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Effects of Increased Self-Regulated Learning Opportunities on Student Teachers' Motivation and Use of Metacognitive Skills

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Abstract: This intervention study focused on the relationships between primary student teachers' self-regulated learning (SRL) opportunities, their motivation for learning and their use of metacognitive learning strategies. The participants were 3 teacher educators and 136 first-year student teachers. During one semester, teacher educators and student teachers were monitored by questionnaires measuring opportunities for SRL offered by the program. Questionnaires were also administered monitoring student teachers' motivation and metacognition. During data collection, teacher educators participated in training courses and tutorial conversations aimed at increasing student teachers' SRL opportunities in the curriculum. At the end of the research period, all teacher educators and a sample of student teachers were interviewed. Results indicate that student teachers' use of metacognitive skills increased significantly in learning environments with increased SRL opportunities. Student teachers' motivation for learning was also enhanced, although to a lesser degree. Finally, significant correlations were found between the metacognitive study process construct and the motivational constructs measured.

Introduction

The motivation for this intervention study of self-regulated learning (SRL) in the context of primary teacher education emerged from the importance attributed to SRL for student teachers' academic success (e.g. Boekaerts, 1999). The study is aimed at examining relationships between primary student teachers' (i.e., prospective primary teachers) SRL opportunities, their use of metacognitive skills and their motivation for learning. Metacognition and motivation and were analysed because of their relevancy in determining student teachers' academic success. In the case of motivation, several researchers (e.g. Pintrich, 2000, 2004) demonstrate that higher motivation results in higher academic achievement. When it comes to metacognition, many studies (e.g. Vermunt & Verloop, 1999) show that student teachers' use of metacognitive skills can improve their learning and comprehension, finally resulting in better academic performance. As for the relatedness

between student' motivation and use of metacognitive learning strategies, these components must be conceived as interacting constructs in research regarding SRL (e.g. Eccles & Wigfield, 2002).

Self-Regulated Learning and Primary Teacher Education

In a society that requires lifelong learning, the ability to steer one's own learning is becoming more and more important to be successful in academic as well as in non-academic contexts (e.g. Kremer-Hayon & Tillema, 1999; Zimmerman, 2002). For that reason, contemporary curricula are increasingly based on social constructivist learning theories in which students' learning activities are more controlled by students themselves compared to more traditional curricula in which students are provided with direct instructional guidance on the concepts and procedures required by a particular discipline (Kremer-Hayon & Tillema, 1999; Lunenberg & Korthagen, 2003).

One of the shared assumptions of social constructivist learning theories is the importance of SRL as the key to successful learning in school and beyond (Boekaerts, 1999). In general, SRL is defined as a goal-oriented process, proceeding from a forethought phase through self-monitoring and self-control to self-reflection (Pintrich, 2000, 2004). Many researchers (e.g. Simons, Van der Linden, & Duffy, 2000; Zimmerman, 2002) stress the importance of SRL to foster students' deep and meaningful learning, resulting in significant gains in student achievement. Self-regulating students in higher education are more successful in learning, problem solving, transfer and academic achievement in general (e.g. Nota, Soresi, & Zimmerman, 2004; Sundre & Kitsantas, 2004). This may also be the case with students in teacher education. As a consequence, primary teacher educators (i.e., teachers of prospective primary teachers) are increasingly urged to renew their teaching concepts to encourage student teachers to demonstrate a high degree of SRL by learning as professionals, constructing their practical knowledge, developing an attitude of reflective inquiry and experimenting with ideas and teaching skills (Kremer-Hayon & Tillema, 1999).

The SRL Model for Primary Teacher Education

Although primary teacher educators support the importance of the idea of SRL, they often find it difficult to actually foster it in educational pre-service programs (Vrieling, Bastiaens, & Stijnen, 2010). Many practising teacher educators have not been prepared for this changing role during their own education (Korthagen, Klaassen, & Russell, 2000) and are often worried about their decreasing role as knowledge providers (Kremer-Hayon & Tillema, 1999). To provide more insight for primary teacher educators into relevant SRL aspects during teaching, Vrieling et al. (2010) formulated seven process-oriented design principles, summarized in an SRL model for primary teacher education.

The first principle of the SRL model suggests that teacher educators should create a sufficient knowledge base for their students. To do this, teacher educators should integrate the necessary metacognitive skills and content matter into their teaching, comprising the second design principle. As part of the third principle, this integration should be modelled upon the following four regulatory skill levels: observation, emulation, self-control and self-regulation. In the fourth principle, control of the learning processes should gradually transfer from teacher to student ('scaffolding'). The fifth principle moves past successful knowledge building to encompass knowledge of the conditional factors that can foster or hinder successful implementation. The sixth principle stresses the engagement of student teachers in collaborative learning environments. Finally, the seventh SRL design principle explores the

relevant aspects of the learning task (goal setting, prior knowledge activation, metacognitive knowledge activation, metacognitive awareness and monitoring of cognition, judgments, attributions, task value activation and time management). Based on the recommendations of the SRL model, Vrieling et al. (accepted) operationalized the theory towards a diagnostic instrument that enables primary teacher educators to assess SRL opportunities in their teaching: the SRL Opportunities Questionnaire (SRLOQ). The SRLOQ is further described below.

Problem Definition

Although primary student teachers are increasingly required to self-regulate their' learning, the consequences of the increased SRL opportunities for student teachers' academic success have not been measured so far. Therefore, in the present study, dynamics of primary student teachers' motivation for learning and use of metacognitive learning strategies were measured in learning environments with increased SRL opportunities. These two concepts were chosen because of their relevancy in determining student teachers' academic success and are discussed hereafter.

Several researchers (e.g. Bruinsma, 2004; Pintrich, 2000, 2004) demonstrate that higher motivation results in higher academic achievement. Motivation can be seen as either a product or a process (Wolters, 2003). When viewed as a product, students have a level of motivation that they experience and that influences their choice, effort and persistence regarding a particular activity. When viewed as a process, motivation refers not just to an end state but also to the means through which that state is determined. In other words, motivational tendencies change during learning in classroom practice (Järvelä, Järvenoja, & Veermans, 2008) and students can learn to regulate their motivational state (Wolters, 2003).

At the same time, self-regulated learners are able to apply a large arsenal of cognitive learning strategies in academic tasks. Pintrich (2000, 2004), for example, distinguishes rehearsal, organization, and elaboration as cognitive learning strategies to understand the material in the course. Moreover, when it comes to the metacognitive concept that can be viewed as a subordinate component to SRL (Muis & Franco, 2010; Veenman, Van Hout-Wolters, & Afflerbach, 2006), its role is generally acknowledged as critical in constructivist views of learning (e.g. Butler, 2002; Efklides, 2006). Metacognition can be defined as the knowledge about and the regulation of one's cognitive activities in learning processes (Veenman et al., 2006) and is positively related to students' academic performances (e.g. Pintrich & De Groot, 1990; Vermunt & Verloop, 1999). It represents "the awareness learners have about their general academic strengths and weaknesses, cognitive resources they can apply to meet the demands of particular tasks, and their knowledge about how to regulate engagements in tasks to optimize learning processes and outcomes" (Winne & Perry, 2000, p. 533).

Many researchers report that metacognitive and motivational variables are positively related (e.g. Bruinsma, 2004; Pintrich, 2000, 2004). In other words, more motivated students are more likely to use a variety of cognitive and metacognitive strategies and are more effective in their effort regulation. Berger and Karabenick (2011) also found evidence for the relatedness between student' motivation and use of learning strategies. More specifically, their research shows no reciprocal, but unidirectional effects between the two constructs: motivation predicts the use of learning strategies, but the use of learning strategies does not predict motivation.

In the present study, the motivational and metacognitive concepts were investigated because of their relevancy for student teachers' academic achievement. Learning

environments were created in which teacher educators were expected to increase student teachers' SRL opportunities. In these learning conditions, the following research questions were studied:

To what extent can teacher educators increase student teachers' SRL opportunities in learning programs?

- In what way does student teachers' use of metacognitive learning strategies change in a learning environment with increased SRL opportunities?
- In what way does student teachers' motivation for learning change in a learning environment with increased SRL opportunities?
- What relationship exists between student teachers' motivation for learning and use of metacognitive learning strategies in a learning environment with increased SRL opportunities?

This article continues with a description of the methods used, containing an explanation of the participants, the research instruments, the procedure, data-collection and -analysis. Then, the results of the study are outlined and conclusions for primary teacher education are discussed. Finally, the limitations of the study and indications for future research are formulated.

Method

Participants

From September 2009 until January 2010, the exploration of the effects of student teachers' increased SRL opportunities on student teachers' motivation for learning and use of metacognitive learning strategies was conducted with 3 teacher educators and 136 first-year (mainly 17-19 year old; average age 17,84 year) student teachers in 2 primary teacher education colleges in the Netherlands. The research was carried out in educational theory courses containing lectures, lessons and moments of guidance. Only teacher educators with a minimum of 10 meetings in the research period and teaching fulltime regular student teachers were allowed to participate. All participating teacher educators volunteered to cooperate.

Instruments

Two instruments were applied in this study: (1) the SRLOQ that enables teacher educators to assess the degree of SRL opportunities they provide to student teachers and (2) the 'Motivation and Metacognition Questionnaire' (MMQ) that measures the level of student teachers' motivation for learning and their use of metacognitive learning strategies. Both instruments are discussed hereafter.

The 'SRL Opportunities Questionnaire'

Student teachers' SRL opportunities were measured by the SRLOQ, developed by Vrieling et al. (accepted). In the scale development phase of the SRLOQ was first determined which principles of the SRL model (see Section 1.2) needed further elaboration towards a diagnostic instrument for classroom practice. The principles concerning collaboration (sixth SRL design principle) and the learning task (seventh SRL design principle) were selected for two reasons: (1) these recommendations are directly related to instructional designs for classroom practice, and (2) by incorporating these recommendations in the SRLOQ, the remaining set of 5 more generic SRL recommendations (knowledge building, integration of

content matter and metacognitive skills, modelling skills, scaffolding, and conditions) are also put in practice by teacher educators in an indirect matter while applying the SRLOQ.

In the second phase of the scale development, the recommendations concerning collaboration and the learning task were operationalized in potentially relevant items of the questionnaire. Based on the literature review of Vrieling et al. (2010) that aimed at formulating SRL design principles for primary teacher education, all selected sources of the literature review concerning collaboration and the learning task were analysed for the operationalization of the SRLOQ. This screening led to the first selection of items that were included in the SRLOQ in analogous versions for student teachers and teacher educators.
In the final phase of the scale development, the selected items were grouped into 5 potentially relevant scales of the SRLOQ: planning, monitoring of the learning process, zone of proximal development, coaching/judging and collaboration.

In de score validation phase, depth interviews with 5 primary student teachers and 4 primary teacher educators were conducted first. Based on qualitative analyses of the interviews, the SRLOQ was adjusted. Then, 62 primary student teachers and 29 primary teacher educators of one primary teacher education institute in the Netherlands completed the SRLOQ. The data of the score validation phase were quantitatively analysed by performing reliability analyses at the level of the scales of the instrument and correlation analyses at the level of the items within the scales of the questionnaire. The analyses confirmed the five scales of the scale development phase. The final SRLOQ consists of 56 items scored on a five-point Likert scale. Student teachers and teacher educators have to indicate to what extent each item is true for them. In Table 1, an example is given for each SRL scale. Table 1 also outlines the number of items and Cronbach's Alpha's for the different scales for the student teacher's (α=0.61-0,86) and the teacher educator's version (α=0,74-0,85) of the questionnaire. In general, these values imply sufficient reliability and homogeneity of items within the scales of the questionnaire.

Scale	Scale example	Number of items	Cronbach's α Version STs	Cronbach's α Version TEs
Planning	The teacher expects me to make a time plan for working on my learning goals	17	α = 0.84	α = 0.85
Monitoring learning process	The teacher expects me to point out in which areas I need feedback	6	α = 0.81	α = 0.74
Zone of proximal development	The manual describes in what way I can prepare myself for the lessons	12	α = 0.84	α = 0.77
Coaching and Judging	The grading of the assignments by the teacher is based on previously formulated criteria	16	α = 0.86	α = 0.81
Collaboration	During collaboration, the teacher pays attention to specific collaboration skills such as dividing tasks and reporting to each other	5	α = 0.61	α = 0.74

Table 1: SRLOQ scales

The 'Motivation and Metacognition Questionnaire'

Student teachers' motivation for learning and use of metacognitive learning strategies were measured by the MMQ, developed for the present study. The 'Motivated Strategies for Learning Questionnaire' (MSLQ, Pintrich, Smith, Garcia, & McKeachie, 1991) was applied as a starting point for developing the MMQ for three reasons: (1) the MSLQ distinguishes a metacognition and a motivation part; (2) the MSLQ focuses on the course level of college students (Duncan & McKeachie, 2005); (3) the MSLQ has been applied and validated at different educational levels, including higher education (Montalvo & Torres, 2004). The

MSLQ was translated into Dutch and validated by Blom and Severiens (2008) in Dutch schools of general secondary higher education and pre-university education.

In the present study, the translated MSLQ by Blom and Severiens and the original MSLQ by Pintrich were screened for differences. In the metacognition part (the items regarding 'metacognitive self-regulation'), the original MSLQ includes 12 items. In the revised MSLQ, however, only 7 items remained. Because these items do not cover all relevant aspects of metacognition for primary teacher education in depth, 3 items of the original MSLQ were re-added to the MMQ. Furthermore, it was noticed that both versions of the MSLQ only measure for the study process. As a consequence, the distinction between study process, study results and study content, as described in the 'Inventory of Learning Styles' (ILS, Vermunt & Van Rijswijk, 1987), was retained in the MMQ to complete the metacognitive scale. Finally, scale analysis led to combining study process and study results into one final study process scale with sufficient values of Cronbach's Alpha (0,76).

It was also noted that the motivation part of the original and translated MSLQ does not distinguish between approach and avoidance goals orientation, but only represents a mastery approach orientation (intrinsic goal orientation) and a performance approach orientation (extrinsic goal orientation). As a result, the mastery-avoidance and performance-avoidance items, as proposed and tested by Elliot and Mc Gregor (2001), were analysed. Their 2x2 achievement goal framework was tested in 3 studies, supporting the independence of the 4 achievement goals constructs. Consequently, the mastery-avoidance and performance-avoidance items of the framework were added to the MMQ to complete the motivation scale.

The final MMQ consists of nine scales. For the metacognition part, two scales were distinguished: study process and study content. The motivation section comprises seven scales: intrinsic goal orientation, extrinsic goal orientation, intrinsic goal avoidance, extrinsic goal avoidance, task value, expectancy, and test anxiety. The final MMQ was completed by 67 student teachers and contains 51 items scored on a five-point Likert scale. Student teachers have to indicate to what extent each item is true for them. In Table 2, an example is given for each scale. Table 2 also shows the number of items and Cronbach's Alpha's of the different scales (α=0,72-0,90). These values imply sufficient reliability and homogeneity of items within the scales of the questionnaire.

Scale	Scale example	Number of items	Cronbach's Alpha
Metacognitive learning strategies			
Study process	When I study for this course, I reflect on questions to keep my mind on the job	14	α = 0.76
Study content	Besides the content of the examination, I also study extra literature related to the course	4	α = 0.82
Motivation			
Intrinsic goal orientation	During this course, I prefer challenging subject material so I can learn new things	3	α = 0.73
Extrinsic goal orientation	I want to do better than the average student	7	α = 0.77
Intrinsic goal avoidance	I worry about not getting the full benefit out of this course	3	α = 0.81
Extrinsic goal avoidance	I only want to avoid doing poorly for this course	3	α = 0.72
Task value	I believe I can apply the subject material of this course in practice	4	α = 0.74
Expectancy	I think that I will get good grades for this course	8	α = 0.90
Test anxiety	I suffer from nerves when I take an exam	5	α = 0.89

Table 2: MMQ scales

Procedure

In order to answer the research questions of the study, intervention research was conducted using a mixed methods pre- and post-test design. No control groups were applied because of the difficulty for teacher educators to differentiate in the level of provided SRL opportunities between their student groups. Table 3 displays the research design of the intervention study. Student teachers' SRL opportunities, motivation for learning and use of metacognitive learning strategies were measured by respectively the SRLOQ and the MMQ. Teacher educators and student teachers were qualitatively tracked by tutorial conversations (teacher educators) and semi-structured interviews (teacher educators and student teachers). These interventions are further explained in Section 2.4.

In this one-group pre- and post-test design, the pre-test (completing both questionnaires) was performed at the end of the third lesson (week 4). At that time, teacher educators and student teachers were expected to be unaware of the increased SRL opportunities that would be applied in the intervention-period and student teachers were expected to be able to indicate their starting level of SRL opportunities. To avoid socially desirable answers, the questionnaires were administered anonymously. By monitoring both teacher educators and student teachers on SRL opportunities rather than teacher educators alone, the statements of both groups could be compared to obtain better interpretable data. After the pre-test, two kinds of treatments were carried out with teacher educators aimed at increasing student teachers' SRL opportunities: (1) training courses after lesson 3 (week 5) and (2) individual tutorial conversations after lesson 4 (week 6). The tutorial conversations were based on analyses of the pre-test.

The intermediate-test (completing the SRLOQ) was performed at the end of the sixth lesson (week 10). Based on analyses of the intermediate-test, tutorial conversations were carried out again after lesson 6 (week 11) aimed at a further increase of student teachers' SRL opportunities. At the end of the last lesson (week 18), the post-test (completing both questionnaires) was conducted. Within five days after the post-test (end of week 18), all teacher educators and a sample of student teachers (3 per teacher educator) were interviewed in depth.

Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Lessons	x	x		x		x	x			x		x				x	x	x
SRLOQ (TEs and STs)				x						x								x
MMQ (STs)				x														x
Course (TEs)					x													
Conversations (TEs)						x					x							
Interviews (TEs and STs)																		x

Table 3: Research design intervention study

Data Collection and Analysis

Student teachers' motivation for learning and their use of metacognitive skills were assessed using quantitative and qualitative methods. Quantitative analyses (correlation analyses, independent-samples t-tests and regression analyses) were based on the data of the pre- and the post-test for all participating teacher educators. The data of the intermediate-test (completing the SRLOQ) were not used for the quantitative analyses because the research period only lasted 10 weeks at that time, a too short period to find preliminary results. However, the data of the intermediate-test provided the necessary input for the second cycle of tutorial conversations with primary teacher educators.

Qualitative analyses were based on the data of the tutorial conversations and the semi-structured interviews. The first cycle of tutorial conversations with teacher educators was

grounded on both teacher educators' SRL planning (a result from the training course) and analyses of the pre-test. The SRLOQ scales (planning, monitoring, zone of proximal development, coaching/judging, collaboration) were the leading themes of the conversations. The concept planning of the teacher educators and analyses of the measured SRL degree as viewed by teacher educators and student teachers, were compared. This comparison resulted in adjusted planning for SRL implementation in classroom practice by teacher educators.

Based on analyses of the intermediate-test, the second cycle of tutorial conversations resulted in adjusted SRL planning for teacher educators. The SRL scales and subscales that could further be improved, as assessed by the SRLOQ, were incorporated in this adjusted planning. In general, the planning aimed at a further increase of student teachers' SRL opportunities in the learning program. In the post-test, all teacher educators and a sample of student teachers (2 per teacher educator) were questioned in semi-structured interviews. The interviews with the student teachers were focused on the way student teachers had experienced the increased SRL opportunities and how these changed learning conditions influenced their motivation for learning and use of metacognitive learning strategies during the research period. The interviews with the teacher educators were based on both teacher educators' SRL planning and analyses of the post-test. The SRL planning of the teacher educators and analyses of the measured SRL degree as viewed by teacher educators and student teachers were compared. The interviews took approximately 45 minutes.

The collected data from questionnaires, tutorial conversations and semi-structured interviews, were analysed and related by triangulation to enhance the internal validity of the results. First, all quantitative and qualitative findings were structured in a matrix containing the scales of the SRLOQ (planning, monitoring of the learning process, zone of proximal development, coaching/judging, collaboration) and the MMQ (metacognition: study process, study content and motivation: intrinsic goal orientation, extrinsic goal orientation, intrinsic goal avoidance, extrinsic goal avoidance, task value, expectancy and test anxiety) and, per scale, all different sources of data collection (analyses pre-, intermediate- and post-test as viewed by teacher educators and student teachers). Second, the content of each category was examined and described for each teacher educator separately. Third, similarities and differences in teacher educators' and student teachers' view of SRL opportunities and the consequences for motivation and metacognition were analysed. For this purpose, patterns in teacher educators' and student teachers' knowledge and beliefs were identified and described. These 'patterns' refer to groups of associated statements that give insight into the similarities and differences in the knowledge and beliefs of the teacher educators and student teachers. Finally, the results of the analysis of the data provided by the different instruments were synthesized in order to gain a deeper level of insight into teacher educators' and student teachers' practical knowledge.

Results

In this section, the four research questions are addressed separately. For each research question, the qualitative and qualitative findings are presented.

To What Extent Can Teacher Educators Increase Student Teachers' SRL Opportunities in Learning Programs?

Table 4 represents student teachers' SRL opportunities, their use of metacognitive skills and their motivation for learning before (pre-test) and after (post-test) the research period for the three participating teacher educators. Because the questionnaires were

administered anonymously, paired-samples t-tests could not be applied to compare the average scores between the pre- and post-test. For that reason, the dynamics in student teachers' SRL opportunities, their use of metacognitive skills and their motivation for learning were analysed by independent-samples t-tests. Since the pre- and post-test samples of the present study are not independent, the independent-samples t-tests were only applied to estimate the significance of the increase of student teachers' SRL, metacognition and motivation. Independent-samples t-tests assume the covariance between the two samples to be zero, which is not the case between our pre- and post-test samples. As a consequence, the estimated significance of the SRL increase is too low and therefore presents minimum values. The degrees of freedom in the independent-samples t-tests varied because the participating student teachers were allowed to skip questions of the questionnaires.

Results of the independent-samples t-tests for SRL and metacognition/motivation

Scale	Points in time	M	SD	t	df	p
SRL opportunities	Pre test	111,48	30,74	3,648	35	0,001*
	Post test	145,50	25,92			
Planning	Pre test	26,87	9,88	4,442	49	0,000*
	Post test	38,00	6,53			
Monitoring of the learning process	Pre test	11,06	5,76	2,864	54	0,006*
	Post test	15,14	4,18			
Zone of proximal development	Pre test	32,35	5,89	1,354	39	0,183
	Post test	34,81	6,74			
Coaching/judging	Pre test	28,88	11,21	4,432	44	0,000*
	Post test	41,60	8,24			
Collaboration	Pre test	13,44	3,71	3,264	45	0,002*
	Post test	16,73	3,72			
Metacognition	Pre test	47,47	7,50	2,566	35	0,015**
	Post test	55,00	10,55			
Motivation	Pre test	103,15	11,73	1,380	25	0,180
	Post test	108,89	10,96			
Expectancy	Pre test	21,84	4,31	2,077	40	0,044**
	Post test	24,87	5,14			

Table 4a: TE 1

* significance: $p < 0.01$
** significance: $p < 0.05$

Scale	Points in time	M	SD	t	df	p
SRL opportunities	Pre test	123,93	28,23	3,497	107	0,001*
	Post test	141,17	24,80			
Planning	Pre test	31,18	8,62	1,808	136	0,073
	Post test	33,64	7,53			
Monitoring of the learning process	Pre test	11,66	4,48	3,587	140	0,000*
	Post test	14,29	4,51			
Zone of proximal development	Pre test	30,12	6,14	4,799	140	0,000*
	Post test	34,62	5,13			
Coaching/judging	Pre test	33,00	10,99	4,743	134	0,000*
	Post test	41,31	8,78			
Collaboration	Pre test	15,21	3,49	5,094	152	0,000*
	Post test	17,88	3,08			
Metacognition	Pre test	48.80	9,69	1,266	134	0,208
	Post test	50,99	11,41			
Motivation	Pre test	107,24	9,90	1,334	112	0,185
	Post test	109,64	10,68			
Expectancy	Pre test	24,45	4,32	2,041	149	0,043**
	Post test	25,83	4,03			

Table 4b: TE 2

* significance: $p < 0.01$
** significance: $p < 0.05$

Scale	Points in time	M	SD	t	df	p
SRL opportunities	Pre test	143,22	34,77	4,128	63	0,000*
	Post test	172,10	16,05			
Planning	Pre test	33,73	11,21	4,262	70	0,000*
	Post test	42,74	4,07			
Monitoring of the learning process	Pre test	15,20	5,19	3,228	75	0,002*
	Post test	18,55	3,35			
Zone of proximal development	Pre test	35,14	6,76	2,365	73	0,021**
	Post test	38,39	4,60			
Coaching/judging	Pre test	41,77	12,37	3,824	67	0,000*
	Post test	51,10	5,72			
Collaboration	Pre test	17,34	3,58	3,868	78	0,000*
	Post test	20,15	2,56			
Metacognition	Pre test	54,17	10,18	2,596	57	0,012**
	Post test	60,55	10,62			
Motivation	Pre test	108,66	9,86	0,319	54	0,751
	Post test	109,47	11,56			
Expectancy	Pre test	26,30	3,52	1,354	49	0,182
	Post test	27,68	4,94			

Table 4c: TE 3

*significance: $p < 0.01$
** significance: $p < 0.05$

Qualitative analyses indicated that teacher educators could distinguish and became more conscious of the five SRL scales. The results of t-tests and qualitative analyses also showed the close connection between the five SRL scales. Although teacher educators often planned to increase SRL opportunities on a selected number of SRL constructs, student teachers' general SRL opportunities increased significantly at the 0,01 significance level for teacher educator 1(t=3,648), teacher educator 2 (t=3,497) and teacher educator 3 (t=4,128). Similarly, all sub-scales within SRL-opportunities increased significantly at the 0,01 level as well. The first exception was the 'Zone of proximal development' scale that increased significantly at the 0,05 significance level (t=2,365) for teacher educator 3 and demonstrated no significant increase for teacher educator 1 (t=1,354). Similarly, the 'Planning' scale of teacher educator 2 did not increase significantly (t=1,808). In short, after being trained, teacher educators are able to increase student teachers' SRL opportunities in pre-service educational learning programs.

In What Way Does Student Teachers' Use Of Metacognitive Learning Strategies Change in a Learning Environment With Increased SRL Opportunities?

The relationships between SRL opportunities, the use of metacognitive skills and motivation for learning were first studied by means of correlational analysis, based on the data of all participating teacher educators (Table 5). Student teachers' SRL opportunities were positively correlated to the use of metacognitive skills at the 0.01 significance level to a strong extent (r = 0,937). The same was true for all separate constructs within SRL opportunities (r varied between 0,837 and 0,959). In addition, qualitative analyses indicated that student teachers were often not aware of their use of metacognitive skills. Moreover, student teachers' need for more explicit metacognitive strategy instruction was identified.

Scale	Metacognition	Motivation	Expectancy
SRL opportunities	0,937*	0,771**	0,881*
Planning	0,913*	0,759**	
Monitoring of the learning process	0,959*	0,756**	
Zone of proximal development	0,870*	0,624	
Coaching/judging	0,933*	0,808*	
Collaboration	0,837*	0,693**	
Metacognition		0,663	
Study process		0,717**	
Study content		0,535	

* **Table 5: Pearson correlation coefficient between SRL and metacognition/motivation**
* significance: p < 0.01
** significance: p < 0.05

Second, independent-samples t-tests were applied to show the statistical significance of metacognitive differences between the pre- and the post-test (Table 4). Student teachers' use of metacognitive learning strategies increased significantly for teacher educator 1 (t=2,556) and teacher educator 3 (t=2,596) at the 0,05 significance level. There was no significant increase of student teachers' use of metacognitive learning strategies for teacher educator 2 between the pre- and post-test (t=1,266). In short, student teachers' use of metacognitive skills was raised to a higher level for two of the three teacher educators after increasing the SRL opportunities in educational pre-service programs.

Finally, regression analyses were performed to investigate whether student teachers' level of SRL opportunities predicted their use of metacognitive learning strategies. Table 6 displays the results of regression analyses with SRL opportunities as the independent variable and the use of metacognitive skills as the dependent variable. The results indicate that the degree of SRL opportunities is a significant positive predictor of the metacognition score at the 0,01 significance level (*B*=0,201). Hence, student teachers that receive more SRL opportunities apply more metacognitive learning strategies.

	t	*P*	*B*
SRL opportunities			
(Constant)	5,878	0,001	23,964
Metacognition [a]	7,127	0,000*	0,201
SRL opportunities			
(Constant)	19,987	0,000	93,430
Motivation [b]	3,200	0,015**	0,103

Table 6: Regression analyses with SRL as the independent variable and metacognition/motivation as the dependent variables

* significance: p < 0.01
** significance: p < 0.05

In What Way Does Student Teachers' Motivation for Learning Change in a Learning Environment With Increased SRL Opportunities?

The relationship between SRL opportunities and motivation was firstly studied by means of correlational analyses, based on the data of all participating teacher educators (Table 5). The relationship between SRL opportunities and motivation was shown to be significantly positive at the 0.05 significance level to a strong extent (r = 0,771). The separate constructs within SRL opportunities also correlated significantly positive to a strong extent with motivation at the 0,01 significance level for coaching/judging (r=0,808) and at the 0,05 significance level for planning (r=0,759), monitoring (r=0,756) and collaboration (r=0,693).

The only exception was the 'zone of proximal development' that showed no significant correlations with motivation (r = 0,624).

Secondly, independent-samples t-tests showed no statistical significance of the differences between the degree of student teachers' motivation for learning before (pre-test) and after (post-test) increasing student teachers' SRL opportunities in the curriculum (Table 4). By contrast, the expectancy component within the motivation scale did increase significantly at the 0,05 significance level for teacher educator 1 (t=2,007) and teacher educator 2 (t=2,041) after the SRL treatments. For that reason, the correlation between SRL opportunities and expectancy was analysed (Table 5) and proved to be positively significant at the 0,01 significance level (r = 0,881). Qualitative analyses also indicated that student teachers appreciated the SRL increase and felt more confident towards the transfer from theory to their own practise, the assignments and the final test. Nevertheless, in line with the findings of Vrieling et al. (2010), student teachers also stressed the important role of the teacher in providing a sufficient knowledge base to avoid uncertainty.

Finally, Table 6 indicates the results of regression analyses with SRL opportunities as the independent variable and motivation for learning as the dependent variable. The results indicate that the amount of SRL opportunities was a significant positive predictor of the motivation score at the 0,05 significance level (*B*=0,103). To recapitulate, student teachers that receive more SRL opportunities in educational programs are more motivated towards learning.

What Relationship Exists Between Student Teachers' Motivation for Learning and Use of Metacognitive Learning Strategies in a Learning Environment With Increased SRL Opportunities?

The relationship between the use of metacognitive skills and motivation for learning was studied by means of correlational analysis (Table 5). The results showed no significant correlation (r = 0,663) between metacognition and motivation. So, contrary to the theoretical findings, no relationships were shown between student teachers' motivation for learning and their use of metacognitive learning strategies. The same goes for the relationship between study content (the second sub scale within metacognition) and motivation for learning that displayed no significant correlation (r = 0,535). However, the relationship between study process (the first sub scale within metacognition) and motivation for learning showed significant correlations at the 0,05 significance level (r = 0,717).

To summarize, student teachers' use of metacognitive learning strategies increased significantly in learning environments with increased SRL opportunities for teacher educator 1 and 3. In addition, qualitative analyses identified student teachers' need for more explicit metacognitive strategy instruction. Although the amount of SRL opportunities was shown to be a significant predictor of motivation, student teachers' motivation for learning did not increase significantly in the research period. Student teachers' expectancy did however show a significant increase during the research period. Similarly, qualitative analyses revealed that student teachers appreciated the SRL increase and felt more confident towards the transfer from theory to their own classroom practice, the assignments and the final test: "Because we cooperated actively, we were forced to think about the subject matter of teaching, resulting in better remembrance and more confidence". The relationship between student teachers' motivation for learning and their use of metacognitive learning strategies appeared significant between the metacognitive study process part and motivation for learning.

Conclusions and Discussion

The present study measured dynamics of student teachers' use of metacognitive learning skills and motivation for learning in learning environments with increased SRL opportunities. With training, teacher educators were able to increase student teachers' SRL opportunities in primary teacher education. The results show that student teachers' use of metacognitive skills increased significantly in learning environments with increased SRL opportunities for 2 of the 3 participating teacher educators. This may indicate that teacher educators can influence student teachers' use of metacognitive learning strategies in a short period (one semester), but more evidence is required. Subsequently, qualitative analyses indicated student teachers' need for more explicit metacognitive strategy instruction. These findings correspond with the recommendations of Veenman et al. (2006) and Vrieling et al. (2010) that indicate the necessity for primary teacher educators to explicitly model metacognitive learning strategies to their student teachers. By modelling metacognitive skills, teacher educators can make their teaching more explicit and improve the transfer between theory and educational practice. This means that the teaching procedures challenge students' thinking and their thinking about thinking. During modelling, the four steps as distinguished by Schunk and Zimmerman (2007) can be used: (1) observation: learners can induce the major features of the skill from watching a model learn or perform; (2) emulation: the learner imitates performances of a model's skill with social assistance; (3) self-control: the learner independently shows a model's skill under structured conditions; and (4) self-regulation: the learner shows an adaptive use of skills across changing personal and environmental conditions.

Student teachers' motivation for learning was also enhanced in learning environments with increased SRL opportunities, but this relationship was less strong than the relationship between SRL opportunities and the use of metacognitive skills. One reason for the absence of motivation effects may be that the temporal interval in the present study was too brief for the effects to be detected. However, the increase of student teachers' expectancy, a component within the motivation scale, was shown to be significant. Student teachers appreciated the increased SRL opportunities in the curriculum. They felt more confident in using the provided knowledge and skills in their own classrooms and towards the assignments and the final test. Nevertheless, they also stressed the importance for teacher educators to provide an adequate knowledge base to avoid uncertainty. For example, student teachers like to know the criteria for judging their work in advance. Therefore, teacher educators are advised to focus on knowledge building in the domain, including both metacognitive skills and content matter (Vrieling et al., 2010). Hence, it is important for teacher educators to strike a balance between teacher-centred and student-centred learning in the curriculum, gradually moving from teacher to student regulation of the learning process.

In line with earlier research (e.g. Eccles & Wigfield, 2002; Pintrich, 2000, 2004), the present study confirmed the assumed positive relationships between the use of metacognitive learning skills (in our study only the metacognitive study process part) and motivation for learning. These interacting components influence students' involvement with their learning and, consequently, academic performance.

In conclusion, this study revealed that teacher educators were able to increase student teachers' SRL opportunities in the curriculum after being trained. Moreover, it was demonstrated that SRL opportunities in learning environments are strongly related to student teachers' use of metacognitive skills and also enhance student teachers' motivation for learning, both important constructs for their academic career. However, if student teachers have ideas about and preferences for learning and teaching that are contrary to appreciating process-oriented learning, it is not likely they will engage in SRL activities (Loyens, 2007).

Also, learners are not always motivated to invest much time and energy in developing adequate learning skills (Van Hout-Wolters, Simons, & Volet, 2000). Qualitative analyses of the present study indicated that, although important for learning, SRL imposes a substantial burden on student teachers and asks for a high responsibility of learners. Therefore, increasing primary student teachers' SLR opportunities does not automatically result in a different attitude towards learning and more use of metacognitive learning strategies by student teachers. To achieve such a positive attitude, it is important to consider the process-oriented design principles as formulated by Vrieling et al. (2010). In this way, student teachers' conceptions can turn in favor of SRL, resulting in more successful learning in school and beyond.

A first limitation of the present study is that no control group was assessed. The point of reference used was the starting situation of student teachers' SRL opportunities. Other experiences by teacher educators and student teachers between the pre- and post-test might have influenced the results of the study. Furthermore, all participating teacher educators volunteered to cooperate and can therefore not be regarded as a fully representative sample of the population. Third, although all selected teacher educators taught the same course for first-year fulltime student teachers, the subjects within the courses differed. This might have influenced the effects on student teachers' motivation and metacognition. Finally, the small sample of participating teacher educators might have limited the generalizability of the results. Therefore, in a follow-up study, the number of teacher educators is increased up to 11 teacher educators in 5 primary teacher education colleges.

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