student-centred teaching strategies, to support students in their goals (Bandura 1993) and to promote learning by providing their students with metacognitive strategies for monitoring and improving their own learning efforts and with structured opportunities for independent learning activities (Hartman 2001; Ross 1998). Teaching self-efficacy beliefs seem to be an important motivator for inducing both teaching with and teaching for self-regulation.

This study also showed that, with reference to this group of participant teachers, teachers that valued highly mathematics teaching also reported higher levels of self-regulating mathematics instruction and of promoting students' self-regulated learning. Previous studies

have also reported links between teachers' task value and degree of teacher strategy use and self-regulation (Arsal 2010; Bembenutty 2007; Hamman 1998). Furthermore, this study showed that teachers' emotional commitment to their profession positively predicted their reported use of STSR of instruction. Significant direct, though weak, associations between teachers' commitment and their reported use of SSSR were also noticed. Previous research proposed that professional commitment is a significant predictor of teaching achievements and significant links between teachers' commitment to their profession and teaching practices have been reported (Bernhardt 2012). Mathematics teachers highly engaged in their profession were rated highly by their students regarding their instructional performance, such as level of cognitive activation in mathematics (Klusmann et al. 2008).

Regarding the relationship between teachers' reported self-regulatory teaching and their enjoyment of mathematics instruction, hypothesis 3 predicting a significant relationship was not confirmed. The direct paths between teachers' enjoyment and self-regulatory teaching were not significant. Although, in general, weak correlations between teachers' enjoyment and self-regulatory teaching were observed, enjoyment of mathematics teaching was moderately correlated to the reported use of Strategies for Planning Instruction and Evaluating Goals (r=.30). Teachers who enjoyed mathematics teaching were more likely to report that they plan mathematics instruction and that they evaluate the attainment of teaching and learning goals. Thus, the present study is in partial agreement with previous claims that teachers' feelings of enjoyment and enthusiasm for teaching might play an important role in their instructional effectiveness (Hean and Garrett 2001; Karp 1991; Kunter et al. 2008). It should be noted, however, that the present study captures only a one time shot of teachers' reported enjoyment and teaching strategies employment. In the future, it may be tested whether teachers' feelings of enjoyment predict strategic teaching in the long term.

Concerning the relationships between the motivational and affective variables examined, path analysis showed that teachers confident in their abilities regarding mathematics teaching were more likely to enjoy mathematics teaching, to attribute higher value to mathematics teaching and to feel committed to their profession, in agreement with previous research (Anderman et al. 2001; Caprara et al. 2003; Klassen and Chiu 2010; Salanova et al. 2006; Wigfield and Eccles 2000). Moreover, in line with past research, value beliefs directly predicted teachers' enjoyment of mathematics teaching and their emotional commitment to their profession (Eccles et al. 1983; Pekrun 2006). This complex interplay of relations among the correlates of self-regulatory strategy use in teachers should be further investigated in other cognitive domains and in other educational settings as well. A similar pattern of relationships between students' self-regulatory strategic activity and individual factors, such as academic self-efficacy, value beliefs and feelings of enjoyment, has been confirmed with reference to elementary school mathematics (Chatzistamatiou et al. 2013).

This study showed that different categories of self-regulatory instructional strategies were somewhat differently related to the above-mentioned individual factors. In general, reports for using STSR were more closely associated to teachers' motivation and affect ($.18<r<.45$) in comparison to their reports for using SSSR ($.14<r<.36$). This finding seems plausible. Individual motivational and affective factors are expected to be associated more closely with strategic activity that teachers implement to themselves in comparison with strategies that they enact to their students. Strategies for Planning Instruction and Evaluating Teaching Goals, that is, the first factor of the STSR questionnaire, had the stronger associations with teachers' motivation, affect and professional commitment ($.27<r<.45$). The higher correlations were observed between teaching self-efficacy beliefs and strategies for Planning Instruction and Evaluating Teaching Goals (r=.45), and between teaching self-efficacy beliefs and the second factor of SSSR, i.e., Encouraging Students' Metacognition and

Reflecting (r=.36). Future research should further define which types of self-regulatory instructional strategies are consistently connected to teachers' motivation and affect, whether this relationship is dependent on the subject domain, on the educational context, what other individual and external factors might be involved in this relationship, etc.

A limitation of this study is that teachers' strategy use was assessed via self-report questionnaires. The study examined teachers' subjective beliefs and not the actual use of strategies within the classroom setting. Future research could link teacher' reports to their actual teaching practices and/or to students' responses via more objective measures of their strategic activity. These findings could be replicated with multi-method research designs. Moreover, the relationships examined focused on the mathematics domain and they were examined within a specific educational system. Future studies could examine the network of relations with reference to other subjects domains and within different educational settings as well.

To conclude, the present study focused on self-regulatory teaching of mathematics and on its relations to teachers' motivation, affect and professional commitment. Teaching with self-regulation and teaching for self-regulation are important aspects of effortful and effective teaching and this study takes into account these dimensions. To our view, this study contributed to the self-regulation literature in that it provided data on the interplay between different categories of self-regulatory instructional practices that teachers report enacting with regard to mathematics and teachers' individual motivational and affective factors. Teaching self-efficacy was an important individual factor that directly predicted both teaching with and teaching for self-regulation in mathematics and the rest of individual factors as well. Furthermore, the value teachers attribute to mathematics and also the commitment to their profession might also play their role in employing self-regulatory instructional strategies with regard to mathematics teaching. The study underlined that different categories of self-regulatory instructional strategies should be studied separately and should be included in teacher education and professional development (see also Kramarski and Revach 2009). Besides, teachers' training programmes in self-regulatory teaching or in metacognitive teaching report promising results both for themselves as effective teachers and for their students as self-regulated learners (Manning and Payne 1996; Mevarech and Kramarski 1997). Future research should further identify the individual and environmental correlates that predict teachers' choices of self-regulatory strategic action with regard to mathematics and with regard to other school subjects as well.

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Metacognition and self-regulation. Academic self-efficacy. Enjoyment of teaching and learning. Professional commitment.

Most relevant publications in the field of Psychology of Education:

Chatzistamatiou, M. & Dermitzaki, I. (2009, November). Elementary students' and teachers' reports of strategic behavior in mathematics: How close are they? Proceedings of the *International Conference of Education, Research and Innovation* (ICERI 2009). Madrid, Spain.
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Investigating the metacognitive processes and self-regulation in the school context, academic self-concept, achievement goals, and the effects of the interplay of cognitive, metacognitive, and motivational factors on student learning and achievement.

Most relevant publications in the field of Psychology of Education:

Chatzistamatiou, M., Dermitzaki, I., Efklides, A., & Leondari, A. (2013). Motivational and affective determinants of self-regulatory strategy use in elementary school mathematics. *Educational Psychology.* doi:10.1080/01443410.2013.822960
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Current themes of research:

Fields of specialization focuses in statistical researches including Data Analysis or any other statistical methods. Major research interests concentrate mainly on medical data.