



The nature of student teachers' regulation of learning in teacher education

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Background. Self-regulated learning (SRL) has mainly been conceptualized to involve student learning within academic settings. In teacher education, where learning from theory and practice is combined, student teachers also need to regulate their learning. Hence, there is an urgent need to extend SRL theories to the domain of teacher learning and to obtain scientific knowledge on the nature of student teachers' SRL to enable support of these processes in teacher education.

Aims. This study was aimed at exploring the nature of student teachers' regulation of learning across various theoretical and practical contexts in teacher education.

Sample. Twenty-eight students from a post-graduate academic teacher education institute participated in this study.

Method. For the measurement of student teachers' regulation activities, an open question log, called Learning Report, was developed. Content analysis and multiple correspondence analyses of 133 Learning Reports were used to identify qualitative differences in regulation activities and the underlying structure in the data.

Results. The analyses resulted in the identification and description of the variety and frequency of student teachers' regulation activities. The relations among the regulation activities were described by an underlying structure of two dimensions: passive versus active regulation of learning and prospective versus retrospective regulation of learning. Active regulation dominated in practice schools, passive regulation at the university.

Conclusions. It is argued that for learning to teach, a different conceptualization of SRL is needed, focusing less on setting initial learning goals and more on retrospective aspects of SRL. Building blocks for such a conceptualization are offered.

To date, research into self-regulated learning (SRL) has focused primarily on student learning in traditional instructional settings. These studies have provided insights into processes and models of SRL and useful applications of theory for school practice

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(Schunk, 2005). Not only students, however, draw on SRL strategies to cope with situational demands in the classroom; the same is true of teachers (Randi, 2004). SRL skills are necessary for teachers' lifelong learning in order to become expert teachers instead of only experienced non-expert teachers (Kreber, Castleden, Erfani, & Wright, 2005). Also, because teachers as experts in learning have to act as role models for their students, it is very important that teachers learn to regulate their own professional learning during their pre-service education (Hagger, Burn, Mutton, & Brindley, 2008; Kramarski & Michalsky, 2009; Vermunt & Endedijk, 2011).

In the past, most teacher education institutions offered university-based curricula, in which theory and practice was separated from each other with little opportunity for SRL (Kremer-Hayon & Tillema, 1999). Nowadays, teacher education programmes have increasingly been organized around different models of partnerships between universities and schools (Edwards & Mutton, 2007). These programmes offer students an opportunity to integrate learning from theory with learning from practice (Jorgensen, 2004). What student teachers learn from practice partly depends on what happens in the classroom, where they work as a teacher. These programmes require a high degree of SRL from student teachers: student teachers have to integrate knowledge gained from teaching experiences and university courses, to self-evaluate their competencies, clarify their learning needs, formulate personal development plans, reflect on their learning, and document their learning progress in a portfolio.

Randi (2004) suggests that teachers may use different self-regulatory skills as teachers than they do as students. A study of Lin, Schwartz, and Hatano (2005) concluded that unlike the contexts of most meta-cognitive intervention studies, teaching situations do not have well-defined problems, are not stable learning environments, and lack shared values and goals (Lin *et al.*, 2005). Furthermore, learning at the workplace is less intentional and planned, and more contextual and collaborative, than learning in traditional learning settings (Hager, 2004; Tynjälä, 2008). Besides, teacher learning does not have preset objectives or easily identifiable outcomes (Hodkinson & Hodkinson, 2005). Most of the research that has been done on student teachers' SRL focused primarily on the orientations, attitudes, or conceptions of student teachers towards SRL (Donche, Vanhoof, & Van Petegem, 2003; Kremer-Hayon & Tillema, 1999; Oosterheert & Vermunt, 2001). This leads to the intriguing question which regulation activities student teachers use in a teacher education programme in which they are learning as students at the university and learning from practice as teachers at the same time. Therefore, this study was aimed at exploring the nature of student teachers' SRL in such a teacher education context.

Theoretical framework

Theories of regulation of learning are based on assumptions about how students learn (Zimmerman & Schunk, 2001) and often apply quantitative methods based on psychological constructs and theories to study student learning (Pintrich, 2004). Regulation of learning is seen as a result of the interaction between biological, developmental, contextual, and individual differences that may hamper or enhance self-regulation at a specific moment (Pintrich, 2004). There are different models of SRL, and these models share some general assumptions and features (Pintrich, 2000). These assumptions form the basis of the working definition of self-regulation of learning as an 'active, constructive process whereby learners set goals for their learning and attempt to monitor, regulate

and control their cognition, motivation, and behaviour, guided and constrained by their goals and contextual features in the environment' (Pintrich, 2000, p. 453).

Self-regulation consists of different phases that represent a general time-ordered sequence that individuals go through as they perform a learning task, although different phases can also occur simultaneously and recursively (Pintrich, 2000). Most models of self-regulation share the same four phases, sometimes also brought down to three (Pintrich, 2000; Winne & Perry, 2000; Zimmerman, 2000). Phase 1 involves planning and goal-setting as well as activation of perceptions and knowledge of the task and context and the self in relation to the task. Phase 2 concerns various monitoring processes that represent meta-cognitive awareness of different aspects of the self and task or context. Phase 3 concerns efforts to control and regulate different aspects of the self or task and context. Finally, Phase 4 represents various kinds of reactions and reflections on the self and the task or context (Pintrich, 2000). Phases 2 (monitoring) and 3 (control/regulation) are often studied as one phase because not much differentiation has been found between these two processes in self-report instruments (Pintrich, 2000). Zimmerman (2000) names this combined phase the performance phase.

Although SRL is by most definitions restricted to student learning in school contexts, the key elements of SRL also resemble the properties of deliberate practice that is necessary for expertise development (Zimmerman, 2006). These key elements of SRL include during the first phase (1) goal setting, (2) strategic planning (the decisions about how to accomplish the goals), and (3) self-efficacy. During the performance phase, these strategies and the accomplishment of the goals must be constantly (4) monitored and (5) controlled. In the self-reflection phase, (6) the learner reflects on the learning outcomes, (7) self-evaluates his or her learning experiences, and (8) draws adaptive or defensive inferences for subsequent learning experiences (Zimmerman, 2006). Zimmerman (2006) showed that in the context of athletic training, the quality or self-regulatory sophistication of the practice methods was more important for the athletes' performance than the quantity of their practice. Also in the context of academic learning, research has identified different qualities of regulation. The study of Schunk and Zimmerman (1998) revealed that compared to naïve self-regulators, skilful self-regulators set higher quality goals, have higher self-efficacy, monitor their learning process instead of using self-handicapping strategies, seek more opportunities for self-evaluation, and reflect systematically on their learning experiences which positively influences new learning processes (Schunk & Zimmerman, 1998). Although these descriptions are helpful for identifying different qualities of SRL, the construct of SRL cannot be divorced from the context in which it occurs: SRL when studying alone may manifest itself in a different way than when learning in social interaction (Alexander, 1995). Therefore, studying qualitative differences of these key elements of SRL in a teacher education programme is necessary to identify what student teachers do to steer their development as a teacher.

Phenomenography is a method to study the qualitatively different conceptions or experiences of various phenomena (Marton, 1986). Traditionally, phenomenographic researchers categorize participants' descriptions of a phenomenon and a limited set of distinctive categories is the main outcome of phenomenographic research. More recently, phenomenographic researchers not only study variation between persons but also the different ways in which the same individuals experience the same phenomenon at different times in different situations (Pang, 2003). Since regulation can be influenced by the learning context, we can expect variance in the nature of regulation of learning within the same student teachers, when they learn in more than one context. Therefore,

this more recent phenomenographic approach seems to be suitable to study the nature of student teachers' regulation of learning by measuring the variation in student teachers' regulation across multiple learning experiences in different contexts of a teacher education programme.

Since the concept of SRL includes different elements, this study will search for the variation within these different elements. Therefore, we will move beyond the set of phenomenographic outcomes by also searching for underlying dimensions to describe how the various categories of these elements are related to each other in single learning experiences. According to Kaplan (2008), in the whole field of SRL research, there is an urgent need to conceptualize self-regulated action in various dimensions in order to get a more detailed understanding of the nature of SRL. This dimensional framework could then provide insight into the qualitative differences in students' regulatory action during their development (Kaplan, 2008).

In conclusion, because of the lack of understanding of the nature of SRL in teacher education, the aim of this study is to describe the regulation activities and underlying dimensions of student teachers' regulation of learning across multiple learning experiences. A learning experience is defined in this study as any kind of experience that according to the student teacher resulted in learning related to his or her development as a teacher. Since multiple learning experiences of student teachers will be measured, this study will have a hierarchical multilevel design, in which multiple learning experiences are grouped within individual learners learning experiences (Hox, 2000). This design also allows us to explore the extent to which the variance in the nature of learning across learning experiences is person related and the extent to which the repeated measures variance is context related. More specifically, we aimed to answer the following research questions:

- (1) What regulation activities do student teachers use in different learning experiences in teacher education?
- (2) Which underlying dimensions can be found to describe the relation between these regulation activities in single learning experiences?
- (3) To what extent is student teachers' regulation of learning person or context related?

This study was conducted in a post-graduate teacher education programme; students first obtain their master's degree in a specific subject area and then enrol on a 1-year programme to obtain their teaching degree for secondary education. During the programme, student teachers attend weekly classes at the university while also doing teaching practice at schools or holding a paid job as a teacher. They spend one and a half day at the university and, depending on the amount of lessons they give, they spend 2 to 3 days at school. At this school, an experienced teacher supervises the teaching practice and learning process of the student teacher. Student teachers design personal curricula with the help of their school-based and university-based supervisors. This personal curriculum is based on their prior experiences and concerns and is connected to the final goals of the programme. The final goals of all teacher education programmes in The Netherlands are based on the teaching competences defined by The Association for the Professional Quality of Teachers (SBL, 2004). One of the competencies is called 'reflection and development'. This competence describes that a teacher in secondary education 'must permanently work on his personal and professional development. That is his/her responsibility, and in order to take this responsibility, the teacher must possess competence for reflection and development' (SBL, 2004, p. 20). They keep a portfolio

in which they make self-evaluations and a personal development plan to direct their learning processes towards these competencies. In this personal development plan, they also reflect on their own responsibility for their learning processes. A reflection model is used in the programme (Korthagen, 2005) to help student teachers in learning from classroom experiences.

Method

Participants

The number of 10 participants is considered to be a minimum in phenomenographic research (Cousin, 2009), but 15 to 20 participants is more common. We asked 28 students from a Dutch post-graduate teacher education institute to volunteer in this study. In line with other phenomenographic studies, in this study participants were selected to maximize the potential variation in the regulation of their learning experiences. In order to achieve this, we made sub-populations for the 16 different school subjects that were taught at this teacher education institute and the eight supervising teacher educators. The participants were selected in such a way that from all school subjects at least one participant was included, and that the selection was representative for the total population ($N = 165$) in terms of supervising teacher educator, gender, and teaching experience. Seven student teachers who were not willing to participate (primarily because of lack of time) were replaced by other student teachers with the same characteristics in terms of the variables as described above. Nine of the students were male, nineteen were female. The average age of the student teachers was 29 years ($SD = 6.1$). The student teachers taught on average 7.3 lessons a week ($SD = 4.0$). Student teachers were requested to report on six different learning experiences.

From the 28 student teachers who agreed to participate, three did not report a single learning experience. One student teacher only completed one Learning Report, which was excluded from analysis, because the reported experience was not related to learning to teach. The other 24 student teachers reported in total 133 learning experiences: 18 student teachers reported six learning experiences as requested, and four student teachers withdrew after four or five Learning Reports. Two student teachers did not send in more than three Learning Reports. All 133 Learning Reports were included in the final analysis. The reasons student teachers gave for stopping before completing all six reports were illness, quitting teacher training, or lack of time. The drop outs included male and female students, experienced and beginning students, and they varied in school subject and supervising teacher educator.

Instrumentation

For the measurement of qualitative differences in student teachers' regulation activities, an open question log, called Learning Report, was developed. In this instrument, student teachers were asked to describe a self-chosen learning experience, with help of eight open questions about different regulation activities. In the Learning Report, questions were asked about the three main phases of SRL (forethought, performance, and self-reflection) as described in the conceptual models of Pintrich (2000) and Zimmerman (2000). The description of Zimmerman (2006) of the key elements of SRL relevant for the development of expertise was used for the selection of the eight key elements of SRL to be included in this study. For every phase of SRL, two or three questions were included in the Learning Report: for the forefront phase, questions were inserted

Table 1. Overview of the SRL elements included in the study and the related questions in the open question log

SRL element	Question
1 Self-reflection on the learning outcome	What did you learn?
2 Goal orientation	Did you plan to learn this, and if so, why did you want to learn this?
3 Self-efficacy	Did you expect to succeed in learning this and what made you think you would (not) succeed in learning this? What was the context in which you learned this?
4 Strategic planning	How did you learn this?
5 Learning strategy control	Why did you learn it in this way?
6 Monitoring of the learning results	How did you realize that you had learned something?
7 Self-evaluation of the learning experience	If you look back, are you completely satisfied, or what would you do differently next time?
8 Inferences for subsequent learning experiences	How will you proceed with this learning experience?

about student teachers' *goal orientation* (Question 2), *self-efficacy* (Question 3), and *strategic planning* (Question 4). The questions concerning the monitoring and control phase described their *learning strategy control* (Question 5) and *monitoring of the learning results* (Question 6). The questions concerning the reflection phase were focused on *self-reflection on the learning outcome* (Question 1), *self-evaluation of the learning experience* (Question 7), and *inferences for subsequent learning experiences* (Question 8). Besides these eight regulation questions, we also asked the student teachers to describe the learning context to increase the interpretability of the Learning Reports and to answer our third research question on context relatedness of the regulation. The descriptions of the questions in relation to the SRL elements can be found in Table 1. The instrument was tested in a small pilot study with three student teachers who completed six Learning Reports each; the results led to some small corrections in the phrasing and order of the questions. It appeared that the student teachers had a desire to start their Learning Report by reflecting on the learning experience; therefore, we made the self-reflection question the first question in the Learning Report.

Procedure

Following the first contact by phone or e-mail, the student teachers received instructions about the Learning Reports orally during an individual meeting with the researcher and afterwards also on paper. They were told that the study was designed in order to get more information about what and how student teachers learn in a teacher education programme. They were instructed to choose a learning experience from the previous week; this could be any kind of experience that was part of their development as teachers. Because of the diversity of student teachers' learning processes, as described previously, they were stimulated to describe different kinds of learning experiences in the six Learning Reports: at least two learning experiences that had taken place in the context of the teacher education institute and at least one from the context of the practice school. Furthermore, they were instructed that they could report planned as well as spontaneous learning experiences and that they had to report at least one

unsuccessful learning experience. We made clear to the student teachers that a learning experience could be a small step ahead as well as change that took a longer time, and that it could include changes in knowledge, skills, and attitude. They were told that in the case of an unplanned learning experience, some questions were not relevant so they had to answer these questions with *not relevant*. Student teachers were asked to report a learning experience every week during a period of six consecutive weeks. To stimulate student teachers to do this, we sent them a weekly reminder by e-mail and phoned them when they did not respond within 2 weeks.

Data analysis

The data were analysed in two phases. The first phase included the phenomenographic analysis to produce a set of categories covering the variation in self-regulation in the reported learning experiences. Our first step of this analysis was reading all the Learning Reports several times in order to become familiar with the data. To reach a set of distinctive categories, a process of continuous comparison of the quotes with the emerging categories was followed. For this process, the programme ATLAS.ti 5.0 was used (Muhr, 1997), which made it possible to have the complete Learning Report visible during the categorization of a fragment in order to maintain context boundness. During this process, eight variables were established, each representing a different element of the regulation process and one of the questions of the Learning Report, around which a set of categories could be constructed. During the analysis, one SRL element was slightly changed. The data did not show a lot of variation in level of self-efficacy, but they did show variation especially in the sources of information the student teachers used for self-efficacy judgements. Therefore, we named this variable *sources of self-efficacy*. After every iteration, colleague researchers critically examined the preliminary set of categories for each variable. Five iterations were needed to reach a stable set of categories covering the qualitatively different descriptions of SRL in the Learning Reports in as few categories as possible. All text fragments of the Learning Report were coded in terms of the developed set of categories. From the total of 1,197 fragments that were coded, 10% were also coded by an independent second researcher to calculate inter-rater reliability. In the first round, an overall Cohen's kappa of .86 was reached. Although this appeared satisfactory, it emerged that the Cohen's kappa for the different separate variables varied from .70 to 1.00, except for one variable (*Inferences for subsequent learning experiences*), for which a Cohen's kappa of only .36 was reached. For this variable, the codebook was made more specific and another 10% of the data were coded to test the changes. This led to a new kappa for this specific variable of .80 and a new overall Cohen's kappa of .90.

In the second phase, multiple correspondence analysis (MCA) was used, also referred to as homogeneity analysis (Mair & De Leeuw, 2008), which is a form of non-linear principal component analysis (De Leeuw, 2005). This technique makes it possible to discover relationships between categorical data and the underlying structure in the data and is especially useful when there are many variables and categories (Mair & De Leeuw, 2008). MCA is a non-parametric factor analytical procedure, and like parametric factor analysis, it orders possibly related variables along a small number of principal components that explain (part of) the variance of the original variables. In MCA, these principal components are called dimensions. After the number of dimensions has been chosen, the outcome of the MCA shows the position of the different categories of the variables on these dimensions. Learning experiences characterized by the same categories are

plotted close together and Learning Reports that do not resemble each other are plotted far apart (Funnell, Bryer, & Grimbeek, 2004). In conclusion, this technique quantifies and visualizes which categories and which learning experiences can be considered as similar or related by putting them close to each other in the solution. Through analysis of the similarities of the categories and both ends of the dimensions, the dimensions and underlying structure in the data can be interpreted. The results of the MCA show the exact position of every learning experience on the dimensions.

In our data, the learning experiences are nested within student teachers and in this way form a multilevel structure. To study the amount of person level variance in scores on the dimensions, we considered a two-level model with learning experiences (level 1) nested within student teachers (level 2) (Snijders, 1999). The intercept-only model estimates the repeated measures variance and the person level variance (Hox, 2000). To study the context relatedness of the data, the context of the learning experience was added as an explanatory variable in this multilevel model.

Results

Student teachers' regulation activities in a dual learning programme

Content analysis of the 133 Learning Reports showed that the variation within each of the eight elements of SRL could be described by five to seven categories. To answer the first research question, a global description of the range of categories will be described below separately for every variable. An overview of the total set of categories, including their full descriptions, illustrative examples from the data, and the observed frequencies, can be found in Table 2. For the variables *goal orientation*, *sources of self-efficacy*, and *learning strategy control* the total frequency is lower than 133, since these aspects could only be categorized for the planned learning experiences.

Goal orientation describes the reason why student teachers learned what they learned. The categorization is based on the answer to Question 2: *did you plan to learn this and if so, why did you want to learn this?* In total, 83 learning experiences were said to be intentional and 50 were reported as unintentional. Within the intentional learning experiences, the reported reasons covered two main aspects: a description of the unsatisfactory current situation that they wanted to change and the learning goal a student teacher aimed to reach. Sometimes, only one aspect was mentioned as an argument for learning, but aspects were also mentioned in combination.

Sources of self-efficacy concern student teachers' argumentations for their expectations of succeeding in a learning experience. Since only in nine cases student teachers expected not to succeed, it turned out to be more insightful to categorize the argumentations they used for estimating their self-efficacy than their self-efficacy beliefs themselves. Independently of whether they expected to succeed or not, they used different kinds of information in order to form their expectations, which were categorized for this variable. Often student teachers reported that this was about trust in their own capacities, but they also based their expectations on their previous experiences with the learning strategy, learning context, or learning content.

The student teachers were asked to describe their *strategic planning*. This refers to the decisions the student teachers made about how to accomplish the goal, or in case of unplanned learning experiences, their description of how they arrived at their learning outcome. Five qualitatively different learning strategies could be discerned. These included learning by doing, learning by interacting, learning by processing information, and learning by applying theory to practice. As a last strategy, student

Table 2. Categories of student teachers' regulation activities, including their description, an example from the data, observed frequencies (N), and category loadings on Dimension 1 and 2 of the MCA. The categories are ordered by the SRL element to which they belong^{a,b}

Category	Category description	Example from the data (summarized)	N	Loading on Dimension 1	Loading on Dimension 2
Goal orientation ^c : 'Did you plan to learn this, and if so, why did you want to learn this?' (Question 2)					
Judgement of current situation	ST described the current situation, but no new goal or direction of growth had been described.	<i>I was unsatisfied about what happened</i>	5	0.17	<u>-0.29</u>
Learning goal	ST described a new goal, but there was no information about the relation with the current situation.	<i>I want to know that all my children learn something from my lesson</i>	22	0.14	0.25
Judgement of current situation and learning goal	Both a judgement of current situation and a new explicit goal had been described.	<i>Until now, I did not succeed in being strict, so that is what I want to reach</i>	26	-0.13	0.27
Direction of growth with learning goal	ST described the direction in which she wanted to grow, including an explicit goal but without describing the starting problem explicitly.	<i>I wanted to learn more about collaborative learning</i>	12	-0.25	1.03
Direction of growth with judgement of current situation	ST described the direction in which she wanted to grow, including an explicit goal but without describing the starting problem explicitly.	<i>I have been struggling for some while now with my reflection skills, I want to change something in that</i>	16	0.26	0.43
No answer	No answer had been given.	...	2	<u>-0.88</u>	<u>-0.05</u>
Sources of self-efficacy ^c : 'What made you think you would (not) succeed in learning this?' (Question 3)					
Experience with learning object	The ST expected a certain amount of success because of her previous experience with the learning object.	<i>We had discussed multiple intelligence already</i>	9	0.18	-0.04
Experience with learning strategy	The ST expected a certain amount of success because of her previous experience with the learning strategy.	<i>Lectures always help me to reflect on myself as a teacher</i>	12	<u>-1.10</u>	0.30

Continued.

Table 2. Continued.

Category	Category description	Example from the data (summarized)	N	Loading on Dimension 1	Loading on Dimension 2
Experience with learning context	The ST expected a certain amount of success because of her previous experience with the learning context.	<i>The pupils I was going to teach are always very cooperative</i>	14	0.76	0.78
Own qualities/efforts	The ST expected a certain amount of success because of her confidence in her own qualities or effort.	<i>I was well prepared and discussed this also with a colleague</i>	22	0.63	0.35
Hope without argumentation	The ST only hoped to succeed but did not mention a reason for this.	<i>I hoped that I would learn something during the lecture</i>	5	<u>-0.51</u>	0.27
No answer	No answer had been given.	...	21	<u>-0.50</u>	0.32
Strategic planning: 'How did you learn this?' (Question 4)					
Learning by doing	ST learned by doing or experiencing things.	<i>I learned this by just trying and seeing what happened</i>	54	0.63	0.14
Reflecting or evaluating	ST learned by evaluating a (teaching) experience or reflecting upon it.	<i>After evaluating the problem, I realised that I need to define my core problem in order to develop myself further.</i>	15	0.72	<u>-0.06</u>
Interacting or getting feedback	ST learned by getting feedback or information from others or more indirectly by observing others.	<i>I discussed this problem with my mentor</i>	14	-0.03	<u>-0.89</u>
Processing information	ST learned by listening or reading or other ways of processing information.	<i>I learned this by listening and watching a DVD</i>	24	<u>-1.77</u>	0.12
Applying theory to practice	ST learned by applying information or theories to her own practice.	<i>First the teachers explained it to me and then I applied it to my own lessons</i>	9	0.24	0.99
No answer	No answer had been given.	...	17	-0.25	<u>-1.52</u>

Continued.

Table 2. Continued.

Category	Category description	Example from the data (summarized)	N	Loading on Dimension 1	Loading on Dimension 2
Learning strategy control ^c : 'Why did you learn it in this way?' (Question 5)					
Argument for a way of teaching	ST gave an argument for a way of teaching, so why the ST had adapted a certain pedagogy in the classroom.	<i>This pedagogy is clear for my pupils and it has immediately effect</i>	4	0.62	0.74
Argument for a learning strategy	ST gave an argument for a way of learning.	<i>I prefer processing information by reflecting on it or discussing it with others</i>	12	0.34	0.29
Part of an instruction	The ST did not choose herself a specific learning strategy, this had been part of an instruction.	<i>We had to learn this via an authentic case</i>	5	<u>-2.09</u>	0.43
No conscious choice	ST explained that is had not been a conscious choice to learn in this specific way.	<i>It was not a conscious choice to learn it that way</i>	4	-0.07	0.95
No answer	No answer had been given.	...	60	0.05	0.31
Monitoring of the learning results: 'How did you realise that you learned something?' (Question 6)					
Reflection on own performance	After reflection on the experience, by analysing the her role in the event, the ST knew what she had learned.	<i>By looking back I realised what went well and what was needing some improvement</i>	20	0.20	-0.01
Experience of what works	The moment that the ST had experienced that her strategy had been effective, she realized that she had learned something.	<i>By realising that I finally did what I planned to do</i>	20	0.25	0.85
Information from (behaviour of) others	Getting information from others, sometimes only by observing their behaviours, made the ST aware of learning something.	<i>My pupils were acting more relaxed and were motivated to cooperate</i>	29	0.54	0.41
Reflection on information of others	After reflecting on information from others, the ST realized that she had learned something.	<i>After communicating with others, I realised that not only external factors have influence</i>	35	0.51	<u>-1.26</u>
Novelty of information	ST became aware that she had learned something, because she had had new information.	<i>After the meeting, I had new and concrete information</i>	19	<u>-1.59</u>	-0.03
No answer	No answer had been given.	...	10	<u>-1.37</u>	<u>-0.26</u>

Continued.

Table 2. Continued.

Category	Category description	Example from the data (summarized)	N	Loading on Dimension 1	Loading on Dimension 2
Self-reflection on the learning outcome: 'What did you learn?' (Question 1)					
Rule of thumb	ST described what she had learned on the level of a rule of thumb, a strict rule that always has to be followed.	Never start a lesson with a negative feeling towards pupils	5	-0.77	-2.58
Knowing that	The learning object had been described as knowledge or information, as a learned fact.	That performance anxiety is related to perfectionism	24	-0.91	0.27
Knowing how	The learning object was described as knowledge about teaching behaviour.	How you can deal with speaking skills in the classroom	13	-1.15	0.59
Knowing about myself	The learning object was described as a change in the ST's identity or awareness of her learning process.	I learned to trust in my own skills	10	0.23	-0.51
Specific teaching practice	The object of learning was described as a specific teaching behaviour.	Structuring homework assignments	40	0.56	0.42
Knowing why	The ST described examples of knowing why in terms of when, why, and under what conditions what kind of teaching is important or good to do.	If you can show the relevance of your lesson, pupils will listen, be quieter and pay more attention	31	0.64	-1.00
Description of an experience	An experience has been described, but it was not clear what had been learned from it.	We talked about motivation	10	-0.38	-0.10
Self-evaluation of the learning experience: 'If you look back, about which aspects are you satisfied and what would you do differently next time?' (Question 7)					
Evaluation of learning strategy	ST evaluated the learning process, what could have been improved, or what she was satisfied with.	It gave me good insights, but next time I have to prepare myself better for the lecture	21	0.05	-0.06
Evaluation of learning context or own behaviour	ST evaluated primarily her own behaviour in the experience.	Actually it would have been better if I could have kicked the student out of my classroom	41	0.78	-0.02
Evaluation of moment of learning	ST evaluated the moment of this learning experience in her development.	I should have followed this lecture in an earlier stage	8	-0.07	0.61

Continued.

Table 2. Continued.

Category	Category description	Example from the data (summarized)	N	Loading on Dimension 1	Loading on Dimension 2
Completely satisfied	The ST only showed that there is nothing that she would have changed and that she was completely satisfied without giving more information why.	<i>I am very happy with it!</i>	20	-0.33	0.64
Learning process under control of others	The ST showed that someone else could have done better.	<i>It was a pity that I did not hear a lot of new things in this lecture</i>	8	-1.94	0.50
Evaluation of learning content	ST evaluated that she was satisfied about what she had learned.	<i>Well, I did it, despite the fact that I had my doubts beforehand</i>	14	-1.16	-1.75
No answer	No answer had been given.	...	21	0.22	-0.71
Inferences for subsequent learning experiences: 'How do you proceed with this learning experience?' (Question 8)					
Action plan	The ST described in terms of concrete actions what she had been planning to do next.	<i>I will not interrupt them in the next lesson for unimportant things</i>	30	0.70	-0.67
Formulating new goal/wish	The ST formulated new learning goals or directions for her development.	<i>I want to grow more as a teacher and be more satisfied about myself</i>	9	-0.07	0.45
Consolidation	The ST notified that she wants to maintain the same (teaching) behaviour.	<i>The next meeting I want to try again to discuss problems thoroughly</i>	27	0.40	0.64
Improving practice	The ST wanted to improve (more) what she had learned so far in the same direction.	<i>I want to be clearer in my assignments by changing to written instructions</i>	22	0.58	-0.31
Applying to practice	The ST wanted to apply what she had learned to practice, possibly with some small adaptations.	<i>I want to apply these ideas in a new group</i>	37	-1.16	-0.34
No specific changes	The ST kept on doing the same as she did before, she had no specific plans.	<i>Just trying again!</i>	6	-0.05	0.11
No answer	No answer had been given.		2	-	-

^aST = Student teacher. Loadings in bold are the one-third highest scoring categories of a dimension and loadings underlined are the one-third lowest scoring categories of a dimension. ^b'She' and 'her' may also be replaced by 'he' and 'his'. ^cFor the variables goal orientation, sources of self-efficacy and learning strategy control the total frequency is less than 133, since these aspects could only be categorized for the planned learning experiences.

teachers also reported reflection or evaluation as a method of learning in combination with one of these learning strategies. In addition to the question about their learning strategies, student teachers were also asked to report their reason for using this strategy (*strategy control*). This seemed to be a hard question for student teachers, because in 60 cases, this question remained unanswered. Actually, in only 12 Learning Reports, an argument for a way of learning was given.

The categories of the *monitoring of the learning results* variable included the different ways student teachers monitored their learning outcomes. The categories of this variable included the same type of categories as the learning strategies; for example, they also used reflection and information from others as an indicator for learning. The other categories are mentioned in Table 2.

Student teachers were also asked to describe their *self-reflection on the learning outcome*. This means that even though student teachers had the same learning experience (e.g., a workshop about classroom management), they described their learning outcome on different levels. Eight qualitatively different kinds of reflections on the learning outcome were identified. These reflections varied from a description of their learning outcome as a rule of thumb, to descriptions of 'knowing that', 'knowing how', and 'knowing why', which described their personal theories of practice.

The student teachers were asked to *evaluate their learning experiences*. They referred to different aspects of the learning experiences, such as the moment of learning, and their learning strategy, and the largest category was an evaluation focused on their own behaviour ($N = 40$). In 20 learning experiences, student teachers were completely satisfied.

The variable *inferences for subsequent learning experiences* deals with the student teacher's plans about how to proceed with their learning during subsequent efforts to learn or to perform. Six different categories were identified, of which four are behaviour oriented in the sense that they are focused on changing or maintaining behaviour on the basis of this learning experience. In nine cases, a new learning goal was set, and in six cases, no new plans were made.

Relations between the categories of description and underlying dimensions

In order to answer the second research question, which was aimed at determining the relations between the categories of the different variables and the underlying structure in the data, a MCA was carried out on the complete set of 133 learning experiences and all 50 categories of the eight variables. As described above, the questions about goal orientation, sources of self-efficacy, and strategy control were not relevant for unintentional learning experiences. These unintentional learning experiences were handled as missing values on these variables instead of being coded with a specific 'missing' category, to prevent them being near each other because of co-occurrence and to stop them influencing the MCA solution too strongly. A common criticism of MCA is that outliers caused by low-frequency categories can have considerable effect on the solution. To discover the influence of possible outliers, we interpreted several solutions with and without outlying objects and categories. This procedure resulted in the removal of one outlying Learning Report from the initial analysis.

The MCA resulted in a two-dimensional solution. The two dimensions have an eigenvalue of 3.61 and 2.71 and explain, respectively, 45.1% and 33.9% of the variance. The scree test (Cattell, 1966) showed that a third dimension would not add a substantial amount of extra explained variance to the solution; in addition, the interpretation of the third dimension was very comparable to the second dimension and did not provide extra

meaningful information. As explained in the Method section, categories close together in the representation are associated with the same Learning Reports and are, therefore, related. In Table 2, the loadings of all categories on the dimensions are presented. By describing the similarities of the regulation activities on both ends of the dimension, it is possible to interpret the dimensions and, thus, the underlying structure in the data. We divided the categories into thirds to discern the high-scoring categories, low-scoring categories, and categories with a middle position. The one-third highest scoring categories of each dimension are presented in bold type in Table 2, and the one-third lowest scoring categories of each dimension are underlined.

The regulation activities scoring *low* on Dimension 1 are categories that show the presence of an external source of regulation in the learning process or reflect lack of regulation. Also, almost all 'no answer' categories of the different variables score low on the first dimension. The other low-scoring activities have in common that the learning is under the control of others (especially the strategic planning and the evaluation) or under the control of an external source of information (monitoring of the learning results). The decisions in the learning process made by the student teacher him/herself are not well thought-out (superficial self-reflection and limited sources of self-efficacy). On the other hand, the *high*-scoring categories show a more active pattern of regulation, where the student teacher reflects more deeply on the learning outcome, the learning process, and his or her own role in this. In these learning experiences, student teachers make their own decisions for a learning strategy, but also actively use information from others and reflect on that. Therefore, this dimension represents passive regulation at one end of the spectrum and more active regulation at the other. Passive regulation means that lack of regulation was found and/or the learning experience was externally regulated, for example, by the context of by someone else. Active regulation means that the student teacher undertook various activities during the learning experience to steer his or her learning.

On the second dimension, the *low*-scoring categories are not well spread over all variables. Table 2 shows that the variables of the first phase of the learning process, namely goal orientation, sources of self-efficacy, and learning strategy control, have almost only categories that score average or high on this dimension. In the other variables, the low-scoring categories also show characteristics of deep processing (when combined with a high score on the first dimension) as well as some 'no answer' categories (when combined with a low score on the first dimension). Examples of these deep activities are learning and monitoring by reflecting and describing the learning object as 'knowing about myself' and 'knowing why'. Furthermore, evaluating the level of the learning strategy is positioned low on this dimension. The *high*-scoring categories on this dimension show a thorough orientation on the learning process with explicit goal-setting, different kinds of sources of self-efficacy, and explicit arguments for the learning strategy. High-scoring categories of the variables of the reflection and evaluation phase of the learning process are, however, more superficial. The learning outcome is described as 'knowing how' or as 'a specific teaching practice', monitoring is based on what works, and only the *moment* of learning is evaluated or the student teacher is completely satisfied. Actually, at both ends of this dimension, we see important regulation activities for steering one's own learning process. The high-scoring categories show regulation of learning in terms of planning and preparing learning opportunities. The low-scoring categories are characterized by unplanned learning experiences, but when combined with the active side of the first dimension, these regulation activities show deep aspects such as reflection and evaluation of the learning process in order to learn from these unplanned experiences. Therefore, we interpreted this dimension as differentiating

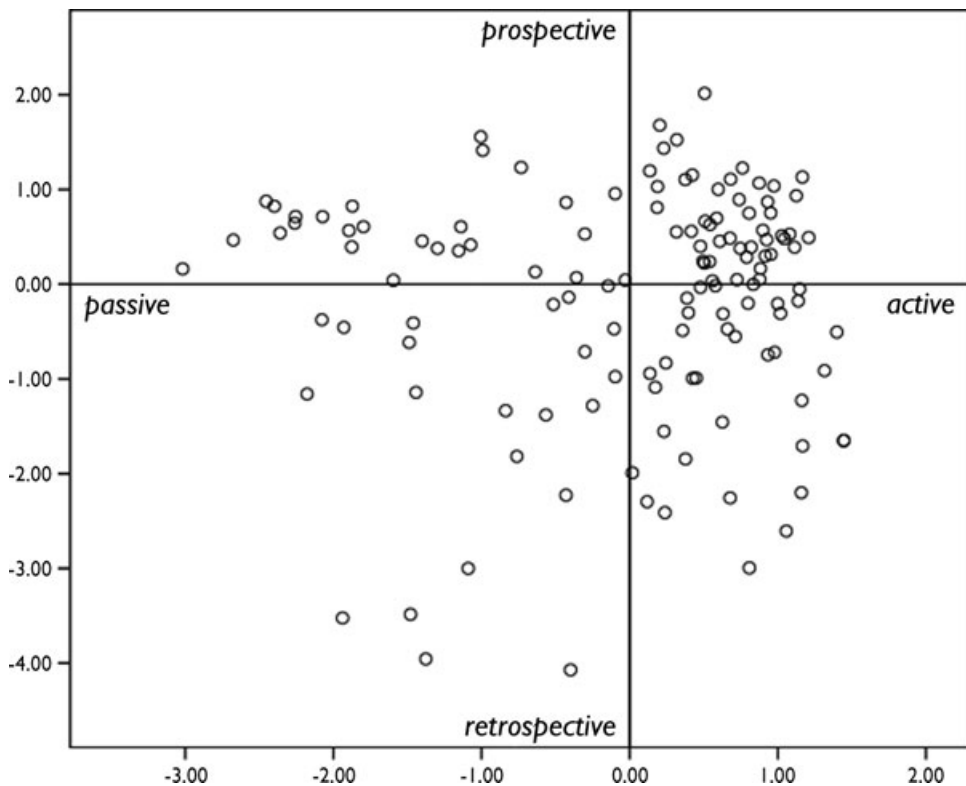


Figure 1. Positions of the 133 learning experiences on the two dimensions of student teachers' regulation of learning.

prospective from more retrospective regulation. In this way, this dimension describes the focus of regulation: prospective regulation is regulation focused on the forethought phase of the learning process, whereas retrospective regulation is regulation focused on the reflective part of the learning process.

The results of the MCA uniquely positioned each learning experience in the dimensional structure, based on the combination of category scores on the eight variables (see Figure 1). As can be seen in Figure 1, the nature of the regulation of a single learning experience can be described by the quadrant in which it is positioned: active prospective regulation, whereby the student teacher actively searches for and plans learning experiences; passive prospective regulation, whereby the learning experiences are planned and the learning processes are set up mostly by others; active retrospective regulation, whereby student teachers learn from spontaneous experiences by actively monitoring, reflecting on, and evaluating them; and passive retrospective regulation, in which the learning experiences are not planned by the student teacher, and during and after the learning experience, no or only a superficial method of regulation can be seen. However, learning experiences also differ in the extent to which they have a more or less extreme position in a quadrant. For example, a learning experience can receive a position in the middle of the active-passive dimension when both types of regulation are present. This can be the case when co-regulation (regulation of the learning experience by the student teacher and another person) has taken place, or active regulation in some

components and lack of regulation in some other components. The same can be the case for a position in the middle on the second dimension. This shows that in this learning experience, the regulation has not a specific prospective or retrospective focus.

Person and context relatedness of the dimension scores

Every student teacher was asked to report six different learning experiences. So, personal characteristics could have influenced the nature of regulation. We tested this by calculating the proportion of the person level variance of the total variance for both dimensions separately with multilevel analysis. The outcomes showed that for dimension 1 (active vs passive regulation), the person level variance was 0.11, which was not significant ($z = 1.17, p = .24$) and the repeated measures variance was 1.09 ($z = 7.39, p < .000$). For dimension 2 (prospective vs. retrospective), the person level variance was 0.32 ($z = 2.14, p = .03$) and the repeated measures variance was 1.11 ($z = 7.43, p < .000$). This resulted in an intra-class correlation of .09 (Dimension 1) and .22 (Dimension 2). These outcomes indicated that the scores of Dimension 1 are person-independent data, whereas for Dimension 2, a significant percentage of the variance (22%) of the dimension score is explained on the level of the individual student teacher.

Before exploring the context relatedness of the dimension scores, we investigated if the repeated measures variance is related to some testing effect. We added the order in which the learning experiences were reported as a level-one predictor to the multilevel model. The results showed that there were no differences in dimension scores between the learning experiences from different moments of reporting [Dimension 1: $F(1, 110.99) = 0.54, p = .75$; Dimension 2: $F(5, 111.55) = 1.10, p = .37$].

To explore if the repeated measures variance is related to the learning context in which learning experiences had taken place, context was also added as a level-one predictor to the model. Three different contexts were distinguished from the descriptions of the student teachers: learning at the practice school ($N = 82$), learning at the teacher education institute ($N = 45$), and learning in contexts outside these two places, for example, at home or in a library ($N = 6$). For Dimension 1 (activeness of regulation), the context turned out to explain differences between learning experiences [$F(2, 121.44) = 57.72, p < .000$] on different moments in time. Only the differences between learning experiences at the teacher education institute and the practice school were significant [$t(113.21) = -10.73, p < .000$]: The intercept value of a learning experience at a practice school was 0.55, whereas the learning experience at the teacher education institute scored on average -0.93 on the first dimension. Since the standard deviation of the scores on Dimension 1 was 0.33, this can be regarded as a large difference. For Dimension 2 (prospectiveness of regulation), there were no significant differences between contexts [$F(2, 122.67) = 0.08, p = .92$]. From this we can conclude that in this sample, the activeness of regulation is related to the context in which the learning experience occurs: learning experiences from the teacher education institute context show more passive regulation activities, whereas learning experiences from the practice school and other contexts show more active regulation activities.

Conclusion and Discussion

The aim of this study was to describe the nature of student teachers' SRL across a variety of theoretical and practical contexts in teacher education. Three questions were posed, which concerned the variety and nature of student teachers' regulation activities, the relation among these regulation activities in underlying dimensions, and person

and context relatedness of the data. Content analysis of 133 Learning Reports resulted in eight variables and five to seven categories per variable. The key elements of SRL, derived from the framework of Pintrich (2000) and Zimmerman (2000), were used to develop the instrument to measure qualitative differences in student teachers' regulation in multiple learning experiences. These elements of SRL were also used as variables for the phenomenographic analysis, although some small changes were made. For example, it turned out that not the self-efficacy beliefs themselves but the argumentations for a certain self-efficacy belief was discriminative for differences between learning experiences. Large variation in regulation activities that student teachers used in the different learning experiences was found. Striking results from the descriptive categories were a strong focus of the regulation activities on teaching practice and changes in own behaviour and a high frequency of spontaneous and unplanned learning experiences. Most models of SRL are based on the assumption that learners consciously direct their activities towards a *learning* goal (Boekaerts & Corno, 2005; Pintrich, 2000; Winne, 1995). The results from the present study resemble earlier observations that in informal learning, the goals tend to be broader, which may result in more variability in what gets learned (Boekaerts & Minnaert, 1999). Teachers' goals are more focused on the achievement and well-being of their students than on their personal achievement (Butler, 2007). Although student teachers focused their regulation activities more on their behaviour, for example, on attaining working goals, choosing strategies for their pupils' learning instead of their own learning, or monitoring in terms of 'what works in the classroom', these activities all resulted in learning for themselves. Further studies have to show whether working goals are as beneficial for student teacher learning as setting personal learning goals.

The solution of the MCA showed the underlying structure in two dimensions in these data. The two dimensions were interpreted as discerning more passive from more active regulation and prospective from retrospective regulation. The combination of these two dimensions resulted in four different types of regulation: active prospective regulation, passive prospective regulation, active retrospective regulation, and passive retrospective regulation. Although in previous research the distinction between self-regulation and external regulation is often used to describe variation in regulation of learning (Kaplan, 2008; Vermunt, 1998), this distinction turned out to be less relevant for the present data. First, we found on the low side of the first dimension not only external regulation but also lack of regulation. Furthermore, on the active side of the first dimension, categories were found that showed the influence of others on the learning process. For example, for the monitoring of their learning results, active regulating student teachers often used information of others, such as colleagues, peers, or pupils, who can consciously or unconsciously steer the student teachers' learning. By naming this dimension passive versus active regulation, we could describe all variations in the activity of the student teachers in regulating their own learning, despite or owing to the presence of others. For example, when a learning experience is co-regulated by the learner and someone else, this learning experience will end up in the middle of this dimension.

The second dimension showed how learning experiences varied in the focus of regulation. Although regulation of learning embraces all phases of the learning process, this dimension showed that in the reported learning experiences the focus was often on prospective regulation, in other words, the planning and goal-setting phase, or on retrospective regulation involving the monitoring, reflection, and evaluation phase. According to Boekaerts and Corno (2005), for the most part, researchers narrow the scope of students' capability to regulate their learning through a focus on the academic

side of education: namely, learning and achievement goals. By describing the regulation strategies that learners use to reach academic goals, the SRL perspective reveals little about students' actions and efforts to regulate, when they are not so mindfully engaged in learning (Boekaerts & Corno, 2005). Although we know that setting learning goals is related to more effective academic learning (Schunk & Zimmerman, 1998), we also know that implicit learning is a large part of the learning process of becoming a teacher. Although teacher learning can also be planned, much of their learning is informal in the sense that it is ongoing and often incidental (Hodkinson & Hodkinson, 2005). Van Eekelen, Boshuizen, and Vermunt (2005) showed that when learning experiences are classified as self-regulated only when they have pre-set learning goals, less than one-third of experienced teachers' learning experiences could be classified as being self-regulated in nature. In the field of workplace learning, it is well known that people learn intentionally as well as unintentionally (Tynjälä, 2008). Eraut (2004) makes a distinction between deliberative, reactive and implicit learning. The distinction between deliberative and reactive learning is particularly comparable with the differences in regulation found within the second dimension. The interpretation of the second dimension showed that learning experiences starting as reactive and non-deliberate, lacking a learning goal, can still involve deliberate, active regulation activities, though in a more retrospective way. Therefore, we argue that for this context, setting goals is not always a pre-requisite for active regulation of learning. Moreover, the fact that this dimension separates active prospective and active retrospective aspects of regulation implies that in this context, active prospective and active retrospective aspects do not occur often together in the same learning experience, showing that regulation of student teachers' learning processes is less sequenced than SRL theories prescribe (Azevedo, 2009).

The multilevel analysis has shown that these two dimensions differ in the extent to which they are person and context related. For the dimension describing the activeness of regulation, no significant person level variance was found. This dimension turned out to be related to the context in which learning occurred in an unexpected way. Learning at the workplace is often less deliberate in nature (Tynjälä, 2008), and also the context of the practice school is often not primarily structured to stimulate the learning of the (student) teacher but that of the pupils instead. From this perspective, we would expect more reactive learning and, therefore, more passive regulation during learning at the practice school and more active regulation, when there is time for learning as it is at the teacher education institute. An explanation of the opposite finding in this study could be that the context of the practice school is not primarily designed as a learning context for the student teacher but more as a learning environment for the pupils. Therefore, student teachers have to be more active to create learning experiences for themselves. On the other hand, these results also show that the teacher education institute does not trigger student teachers to actively engage in their learning. Although in some situations external regulation of a teacher educator is very important to support the student teacher in his or her development, student teachers often showed limited activeness during all phases of regulation while learning at the university. Boekaerts and Niemivirta (2000) have suggested that SRL may be hard to accomplish as long as students still have the assumption that the teacher takes responsibility for their learning. Furthermore, they found that students often feel less opportunity and necessity to regulate their learning, than teachers think they have created. Further research is needed to discover if this is also the case in teacher education.

The second dimension did show a significant person level variance. This indicates that some student teachers are more inclined to regulate in a prospective way and

others more in a retrospective way. Although this study was not designed to measure differences between student teachers, these outcomes suggest that the individual quality of self-regulation is more determined by the focus of the regulation on prospective or retrospective elements than on the activeness or passiveness of the regulative behaviour. Previous studies have shown that the amount of phases of SRL that students use is decisive for their performance (Zimmerman, 2006). In other words, focusing on only prospective or only retrospective elements is not enough; both sides should be included to become an expert teacher. This means that for teacher education institutes, this prospective versus retrospective regulation is an important dimension to focus on when trying to support student teachers to regulate their learning.

In this study, student teachers were asked to report several self-chosen learning experiences from different learning contexts. The advantage of this design is that student teachers could report learning experiences very close to the moment that they occurred and, if necessary, after some time for reflection. Also, the openness of the instrument made it possible to fill in different kinds of learning experience, and this resulted in a very broad overview of student teachers' regulation of learning in various learning experiences in a teacher education programme. Although the sample was selected to be large enough to maximize the variation in regulation activities, it was not selected in a way that the frequencies of these categories can be generalized to other populations. Further research is necessary in order to study how often different types of regulation occur in certain situations. The inclusion of observations and stimulated recall interviews could help to find out why student teachers regulate in a specific context in a specific way. The study has been conducted at only one teacher education institute; further research is necessary to confirm the existence of the different dimensions in a larger population.

The instrument also has some limitations; leaving the control of the selection of the learning experiences to the student teachers has as well some disadvantages. We have no information of why student teachers selected the learning experiences as they did. This might have resulted in an over-representation of some type of learning experiences, for example, learning experiences that they were proud of. Therefore, in order to use this instrument and framework to assess the quality of regulation of learning of the individual student teacher and to compare student teachers with each other, the selection of learning experiences should be prescribed to a greater extent. Another limitation of the instrument is that it may have under-represented the regulation of the process of development spread over multiple experiences. Although student teachers were instructed to describe learning experiences on different levels, the focus on the learning *experience* may have caused reports of learning experiences limited to one short event. Furthermore, to use the instrument, it was necessary for student teachers to be aware of something they had learned. Therefore, it is possible that experiences, from which the learning results evolved only after some time were reported less often.

The set of categories identified in this study shows the variation in regulation of learning across multiple learning experiences. The dimensions underlying these categories provide a better understanding of the concept of regulation of learning in the context of teacher education. The positioning of the categories gives a detailed picture of what regulation activities belong to different types of regulation. This contributes to the understanding of the phenomenon of regulation of learning in the context where learners need it most, in the absence of a structured learning environment. These results make it possible for future studies and practice to describe and improve the quality

of student teachers' regulation of learning in a more nuanced and relevant way in this specific context.

References

- Alexander, A. (1995). Superimposing a situation-specific and domain-specific perspective on an account of self-regulated learning. *Educational Psychologist*, 30, 189–193.
- Azevedo, R. (2009). Theoretical, conceptual, methodological, and instructional issues in research on metacognition and self-regulated learning: A discussion. *Metacognition and Learning*, 4, 87–95. doi:10.1007/s11409-009-9035-7
- Boekaerts, M., & Corno, L. (2005). Self-regulation in the classroom: A perspective on assessment and intervention. *Applied Psychology: An International Review*, 54, 199–231. doi:10.1111/j.1464-0597.2005.00205.x
- Boekaerts, M., & Minnaert, A. (1999). Self-regulation with respect to informal learning. *International Journal of Educational Research*, 31, 533–544. doi:10.1016/S0883-0355(99)00020-8
- Boekaerts, M., & Niemivirta, M. (2000). Self-regulated learning: Finding a balance between learning goals and ego-protective goals. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 417–450). San Diego, CA: Academic Press.
- Butler, R. (2007). Teachers' achievement goal orientations and associations with teachers' help seeking: Examination of a novel approach to teacher motivation. *Journal of Educational Psychology*, 99, 241–252. doi:10.1037/0022-0663.99.2.241
- Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research*, 1, 245–276.
- Cousin, G. (2009). *Researching learning in higher education: An introduction to contemporary methods and approaches*. New York: Routledge.
- De Leeuw, J. (2005). Nonlinear principal component analysis. Department of Statistics Papers. Retrieved from <http://respositories.cdlib.org/uclastat/papers/2005070801>
- Donche, V., Vanhoof, J., & Van Petegem, P. (2003). *Beliefs about learning environments: How do student teachers think, reflect and act concerning self-regulated and cooperative learning in Flanders (Belgium)*. Paper presented at the annual meeting of the AERA, Seattle, WA.
- Edwards, A., & Mutton, T. (2007). Looking forward: Rethinking professional learning through partnership arrangements in initial teacher education. *Oxford Review of Education*, 33, 503–519. doi:10.1080/03054980701450928
- Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education*, 26, 247–273. doi:10.1080/158037042000225245
- Funnell, B., Bryer, F., & Grimbeek, P. (2004). *Demographic profiling for educational researchers: Using Optimal Scaling to identify distinct groups of participants*. Paper presented at the 2nd annual international conference on Cognition, Language and Special Education Research, Gold Coast, Queensland, Australia.
- Hager, P. (2004). Conceptions of learning and understanding at work. *Studies in Continuing Education*, 26, 3–17. doi:10.1080/158037042000199434
- Hagger, H., Burn, K., Mutton, T., & Brindley, S. (2008). Practice makes perfect? Learning to learn as a teacher. *Oxford Review of Education*, 34, 159–178. doi:10.1080/03054980701614978
- Hodkinson, H., & Hodkinson, P. (2005). Improving schoolteachers' workplace learning. *Research Papers in Education*, 20, 109–131. doi:10.1080/02671520500077921
- Hox, J. J. (2000). Multilevel analysis of grouped and longitudinal data. In T. D. Little, K. U. Schnabel, & J. Baumert (Eds.), *Modeling longitudinal and multilevel data: Practical issues, applied approaches, and specific examples* (pp. 15–32). Mahwah, NJ: Lawrence Erlbaum Associates.
- Jorgensen, C. H. (2004). Connecting work and education: Should learning be useful, correct or meaningful? *The Journal of Workplace Learning*, 16, 455–465. doi:10.1108/13665620410566423
- Kaplan, A. (2008). Clarifying metacognition, self-regulation, and self-regulated learning. *Educational Psychology Review*, 20, 477–484. doi:10.1007/s10648-008-9087-2

- Korthagen, F. A. J. (2005). Practice, theory, and person in life-long learning. In D. Beijaard, P. C. Meijer, G. Morine-Dersheimer, & H. H. Tillema (Eds.), *Teacher professional development in changing conditions*. Dordrecht, The Netherlands: Springer.
- Kramarski, B., & Michalsky, T. (2009). Investigating preservice teachers' professional growth in self-regulated learning environments. *Journal of Educational Psychology*, 101, 161–175. doi:10.1037/a0013101
- Kreber, C., Castleden, H., Erfani, N., & Wright, T. (2005). Self-regulated learning about university teaching: An exploratory study. *Teaching in Higher Education*, 10, 75–97. doi:10.1080/1356251052000305543
- Kremer-Hayon, L., & Tillema, H. H. (1999). Self-regulated learning in the context of teacher education. *Teaching and Teacher Education*, 15, 507–522. doi:10.1016/S0742-051X(99)00008-6
- Lin, X., Schwartz, D. L., & Hatano, G. (2005). Toward teachers' adaptive metacognition. *Educational Psychologist*, 40, 245–255. doi:10.1207/s15326985ep4004.6
- Mair, P., & De Leeuw, J. (2008). Rank and set restrictions for homogeneity analysis in R: The "homals" package. UCLA Statistics Preprint Series. Retrieved from <http://preprints.stat.ucla.edu>
- Marton, F. (1986). Phenomenography – A research approach to investigating different understandings of reality. *Journal of Thought*, 21, 28–94.
- Muhr, T. (1997). *ATLAS.ti: The knowledge workbench: Visual qualitative data, analysis, management, model building: Short user's manual*. Berlin: Scientific Software Development.
- Oosterheert, I. E., & Vermunt, J. D. (2001). Individual differences in learning to teach: Relating cognition, regulation and affect. *Learning and Instruction*, 11, 133–156. doi:10.1016/S0959-4752(00)00019-0
- Pang, M. F. (2003). Two faces of variation: On continuity in the phenomenographic movement. *Scandinavian Journal of Educational Research*, 47, 145–156. doi:10.1080/0031383032000047466
- Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451–502). San Diego, CA: Academic Press.
- Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review*, 16, 385–407. doi:10.1007/s10648-004-0006-x
- Randi, J. (2004). Teachers as self-regulated learners. *Teachers College Record*, 106, 1825–1853.
- SBL. (2004). Competence requirements in pre-higher education. Retrieved from www.lerarenweb.nl
- Schunk, D. H. (2005). Commentary on self-regulation in school-contexts. *Learning and Instruction*, 15, 173–177. doi:10.1016/j.learninstruc.2005.04.013
- Schunk, D. H., & Zimmerman, B. J. (1998). *Self-regulated learning from teaching to self-reflective practice*. New York: The Guildford Press.
- Snijders, T. A. B. (1999). *Multilevel analysis. An introduction to basic and advanced multilevel modeling*. London: Sage publications.
- Tynjälä, P. (2008). Perspectives into learning at the workplace. *Educational Research Review*, 3, 130–154. doi:10.1016/j.edurev.2007.12.001
- Van Eekelen, I. M., Boshuizen, H. P. A., & Vermunt, J. D. (2005). Self-regulation in higher education teacher learning. *Higher Education*, 50, 447–471. doi:10.1007/s10734-004-6362-0
- Vermunt, J. D. (1998). The regulation of constructive learning processes. *British Journal of Educational Psychology*, 68, 149–171. doi:10.1111/j.2044-8279.1998.tb01281.x
- Vermunt, J. D., & Endedijk, M. D. (2011). Patterns in teacher learning in different phases of the professional career. *Learning and Individual Differences*, 21, 294–302. doi:10.1016/j.lindif.2010.11.019
- Winne, P. H. (1995). Self-regulation is ubiquitous but it forms vary with knowledge. *Educational Psychologist*, 30, 223–228.
- Winne, P. H., & Perry, N. E. (2000). Measuring self-regulated learning. In M. Boekaerts, P. R. Pintrich & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 531–566). San Diego: Academic Press.

- Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). San Diego, CA: Academic Press.
- Zimmerman, B. J. (2006). Development and adaptation of expertise: The role of self-regulatory processes and beliefs. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 705–742). New York: Cambridge University Press.
- Zimmerman, B. J., & Schunk, D. H. (2001). *Self-regulated learning and academic achievement. Theoretical perspectives* (2nd ed.). Mahwah: Lawrence Erlbaum Associates.

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