Studies in Educational Evaluation 39 (2013) 56–65

Contents lists available at SciVerse ScienceDirect

Studies in Educational Evaluation

journal homepage: www.elsevier.com/stueduc

Relations between student teachers' learning patterns and their concrete learning activities

Maaike D. Endedijk [a,*], Jan D. Vermunt [b]

[a] University of Twente, Faculty of Behavioural Sciences, P.O. Box 217, 7500 AE Enschede, The Netherlands
[b] University of Cambridge, Faculty of Education, 184 Hills Road, Cambridge CB2 8PQ, United Kingdom

ARTICLE INFO

Article history:
Received 23 February 2012
Received in revised form 18 September 2012
Accepted 3 October 2012

Keywords:
Learning patterns
Student teachers
Learning activities
Self-regulated learning
Questionnaires

ABSTRACT

This study aims to unravel the relationships between student teachers' learning patterns and how they actually learn in practice as measured during multiple concrete learning experiences. In previous research aptitude and event measures often pointed in different directions. 90 student teachers' learning patterns were measured with an aptitude instrument, designed for the specific context of learning to teach. Multiple concrete learning activities were measured with a structured digital log. Results showed meaningful relations between students' learning patterns and their learning activities, taking multiple learning experiences into account. Survival oriented student teachers show more inactiveness in their learning, reproduction oriented student teachers learn by doing to improve their teaching behavior, dependent meaning oriented student teachers are more influenced by previous negative experiences and independent meaning oriented student teachers show the most deep and most active way of learning. But interestingly, the results also show that some relations as described in literature did not show up. The choice for a particular processing strategy and also the intentionality of the learning experiences was not related to student teachers' learning patterns. This study demonstrates the added value of combining both types of instruments in research and practice.

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In the era in which lifelong learning is essential for further professional development, educational programs are spending part of their curriculum on developing students' skills in professional learning. This is also the case in many teacher education programs. To support student teachers in their development of professional learning, it is essential to know how different qualities in learning can be recognized in practice (Vermunt & Endedijk, 2011). Previous research has resulted in the development of the Inventory Learning to Teach Process (ILTP) to measure student teachers' patterns of learning (Oosterheert, Vermunt, & Denessen, 2002). This self-report instrument turned out to be a reliable and valid way to measure individual differences in student teachers' *professional* learning. Studies on the relation between students' learning patterns as measured by these general learning questionnaires and how students actually learn in concrete learning experiences measured with on-line methods have resulted in mixed findings (e.g., Perry & Winne, 2006; Veenman, 2005; Veenman, Prins, & Verheij, 2003). Learning is always influenced by the context in which it occurs. This may have been one of the causes of the lack of significant relations in studies in which outcomes from *general* learning pattern surveys were related to how students learned in a *specific* learning experience. This study aims to unravel relationships between student teachers' learning patterns and how they actually learn in practice as measured during multiple concrete learning experiences. In this way the study may contribute to the validation of the research instruments used, as well as to the identification of students for whom a difference exists between their learning pattern and their actual learning behavior or activities. We will study the added value of using both types of instruments measuring learning patterns and multiple concrete learning activities in research and in practice to get a comprehensive overview of how students learn instead of solely relying on one type of measurement.

Theoretical framework

Patterns in student learning

Research into student learning over the last decades has consistently identified the existence of qualitatively different ways in which students learn (e.g., Entwistle & McCune, 2004; Lonka, Olkinuora, & Mäkinen, 2004; Richardson, 2000). The first generation of models on student learning mostly incorporated two components: student motivation and cognitive learning strategies

* Corresponding author. Tel.: +31 53 4893608; fax: +31 53 4893791.
E-mail addresses: m.d.endedijk@utwente.nl (M.D. Endedijk), jdhv2@cam.ac.uk (J.D. Vermunt).

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http://dx.doi.org/10.1016/j.stueduc.2012.10.001

(e.g., Biggs, 1982; Entwistle & Ramsden, 1983). For example, in his 1982 model Biggs discerned reproducing (surface), meaningful (deep) and organizing (achieving) strategies, and three parallel motives: instrumental (surface), intrinsic (deep) and achievement (achieving). A strategy refers to a typical combination of more basic learning activities that students use to learn. A deep strategy, for instance, refers to the combined use of learning activities like searching for relations in the subject matter, processing critically, and trying to structure different pieces of subject matter into a whole. A second generation of models on student learning added metacognitive components: knowledge and beliefs (the more static aspect of metacognition), and self-regulation of learning (the more dynamic and online aspect). In these models student learning is conceptualized as involving cognitive processes, metacognitive regulation, learning motivation, and knowledge and beliefs about learning. Representations of this second generation of models are those of Pintrich and his collaborators (e.g., Pintrich, 2004) and our own work (e.g., Vermunt & Vermetten, 2004).

Typically, these studies show patterns in student learning characterized by strong relations between behavioral, knowledge/belief, and motivational components. In earlier studies, these patterns were called 'learning styles' (Vermunt, 1996). These learning styles were conceived as a coherent repertoire of learning activities that students usually employ, their learning motivation and their conception of learning, a whole that is characteristic of them in a certain period. Within this broader meaning learning style is thus a coordinating concept, in which the interrelations among cognitive, affective and regulative learning activities, conceptions of learning and learning motivations are united. Learning style is *not* conceived of as an unchangeable personality attribute, but as the result of the temporal interplay between personal and contextual influences (Vermunt, 1996, 1998). Later on, because learning 'style' was often conceived by other people as something unchangeable, almost innate, an invariant attribute of students, deeply rooted in personality, this was changed to the more neutral term 'learning pattern' for the same phenomenon that was previously described as a 'learning style' (e.g., Vermunt, 2005). Other authors have used different terms to denote these patterns, such as 'study orientations' (e.g., Entwistle & McCune, 2004), 'study orchestrations' (Meyer, 1991), and 'learning orientations' (e.g., Lonka & Lindblom-Ylänne, 1996). Here, we will use the term 'learning pattern' as consistently as possible for the phenomenon described above. Coffield, Moseley, Hall, and Ecclestone (2004), in their excellent review of learning style models, note that there are different 'families' of learning style models, differing in their assumption of the degree to which learning styles are fixed traits (e.g. Gregorc, 1982) or changeable through personal and environmental influences (Entwistle & Ramsden, 1983).

Reproduction oriented learning and meaning oriented learning have remained the main two dimensions for describing individual differences in students' learning conceptions (Marton & Säljö, 1976), learning approaches (Biggs, 1988; Entwistle, 1988), learning styles (Vermunt, 1996), and learning patterns (Vermunt & Vermetten, 2004). However, in addition to the basic distinction between meaning and reproduction directed learning, several authors have also identified an application-directed and an undirected way of learning (cf. Lonka & Lindblom-Ylänne, 1996; Schmeck, 1983; Vermunt & Vermetten, 2004).

This field of research had led to the development of multiple self-report instruments to measure these learning patterns, such as the Learning and Study Strategies Inventory (LASSI) (Weinstein, Schulte, & Palmer, 1987), Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich & Smith, 1993), Inventory of Learning Styles (ILS) (Vermunt, 1998), the revised two-factor Study Process Questionnaire (R-SPQ-2F) (Biggs, Kember, & Leung, 2001), and the Approaches to Learning and Studying Inventory (ALSI) (Entwistle & McCune, 2004). These instruments are valuable for measuring what students perceive to be their general learning preferences, as well as their general motivation and capacity for self-regulation (Perry & Winne, 2006; Pintrich, 2004; Zimmerman, 2008) and are also most practical in use (Pintrich, 2004). Although these instruments can be reliable and valid, many authors consider the results to be poor indicators of the actual activities that students use while studying (e.g., Perry, 2002; Perry & Winne, 2006; Pintrich, 2004; Veenman, 2005; Winne & Perry, 2000). This often leads to low predictive values of these instruments for learning outcomes and low correlations with on-line methods (Veenman, 2005). These low correlations may be caused by the fact that outcomes of these instruments are always compared with a single on-line measurement of concrete learning activities. In this way the specific context of the concrete learning experience may be very influential. Therefore, in this study we will focus on students' actual learning activities as performed in multiple concrete learning experiences.

Patterns in learning to teach

In a previous study (Vermunt & Endedijk, 2011), we compared models of student learning patterns with teacher learning patterns. A review of literature showed that patterns in teacher learning consist of comparable *elements* as student learning models: beliefs on learning, motivations to learn, learning activities, and regulation activities. In teacher learning, however, the patterns derived from combinations of these elements are different than in student learning, or patterns have been defined in another way. This is especially the case for reproduction oriented learning which is often not found in teacher learning or defined differently as is done in the study of Oosterheert and Vermunt (2001). In this study, reproduction is more defined as a reproduction of practice than as a reproduction of knowledge. They studied individual differences in learning to teach in several Dutch pre-service teacher education programmes. Based on extensive interviews with student teachers and a follow-up questionnaire study they discerned the following four learning patterns:

1. *Inactive or survival pattern*: student teachers with this pattern stress that all one needs for learning to teach is a lot of teaching practice and experience. They do not appreciate the help of others to become aware of their teaching, but also do not think that they are able to regulate their learning themselves. They hardly use the available sources of information and feedback in their learning environment, such as their mentor and are very avoidant and not preoccupied with bad lesson experiences.
2. *Reproduction pattern*: these student teachers are focused on improving their teaching performance within their actual frame of reference. They are not directed at further developing this frame of reference which results in limited use of available sources. They acknowledge bad lesson experiences and have serious worries about these.
3. *Closed (or dependent) meaning pattern*: these student teachers try to extend their frame of reference and depend on external sources in doing so, which they highly value. They do not trust their own perceptions and thinking; others have to help them to interpret their experiences. They are extremely preoccupied with their bad teaching experiences.
4. *Open (or independent) meaning pattern*: these student teachers are most independent in learning to teach: they try to develop their frame of reference, make broad use of external sources and are highly self-regulative. They define problems of learning to teach not only as problems of performance, but also of meaning. They are not very preoccupied with bad lesson experiences (Oosterheert, Vermunt, & Veenstra, 2002).

Not only for academic learning, but also for learning to teach, an independent meaning oriented learning pattern is regarded as

essential in being prepared for further professional development (Bakkenes, Vermunt, & Wubbels, 2010; Oosterheert, 2001). The study of Oosterheert, Vermunt, and Denessen (2002) is also the only study on learning to teach that led to the development of an aptitude instrument named the Inventory Learning to Teach Process (ILTP). This instrument measures student teachers' learning patterns in which preferences for learning activities have also been included. In contrast with the other instruments, this is the only instrument that covers not academic learning, but measures *professional* learning of the students.

Learning activities during learning to teach

Learning activities in the context of student learning have been categorized in cognitive, affective and regulative activities (Vermunt & Verloop, 1999). These activities have especially been defined for learning in terms of change of knowledge and less in terms of change in skills and attitude which are essential elements of learning in professional practice. Literature from the context of professional learning shows various typologies of teachers' learning activities in which learning by doing, reading, experimenting, observing, reflecting, co-operating, and asking feedback are often mentioned activities (Vermunt & Endedijk, 2011; Bakkenes et al., 2010; Hoekstra, Brekelmans, Beijaard, & Korthagen, 2009; Kwakman, 2003). The study of Van Eekelen, Boshuizen and Vermunt (2005) focused explicitly on teachers' regulation of learning, showing three types of teacher regulation: spontaneous learning, non-linear learning and planned learning. This study did not result in a description of more specific regulation activities of teachers.

Most studies in the context of *learning to teach* examined aspects of student teachers' learning while following a course at the university (Donche & Van Petegem, 2009; Järvenoja & Järvelä, 2009). Studies on student teachers' learning activities that also include professional learning are almost absent. One of our previous studies focused therefore on identifying the nature of student teachers' regulation of learning and individual differences herein during both theoretical study and teaching practice in parallel (Endedijk, Vermunt, Verloop, & Brekelmans, 2012). In this study student teachers' goal setting, strategic planning (the decisions about how to accomplish the goals), strategy choice, self-efficacy, monitoring, self-reflection, self-evaluation and inferences for subsequent learning experiences was measured in concrete learning experiences (Endedijk, Vermunt, Verloop, & Brekelmans, 2012). Content analysis of 133 learning experiences resulted in a description of five to seven categories per element, reflecting the large variety in activities that student teachers used in the context of learning to teach. Results from the descriptive categories were a strong focus of the activities on teaching practice and changes in own behavior, and a high frequency of spontaneous and unplanned learning experiences. At the same time, it turned out that also in these spontaneous learning experiences high quality of regulation could be found (Endedijk, Vermunt, Verloop, & Brekelmans, 2012). Just as in the context of teacher professional learning (Bakkenes et al., 2010; Van Eekelen et al., 2005), this study showed that student teachers' learning processes are less sequenced than theories developed for the context of academic learning prescribe (Azevedo, 2009). Research on learning to teach in which professional learning in practice is included can therefore often not rely on existing frameworks and instruments which are developed in the field of student learning in pure academic learning environments.

The present study

The main research question of this study is: what are the relationships between student teachers' learning patterns and their concrete learning activities in multiple learning experiences? We expect to find relations between student teachers' learning patterns and concrete learning in line with the typology of Oosterheert (2001). We expect student teachers with a meaning oriented pattern of learning to conduct learning activities referring to a deep way of learning and an active way of regulation of learning and to show a more intrinsic learning motivation. We expect inactive or survival oriented learners to learn less in a planned way, to often use learning by doing as a learning activity and not often to ask for help from other people. We expect that reproduction oriented student teachers show learning activities focused on improving their practice and not much related to integrating new insights.

This study was carried out in a teacher education context in which professional learning in practice is combined with learning at the university. This context was chosen, because in programs where students learn in different types of environments, more variation can be expected in learning activities than in solely academic or professional learning environments, since both contexts influence what and how student teachers learn. In the teacher education program studied here, students first obtain their master's degree in a specific subject area and then enter the one-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.

Method

Participants

All 90 full-time student teachers from the teacher education programme under study initially volunteered in this study. Five student teachers cancelled their participation before the start of the research project, because of lack of time, illness, pregnancy, other expectations, and one left the teacher education programme. Four other student teachers did not cancel their participation explicitly, but also did not complete any of the instruments. The final set of 81 participants (response rate 90%) consisted of 24 (29.6%) male and 57 (70.4%) female student teachers from eighteen different general secondary school subjects. They were on average 25 years and 11 months old (SD = 3.96).

Instruments

Student teachers' learning patterns were measured with an aptitude instrument, designed for the specific context of learning to teach. The concrete learning activities were measured with a structured digital log, also specifically designed for the context of learning to teach. Both instruments are described below in more detail.

Measuring learning patterns

The student teachers' learning patterns were studied with the Inventory Learning to Teach Process (ILTP), developed by Oosterheert, Vermunt, and Denessen (2002). In this study, the revised and shortened version of 52-items was used (Oosterheert, Vermunt, & Veenstra, 2002). This questionnaire has been validated in The Netherlands with 382 student teachers (Oosterheert, 2001) and in Belgium with 366 student teachers (Donche & Van Petegem, 2005). The instrument consists of ten scales with Likert-scale items reflecting their learning conception, learning activities, and emotion regulation. The internal consistency of the scales in the original study of Oosterheert (2001) with a five points Likert scale ranged from Chronbach's α = .66 to α = .86. In this study we used a seven points Likert scale ranging from 1 (not true of me) to 7 (true

of me). Reliability analysis of the data set used in this study showed comparable or higher consistency scores (α = .63–.89), except for one scale, resulting in score of α = .54 (α = .67 in the study of Oosterheert (2001)). This was a three-item scale and removing items did not increase the reliability. For a more complete description of the development and description of the instrument and scales we refer to Oosterheert (2001).

Measuring learning activities

For the purpose of this study a structured version of an open question log was developed, which was used in a previous small-scale study (Endedijk, Vermunt, Verloop, & Brekelmans, 2012). In the previous version, student teachers were asked to describe learning activities from concrete learning experiences, which we categorized. The answer options of the current structured version were derived from these categories and pilot tested (Endedijk, 2010). The instrument was developed and validated to measure student teachers' learning activities in multiple concrete learning experiences. This instrument, called the Structured Learning Report is a multiple-event measurement device, meaning that learning is measured from student teachers' reports of different concrete learning experiences. In this study we chose to collect six learning experiences on three measurement moments, to get a good overview of their variation in learning experiences. The Structured Learning Report was transformed into a web-based questionnaire which could be accessed at any moment during the data collection period by the student teacher. In the Structured Learning Report questions were included about several learning activities, including concrete processing activities, regulative activities and affective activities. These were based on the conceptual models of Pintrich (2000), Vermunt and Verloop (1999) and Zimmerman (2000). The following variables were included: reflection on the learning outcome, motivation for learning, processing strategy, strategy choice, monitoring of the learning results, evaluation of the learning experience, and inferences for subsequent learning experiences. In the original Learning Report (Endedijk, Vermunt, Verloop, & Brekelmans, 2012), also *sources of self-efficacy* was included as a variable, but in the structured version not enough variation was found to include it in the analysis. The first question regarding *reflection on the learning outcome* was the only open question in the questionnaire. Here, the student teachers were able to describe their learning outcomes in their own words, after which they proceeded with the multiple choice questions. The remaining seven questions were multiple choice questions about learning activities. The choice and phrasing of the options was based on the previous open question version (Endedijk, Vermunt, Verloop, & Brekelmans, 2012). The different multiple choice options are described in the result section. Student teachers also had the possibility to answer "I don't know" or "other, namely…", after which they could phrase their own option. These two extra options were chosen very infrequently and are therefore not included in the analyses. The answers to the first open question were categorized by the principal researcher into seven qualitative different categories of reflections on learning outcomes. An inter-rater reliability procedure was carried out by a second independent researcher, resulting in a Cohen's Kappa of .81.

Procedure

The data collection took place in three periods of two weeks with three months interval. In every period student teachers were asked to complete the ILTP. Moreover, during every period they were instructed to report six different learning experiences online. They were asked to describe different kinds of learning experiences as part of their development as a teacher: two learning experiences that had taken place in the context of the teacher education institute, at least two that had taken place in the context of the practice school, and two free of choice. Student teachers could choose any experience that they considered as being a learning experience part of their development as a teacher, planned and unplanned, successful or unsuccessful. As a reward for their participation, they received a written personal description of their development as a learner at the end of the study.

During the three measurement periods, respectively 78, 74, and 68 student teachers completed the ILTP. For the measurement of the concrete learning activities, 75 student teachers participated during the first period, 71 participants in period two, and 69 participants in period three. Some student teachers did not complete all six Learning reports during every period as requested. In this way 1292 Learning Reports were collected.

Analysis

To analyze the relation between learning patterns and learning activities, Chi-square analyses were carried out. The Chi-square analyses were supplemented with post hoc adjusted residual analyses (Haberman, 1973) to test not only whether the relation between two variables was significant, but also whether particular cells in the crosstabs show a significant deviation from the expected frequency. When an adjusted residual larger than 2 (or smaller than −2) is found, indicating a difference of two standard deviations, the deviation from the expected frequency in the particular cell can be regarded as statistically significant (Haberman, 1973). In this way, relations between specific categories of the variables under study can be identified as well. The analyses have been conducted on learning experiences (N = 1292) as the unit of analysis, since aggregation of categorical data is not possible. Therefore, we also analyzed whether student teachers with certain learning orientations completed more Learning Reports and therefore could be overrepresented in our data set.

Results

In the overall dataset, across three measurement moments, 64 (29.8%) student teachers had a survival oriented way of learning, 41 (19.1%) student teachers had a reproduction oriented pattern, 61 student teachers (28.4%) a dependent meaning oriented way of learning, and 49 (22.8%) meaning oriented learners were found. From the student teachers who completed the ILTP, 1266 learning experiences were collected. In total, 377 learning experiences were collected from survival oriented learners (M = 5.89, SD = .65), all reproduction oriented learners completed all the six Learning Reports, resulting in 246 learning reports. In total, 356 learning experiences were collected from dependent meaning oriented learners (M = 5.84, SD = .55) and 287 from independent meaning oriented learners (M = 5.86, SD = .65). The number of reported learning experiences was not related to the learning patterns, $F(3) = 0.79$, p = .50. This shows that no group of student teachers is under- or overrepresented in the Learning Report data.

The relation between the learning activities as described in the Learning Reports with student teachers' learning patterns was calculated with Chi-square analyses with the Learning Report as the unit of analysis and will be presented below. The outcomes are also displayed in Tables 1–7, showing the Observed Frequency (OF), Expected Frequency (EF), and Adjusted Residual (AR).

Learning patterns in relation to reflection on learning outcomes

Seven different reflections were identified in the qualitative analysis of the open question: *What did you learn?* These included reflection on learning outcomes as a *rule of thumb*, as *factual knowledge*, as *procedural knowledge*, as *change in their own learning*

Table 1
Crosstab of learning patterns with reflection on learning outcome, including Observed Frequencies, Expected Frequencies and Adjusted Residuals.

Categories	S	R	DM	IM	Total
Rule of thumb					
Observed Frequency	64	55	59	38	216
Expected Frequency	64.3	42.0	60.7	49.0	216.0
Adjusted Residual	−0.1	2.5*	−0.3	−2.0*	
Factual knowledge					
Observed Frequency	111	51	74	61	297
Expected Frequency	88.4	57.7	83.5	67.3	297.0
Adjusted Residual	3.3*	−1.1	−1.4	−1.0	
Procedural knowledge					
Observed Frequency	19	17	25	16	77
Expected Frequency	22.9	15.0	21.7	17.5	77.0
Adjusted Residual	−1.0	0.6	0.9	−0.4	
Own learning or identity					
Observed Frequency	78	53	71	72	274
Expected Frequency	81.6	53.2	77.0	62.1	274.0
Adjusted Residual	−0.5	0.0	−0.9	1.6	
Teaching practice					
Observed Frequency	40	21	43	28	132
Expected Frequency	39.3	25.6	37.1	29.9	132.0
Adjusted Residual	0.1	−1.1	1.2	−0.4	
Theory of practice					
Observed Frequency	41	30	64	54	189
Expected Frequency	56.3	36.7	53.1	42.8	189.0
Adjusted Residual	−2.6*	−1.3	1.9	2.1*	
No description of learning					
Observed Frequency	24	19	20	18	81
Expected Frequency	24.1	15.7	22.8	18.4	81.0
Adjusted Residual	0.0	0.9	−0.7	−0.1	
Total					
Observed Frequency	377	246	356	287	1266
Expected Frequency	377.0	246.0	356.0	287.0	1266.0

S = survival oriented, R = reproduction oriented, DM = dependent meaning oriented, IM = independent meaning oriented.
* Significant deviation of the Observed Frequency from the Expected Frequency.

Table 2
Crosstab of learning patterns with motivation for learning, including Observed Frequencies, Expected Frequencies and Adjusted Residuals.

Categories	S	R	DM	IM	Total
Unintentional learning experience					
Observed Frequency	168	124	151	127	570
Expected Frequency	172.4	113.3	158.8	125.4	570.0
Adjusted Residual	−0.6	1.6	−1.0	0.2	
Unsatisfied about a previous experience					
Observed Frequency	45	38	82	37	202
Expected Frequency	61.1	40.2	56.3	44.5	202.0
Adjusted Residual	−2.7*	−0.4	4.4*	−1.4	
To practice					
Observed Frequency	41	15	19	19	94
Expected Frequency	28.4	18.7	26.2	20.7	94.0
Adjusted Residual	2.9*	−1.0	−1.7	−0.4	
Curiosity					
Observed Frequency	45	20	29	30	124
Expected Frequency	37.5	24.7	34.6	27.3	124.0
Adjusted Residual	1.5	−1.1	−1.2	0.6	
Stimulation by others					
Observed Frequency	28	18	25	19	90
Expected Frequency	27.2	17.9	25.1	19.8	90.0
Adjusted Residual	0.2	0.0	0.0	−0.2	
Preparing for future					
Observed Frequency	29	19	22	27	97
Expected Frequency	29.3	19.3	27.0	21.3	97.0
Adjusted Residual	−0.1	−0.1	−1.2	1.4	
Total					
Observed Frequency	356	234	328	259	1177
Expected Frequency	356.0	234.0	328.0	259.0	1177.0

S = survival oriented, R = reproduction oriented, DM = dependent meaning oriented, IM = independent meaning oriented.
* Significant deviation of the Observed Frequency from the Expected Frequency.

or identity, as *teaching practice*, as *theory of practice*, and in some cases *no description of learning* was found in the description. Chi-square analyses showed that these different reflections were related to the learning patterns of the student teachers, $\chi^2(18) = 32.0$, $p = .002$. Post hoc analyses (see Table 1) showed that especially the reflection as a rule of thumb was significantly more often reported by reproduction oriented learners (OF = 55, EF = 42, AR = 2.5) and less often by independent meaning oriented learners than expected (OF = 38, EF = 49, AR = −2.0). Furthermore, a description of learning in terms of factual knowledge was more frequently done by survival oriented learners (OF = 111, EF = 88.4, AR = 3.3). Reflections on learning in terms of theory of practice are more often done by independent meaning oriented learners (OF = 54, EF = 42.8, AR = 2.1) and less frequent by survival oriented learners (OF = 41, EF = 56.3, AR = −2.6).

Learning patterns in relation to motivation for learning

In the questionnaire, six options were given as motivations for this specific learning experience. Before this question, student teachers first answered the question whether this learning experience was an intentional learning experience. In case of *unintentional* learning experiences, student teachers did not have to answer the question about their motivation for wanting this to learn, since the learning experience took place spontaneously. In total 570 unintentional learning experiences were found (see Table 2). The other options were that they wanted to learn this because they were *unsatisfied about a previous experience*; they wanted *to practice* with something; they were *curious* about something; *others stimulated* to develop themselves in this, or because they wanted *to prepare myself for future possible experiences*. These different motivations for learning were significantly related to their learning patterns, $\chi^2(15) = 33.3$, $p = .004$. Analyses of the Adjusted Residuals (see Table 2) showed that especially for dependent meaning oriented learners being unsatisfied about a previous experience was a drive for learning (OF = 82, EF = 56.3, AR = 4.4), while survival oriented learners reported this significantly less often than expected (OF = 45, EF = 61.1, AR = −2.7). These survival oriented learners reported significantly more practicing as a reason for learning (OF = 41, EF = 28.4, AR = 2.9). Stimulation by others was equally distributed among the four learning patterns. Learning to prepare oneself for future experiences were found more than expected with independent meaning oriented learners, but this was not significant on the cell level (OF = 27, EF = 21.4, AR = 1.4). Also the intentionality of the learning experience was not related to the learning patterns.

Learning patterns in relation to processing strategies

Seven processing strategies were discerned in this questionnaire: learning by *doing* it or experiencing it, learning by *experimenting*, by *evaluating* what went well and wrong in my lesson or another situation, by *analyzing* my and others' role in a situation, by *getting information*, by *getting feedback* from others, and by *observing* how others do something. The relation between these strategies and learning patterns was not significantly related on the $p = .05$ level ($\chi^2(18) = 28.2$, $p = .059$). In Table 3 some trends

Table 3
Crosstab of learning patterns with processing strategies, including Observed Frequencies, Expected Frequencies and Adjusted Residuals.

Categories	S	R	DM	IM	Total
Learning by doing					
Observed Frequency	105	82	82	74	343
Expected Frequency	103.2	68.3	95.9	75.6	343.0
Adjusted Residual	0.3	2.2*	−2.0*	−0.2	
Learning by experimenting					
Observed Frequency	54	39	42	34	169
Expected Frequency	50.8	33.7	47.3	37.2	169.0
Adjusted Residual	0.6	1.1	−1.0	−0.6	
Learning by evaluating					
Observed Frequency	20	17	29	23	89
Expected Frequency	26.8	17.7	24.9	19.6	89.0
Adjusted Residual	−1.6	−0.2	1.0	0.9	
Learning by analyzing					
Observed Frequency	22	5	28	28	83
Expected Frequency	25.0	16.5	23.2	18.3	83.0
Adjusted Residual	−0.7	−3.3*	1.2	2.7*	
Learning by getting information					
Observed Frequency	83	49	82	53	267
Expected Frequency	80.3	53.2	74.7	58.8	267.0
Adjusted Residual	0.4	−0.7	1.1	−1.0	
Learning by getting feedback					
Observed Frequency	54	34	55	41	184
Expected Frequency	55.4	36.6	51.5	40.5	184.0
Adjusted Residual	−0.2	−0.5	0.6	0.1	
Learning by observing					
Observed Frequency	17	9	12	7	45
Expected Frequency	13.5	9.0	12.6	9.9	45.0
Adjusted Residual	1.1	0.0	−0.2	−1.1	
Total					
Observed Frequency	355	235	330	260	1180
Expected Frequency	355.0	235.0	330.0	260.0	1180.0

S = survival oriented, R = reproduction oriented, DM = dependent meaning oriented, IM = independent meaning oriented.
* Significant deviation of the Observed Frequency from the Expected Frequency.

in the data can be found, namely that dependent meaning oriented learners less often learn by doing (OF = 82, EF = 95.9, AR = −2.0), while reproduction oriented learning do this more frequent (OF = 82, EF = 68.3, AR = 2.2). Furthermore, independent meaning oriented learners learn more than expected by analyzing (OF = 28, EF = 18.3, AR = 2.7), which is something that reproduction oriented learners hardly do (OF = 16.5, EF = 5, AR = −3.3).

Learning patterns in relation to strategy choices

Student teachers were also asked why they had chosen a specific strategy. Again this was only asked to student teachers who said to have had an intentional learning experience. Reasons for this were that: it is *not possible to learn it in another way*, *someone else suggested* to me to learn it this way, this was the *easiest or the fastest way* to learn it, or *compared with other ways of learning this way of learning often works well* for me. These reasons were also significantly related to the learning patterns, $\chi^2(12) = 25.17$, $p = .014$. The option *there is no other way to learn this* was significantly more chosen by survival oriented learners (OF = 50, EF = 37.5, AR = 2.6) and less often by independent meaning oriented learners (OF = 18, EF = 28.1, AR = −2.3). Furthermore, the option that it *compared with other options the way of learning that works well* showed the opposite distribution, namely it was significantly less frequently chosen by survival oriented learners (OF = 6, EF = 13.6, AR = −2.5) and more than expected by independent meaning oriented learners (OF = 16, EF = 10.2, AR = 2.1) (see Table 4).

Table 4
Crosstab of learning patterns with strategy choice, including Observed Frequencies, Expected Frequencies and Adjusted Residuals.

Categories	S	R	DM	IM	Total
Unintentional learning experience					
Observed Frequency	258	183	228	197	866
Expected Frequency	261.6	171.4	236.6	196.4	866.0
Adjusted Residual	−0.5	1.9	−1.3	.1	
No other way to learn this					
Observed Frequency	50	22	34	18	124
Expected Frequency	37.5	24.5	33.9	28.1	124.0
Adjusted Residual	2.6*	−0.6	.0	−2.3*	
Suggestion of someone else					
Observed Frequency	21	8	28	16	73
Expected Frequency	22.0	14.5	19.9	16.6	73.0
Adjusted Residual	−0.3	−2.0*	2.2*	−0.2	
Easiest of fastest way					
Observed Frequency	22	13	18	21	74
Expected Frequency	22.4	14.6	20.2	16.8	74.0
Adjusted Residual	−0.1	−0.5	−0.6	1.2	
Compared with other ways of learning, this works well					
Observed Frequency	6	8	15	16	45
Expected Frequency	13.6	8.9	12.3	10.2	45.0
Adjusted Residual	−2.5*	−0.3	0.9	2.1*	
Total					
Observed Frequency	357	234	323	268	1182
Expected Frequency	357.0	234.0	323.0	268.0	1182.0

S = survival oriented, R = reproduction oriented, DM = dependent meaning oriented, IM = independent meaning oriented.
* Significant deviation of the Observed Frequency from the Expected Frequency.

Table 5
Crosstab of learning patterns with monitoring of the learning results, including Observed Frequencies, Expected Frequencies and Adjusted Residuals.

Categories	S	R	DM	IM	Total
Something worked out well					
Observed Frequency	70	58	77	55	260
Expected Frequency	76.4	48.9	73.5	61.2	260.0
Adjusted Residual	−1.0	1.7	0.6	−1.0	
Something did NOT work out well					
Observed Frequency	21	12	9	26	68
Expected Frequency	20.0	12.8	19.2	16.0	68.0
Adjusted Residual	0.3	−0.3	−2.8*	3.0*	
The reaction of others					
Observed Frequency	36	16	30	21	103
Expected Frequency	30.3	19.4	29.1	24.2	103.0
Adjusted Residual	1.3	−0.9	0.2	−0.8	
Feedback					
Observed Frequency	44	33	38	26	141
Expected Frequency	41.4	26.5	39.8	33.2	141.0
Adjusted Residual	0.5	1.5	−0.4	−1.5	
Reflection on my experience					
Observed Frequency	42	32	42	45	161
Expected Frequency	47.3	30.3	45.5	37.9	161.0
Adjusted Residual	−1.0	0.4	−0.7	1.4	
New information					
Observed Frequency	68	40	67	56	231
Expected Frequency	67.9	43.4	65.3	54.4	231.0
Adjusted Residual	0.0	−0.7	0.3	0.3	
Awareness of own behavior					
Observed Frequency	30	8	36	20	94
Expected Frequency	27.6	17.7	26.6	22.1	94.0
Adjusted Residual	0.6	−2.7*	2.3*	−0.5	
Total					
Observed Frequency	311	199	299	249	1058
Expected Frequency	311.0	199.0	299.0	249.0	1058.0

S = survival oriented, R = reproduction oriented, DM = dependent meaning oriented, IM = independent meaning oriented.
* Significant deviation of the Observed Frequency from the Expected Frequency.

Table 6
Crosstab of learning patterns with evaluation of the learning experience, including Observed Frequencies, Expected Frequencies and Adjusted Residuals.

Categories	S	R	DM	IM	Total
Totally satisfied					
Observed Frequency	312	206	282	207	1007
Expected Frequency	296.6	198.9	284.0	227.5	1007.0
Adjusted Residual	2.7*	1.4	−0.4	−3.9*	
Earlier in my development					
Observed Frequency	15	9	35	27	86
Expected Frequency	25.3	17.0	24.3	19.4	86.0
Adjusted Residual	−2.5*	−2.2*	2.7*	2.0*	
Better preparation					
Observed Frequency	7	3	6	14	30
Expected Frequency	8.8	5.9	8.5	6.8	30.0
Adjusted Residual	−0.7	−1.4	−1.0	3.2*	
Tackling things differently					
Observed Frequency	11	15	11	11	48
Expected Frequency	14.1	9.5	13.5	10.8	48.0
Adjusted Residual	−1.0	2.0*	−0.8	0.1	
Behavior of my pupils					
Observed Frequency	7	3	3	11	24
Expected Frequency	7.1	4.7	6.8	5.4	24.0
Adjusted Residual	0.0	−0.9	−1.7	2.8*	
Total					
Observed Frequency	352	236	337	270	1195
Expected Frequency	352.0	236.0	337.0	270.0	1195.0

S = survival oriented, R = reproduction oriented, DM = dependent meaning oriented, IM = independent meaning oriented.
* Significant deviation of the Observed Frequency from the Expected Frequency.

Table 7
Crosstab of learning patterns with inferences for subsequent learning experiences, including Observed Frequencies, Expected Frequencies and Adjusted Residuals.

Categories	S	R	DM	IM	Total
No new plans					
Observed Frequency	50	28	26	17	121
Expected Frequency	36.0	23.7	33.9	27.4	121.0
Adjusted Residual	2.9*	1.0	−1.7	−2.4*	
Trying again					
Observed Frequency	8	5	7	7	27
Expected Frequency	8.0	5.3	7.6	6.1	27.0
Adjusted Residual	0.0	−0.1	−0.2	0.4	
Concrete action plan					
Observed Frequency	19	17	16	21	73
Expected Frequency	21.7	14.3	20.5	16.5	73.0
Adjusted Residual	−0.7	0.8	−1.2	1.3	
Consolidation					
Observed Frequency	51	34	46	21	152
Expected Frequency	45.3	29.7	42.6	34.4	152.0
Adjusted Residual	1.1	0.9	0.6	−2.8*	
Further improving					
Observed Frequency	74	65	90	71	300
Expected Frequency	89.4	58.7	84.2	67.8	300.0
Adjusted Residual	−2.2*	1.1	0.9	0.5	
Applying in practice					
Observed Frequency	108	64	110	81	363
Expected Frequency	108.1	71.0	101.8	82.1	363.0
Adjusted Residual	0.0	−1.1	1.1	−0.2	
Trying out in different situation					
Observed Frequency	24	12	24	33	93
Expected Frequency	27.7	18.2	26.1	21.0	93.0
Adjusted Residual	−0.9	−1.7	−0.5	3.1*	
New learning goal					
Observed Frequency	27	12	21	23	83
Expected Frequency	24.7	16.2	23.3	18.8	83.0
Adjusted Residual	0.6	−1.2	−0.6	1.2	
Total					
Observed Frequency	361	237	340	274	1212
Expected Frequency	361.0	237.0	340.0	274.0	1212.0

S = survival oriented, R = reproduction oriented, DM = dependent meaning oriented, IM = independent meaning oriented.
* Significant deviation of the Observed Frequency from the Expected Frequency.

Learning patterns in relation to monitoring of learning results

Student teachers were also asked how they knew that they learned something. The options in the questionnaire were: the moment I experienced that *it worked out* well; the moment I experienced that *it did NOT work out well*; the moment I saw or heard *the reaction of others*; the moment I received *feedback*; the moment I *reflected on my experience*; the moment I realized that *I received new information*; the moment *I became aware of my own behavior*. These monitoring strategies were significantly related to the learning patterns, $\chi^2(18) = 32.04$, $p = .022$. Especially the realization that something did NOT work out well was more reported as a reason for independent meaning oriented learners to realize that they learned something (OF = 26, EF = 16, AR = −3.0), while this was significantly less often the case for dependent meaning oriented learners (OF = 9, EF = 19.2, AR = −2.8). These dependent meaning oriented learners realized in more cases than expected that they learned something because they became aware of their own behavior (OF = 36, EF = 26.6, AR = 2.3), something that is done less frequent by reproduction oriented learners (OF = 8, EF = 17.7, AR = −2.7) (see Table 5).

Learning patterns in relation to evaluation of the learning experience

Student teachers also had to evaluate the learning experience. The major part said to be totally satisfied with it ($N = 1007$), others could choose from the options that they retrospectively: would have wanted to learn this *earlier in my development*; would have wanted *to prepare myself better*; would have wanted to *tackle things differently* during this experience; would have wanted *my pupils to behave differently*. In the questionnaire also the options: I would have liked *to learn this in a different way* and I would have hoped that *others would cooperate better*, were given, but they were chosen so infrequently that they could not be included in the analyses. The relations with learning patterns were significant, $\chi^2(12) = 41.7$, $p = .000$. Post hoc analyses (see Table 6) showed that survival oriented learners were significantly more often totally satisfied with their experience (OF = 312, EF = 296.6, AR = 2.7), while independent meaning oriented learners were this less than expected (OF = 207, EF = 227.5, AR = −3.9). Furthermore, student teachers with both meaning oriented learning patterns realized more often that they would have preferred to learn this earlier in their development, compared to survival and reproduction oriented learners. Independent meaning oriented learners are also more frequent not happy with their own preparation (OF = 14, EF = 6.8, AR = 3.2) and with the behavior of their pupils (OF = 11, EF = 5.4, AR = 2.8). Reproduction oriented learners were more unhappy with how they tackled thing during their experience (OF = 15, EF = 9.5, AR = 2.0).

Learning patterns in relation with inferences for new learning experiences

Student teachers were asked how they would proceed with this learning experience. Options in the questionnaire were: I have *no new plans* (yet); It did not work out the way I wanted, so I am going *to try again*; I have *a concrete action plan* for what I will do next time in a comparable situation; I want to *consolidate* what I have learned; I want to *further improve* what I have learned; I want to

apply in practice what I have learned; I want to *try out what I have learned in a different situation*; Based on what I have learned, I have formulated *a new learning goal* for myself. Again these strategies for further learning were significantly related to the learning patterns, $\chi^2(21) = 39.4$, $p = .009$. Analyses of the adjusted residuals (see Table 7) showed that having no new plans was more frequently noticed with survival oriented learners (OF = 50, EF = 36, AR = 2.9) and less often with independent meaning oriented learners (OF = 17, EF = 27.4, AR = −2.4). Survival oriented learners wanted in less experiences to further improve their learning (OF = 74, EF = 89.4, AR = −2.2), and independent meaning oriented learners chose less often for consolidation (OF = 21, EF = 34.4, AR = −2.8), but more frequent to try things in different situations (OF = 33, EF = 21.0, AR = 3.1).

Conclusion: student teachers' learning patterns and how they actually learn in concrete learning experiences

The study was designed to unravel the relationship between student teachers' learning patterns and their concrete learning activities. Results have shown that for all learning activities, except for the processing strategies, significant relations were found. Additional analyses have shown that student teachers with different learning patterns can be typified in terms of what they actually do while learning as following:

Student teachers with a *survival oriented way* of learning reflect on their learning more often in terms of factual knowledge and less often in terms of an integrated theory of practice. Their intentional learning experiences often start because they want to practice, this is less often related to a previous bad lesson experience. They do not often deliberately choose for a certain strategy, since they often think that there is no other way to learn this. Furthermore, they are often totally satisfied with their learning experiences and very infrequently think that this could have been planned earlier in their development. After the learning experience they have, more often than other student teachers, no new plans. Overall, the learning activities which are related to survival oriented learning represent an inactive way of learning in which learning experiences seem to be very disconnected to each other.

Student teachers with a *reproduction oriented way* of learning show a different profile in terms of their learning activities. They often reflect of their learning outcomes in terms of a rule of thumb and they more often learn by doing and hardly by analyzing what went well and wrong in a situation. They are not very keen on basing their strategies on the suggestion of someone else. The monitoring of their learning is often focused on something that worked out well and hardly on becoming aware of their own behavior. While evaluating they often realize that they wanted to have tackled things differently. These activities show that for student teachers with a reproduction oriented way of learning, their concrete teaching behavior in practice is decisive in their learning experiences.

Dependent meaning oriented student teachers do not have a very distinct way of reflecting on their learning outcomes. For them, being unsatisfied with a previous experience is a very important motivation for learning. They learn less often by doing compared to other student teachers, they use more often suggestions of someone else to choose for a different strategy. Although a bad lesson experience might drive them to learn, they do not often have the idea that they learned something from the fact that something did not work out well. Becoming aware of one's own behavior, is more important for knowing that they learned something. When they evaluate a learning experience, they often regret that they did not learn that earlier. Overall, compared to their peers, for these student teachers bad previous experiences are an important motivation to learn, as well as suggestions from others are for their strategy choices.

Independent meaning oriented student teachers show a deep, active and independent way of learning in their learning activities. They reflect on their learning experience more often in terms of a theory of practice and learn often by analyzing situations. They often make deliberate choices for their processing strategies, instead of saying that there is no other way to learn this. They often realize that they learned something because something did NOT work out well and they evaluate their learning experiences more often and on different levels, like the moment of learning, their own preparation and the behavior of their pupils. They rarely have any new plans for new learning experiences, and they more often prefer to try things out in a different situation.

Discussion

This study showed that meaningful relations can be found between learning patterns and actual learning activities of students, taking multiple learning experiences into account. The learning activities which turned out to be related to the different learning patterns also resembled the typology as described by Oosterheert (2001). The results showed that survival oriented student teachers show more inactiveness in their learning, reproduction oriented student teachers learn by doing to improve their teaching behavior, dependent meaning oriented student teachers are more influenced by previous negative experiences and independent meaning oriented student teachers show the most deep and most active way of learning. Overall, the results show a consonant relationship between learning patterns on the one hand and concrete learning activities on the other. However, all learning activities were found to some degree among student teachers with all different patterns, meaning that on the level of the individual student teachers dissonant relations (Lindblom-Ylänne & Lonka, 2000; Vermunt & Verloop, 2000) may be found, which could be indicators for tension or friction. A discrepancy between students teachers' general, habitual way of learning and their learning behavior in actual learning situations may point to problems students experience with adapting to the new learning environment that teacher education programmes often represent. On the other hand, students' conceptions, motives, and strategies also become more differentiated as learners have greater experience with different domains (Buehl & Alexander, 2006). Below, we will discuss some implications of our findings for theory, practice and future research.

Besides these relations that were found, there were also some interesting results in terms of relations which were not found. For example, it turned out that the choice for a particular processing strategy was not related to student teachers' learning patterns, only the *reason* for choosing the strategy was so. Also the amount of intentional and unintentional learning experiences was not related to the learning patterns. This shows that in the context of learning to teach all students sometimes learn in a more planned way, but also often learn in a more spontaneous way, and that all processing strategies are relevant for all different types of student teachers. It might be the case that these aspects in the context of learning to teach are less under influence of the student teacher and more determined by the context of the specific learning experience.

Learning patterns and concrete learning activities have been regarded as being part of the same concept, although they have been studied mostly separately within different frameworks and with different measurement instruments (Lonka et al., 2004; Pintrich, 2004). In this study both perspectives and different types of measurements were included. Previous studies have shown that often low correlations have been found between general aptitude measurements and event measurement (Veenman, 2005;

Veenman et al., 2003). These results have often led to questions concerning the validity of both types of instruments, instead of more fundamental questions about how these two parts are related to each other. Considering that every learning experience happens in a certain context that influences the concrete learning activities, we expected that by including multiple events we could rule out this influence to some extent. In this way we have been able to find clearer relationships between learning patterns and what people do during concrete learning experiences, and to bring both research traditions closer to each other. Although this study was carried out in the specific context of learning to teach, also in other learning contexts this type of design might shed more light on the relations between learning patterns as measured by aptitude instruments and the concrete learning activities of students or professionals.

There are also disadvantages of our design. For example, in this study student teachers could select learning experiences themselves. In this way, we did not have control over which learning experiences they did and did not select and why. Further research is necessary to find to what extent this selection might also be related to student teachers' learning patterns. Furthermore, combining results from multiple measurements with the outcomes of one measurement of an aptitude instrument is also methodologically challenging. In this way, a multilevel data structure was created. Since multilevel analysis on categorical data is hardly developed to date, we were not able to take this structure into account in the analysis. In a previous study (Endedijk, Vermunt, Verloop, & Brekelmans, 2012) we transferred the same type of data into two continuous variables and found that the largest variance was on the level of the learning experience, and not on the level of the individual. Nevertheless, neglecting the multilevel structure may have resulted in a slight overestimation of the relations in our data, caused by having the same student teacher with the same learning orientation report six learning experiences.

Although the results show theoretically coherent relations between learning patterns and learning activities, both ways of measuring learning have their own strengths, not only for research but also for practice. Although a learning pattern questionnaire is easy to administer, the results in terms of a categorization in learning patterns is very global and might not give student teachers and their teacher educators concrete suggestions of how to improve the quality of learning. When this is combined with an overview of concrete learning activities that a student teacher has conducted, a more detailed insight is gained in what could be alternative options for future learning experiences. On the other hand, the outcomes of the learning pattern questionnaire also includes learning conceptions and emotion regulation, which are less easy to find out by looking solely at the student teachers' activities in concrete learning experiences. Therefore, the inclusion of both of these types of instruments in teacher education programs can lead to valuable insights for teacher educators on how their students learn and the results can help teacher education programs to develop their program towards a research-based teacher education program with respect to supporting student teachers' skill for further professional learning.

All in all, in this study meaningful relations were found between a self-report student learning inventory, the ILTP, and multiple measurements of actual student teachers' learning activities. These results support the validity of the ILTP. It was also found that, on an individual level, student teachers' beliefs about their own learning did not always coincide with their actual learning activities. These results suggest that for some students there may be a tension between their beliefs about learning and their actual learning. In the literature this phenomenon is known as dissonance or friction between students' beliefs, motives and actions (e.g. Lindblom-Ylänne & Lonka, 2000; Cliff, 2000). Especially when students enter a new type learning environment there may be a tension between their habitual way of learning that they were used to and the way of learning that is demanded from them by the new circumstances. For many student teachers the teacher education program may represent such a new type of learning environment, in which learning from own practical experiences and integrating this experiential knowledge with knowledge gained from coursework is much more important than they were used to do in previous, more theory-based studies.

Helping student teachers overcome these tensions seems to be of eminent importance. Successful adaptation to new learning environments may well require a period in which old habits need to be left behind, well before new patterns in learning have been established. This may represent a period of strong emotional discomfort, as Lindblom-Ylänne and Lonka (2000) have shown among high-achieving medical students. In such a period students' beliefs, motives and actions are often not aligned. They may adapt successfully and grow towards new patterns of learning in which beliefs, motives and actions get aligned in a new way. However, some students may not reach such a new equilibrium on their own accord and need help from university teachers to achieve this, or drop out from the teacher education program.

We recommend future research to explore these theoretical notions and implications for practice. Discrepancies between student teachers' general learning pattern and their learning behavior in specific situations may identify students at risk of dropping out of teacher education. Further research is necessary to see whether the instruments used in this study are suited for such an identification purpose. Moreover, intervention models need to be developed targeted at helping student teachers at risk to re-align their learning conceptions, motives and beliefs in a totally new type of learning environment. Studying these intervention models to find out whether, how, when and why they are effective is an important direction of future research.

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