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Published online: 26 Feb 2024.

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# Importance of regulation and the quality of teacher learning in student-centred teaching

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**ABSTRACT**

This study aimed to build an integrative model of the interrelations between pedagogical training, teacher regulation skills, learning patterns and student-centred teaching approach. Self-reported questionnaire data were collected from 378 higher education teachers and analysed using structural equation modelling. The findings indicated that pedagogical training was related to teachers' regulation of their pedagogical development, which was further connected to both meaning-oriented and application-oriented teacher learning. However, only meaning-oriented teacher learning was connected to adopting a student-centred teaching approach, while application-oriented teacher learning was not. Teacher regulation was negatively connected to problematic learning, meaning that those who did not regulate their pedagogical development more often reported a problematic pattern towards teacher learning. Thus, pedagogical training, regulation skills and teacher learning patterns are important in terms of teachers' pedagogical development to a student-centred teaching approach. The findings highlight the importance of regulation and the quality of teacher learning in increasing student-centred teaching.

## Introduction

Improving the quality of teaching and teachers' pedagogical competencies are key factors in developing and modernising higher education (European Commission 2016; Hénard and Roseveare 2012). Pedagogical research on higher education teaching and learning has shown that a student-centred teaching approach is important for students' approach to their learning, which further has an impact on the quality of their learning (e.g. Entwistle 2009). Thus, it is widely acknowledged that high-quality teaching is student centred, in that it fosters active, deep, self-regulated and collaborative learning. For example, the EU has stated these research-based goals as its official objectives in the Bologna Process (Leuven and Louvain-la-Neuve Communiqué 2009). To achieve a student-centred approach, teachers must change from being experts in transmitting

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knowledge to being learning process experts, i.e. encouraging students' active, deep, self-regulated and collaborative learning (Vermunt et al. 2017). Furthermore, increasing students' self-regulation requires that teacher regulation in student learning gradually decreases, which might contradict many teachers' common practices and beliefs about good teaching (Vermunt et al. 2017). Developing such an approach to teaching requires goal-oriented teacher learning, supported by the high-regulation skills of one's pedagogical development.

Despite the acknowledged key role of teaching, we do not fully understand what is needed to develop a student-centred teaching approach. In addition, teachers' pedagogical development at universities is often their own responsibility, as in many countries, such as Finland, participating in pedagogical training remains voluntary (e.g. Murtonen and Vilppu 2020), although increasingly encouraged. The situation is different in Finnish universities of applied sciences, where pedagogical studies are usually required. When pedagogical training is voluntary, university teachers' own initiative and regulation in developing teaching and their own pedagogical expertise are crucial to improving teaching practices and student learning. Even if pedagogical training were obligatory, according to the idea of lifelong learning (e.g. Volles 2016), searching for new knowledge and further education, and regulating one's teacher learning throughout the working career, are important skills for university teachers.

The aim of the study was to understand the interplay between pedagogical training, teachers' regulation skills, their learning patterns and teaching approach. Previous studies have shown conflicting results concerning the impact of pedagogical training on teaching approaches (e.g. Gibbs and Coffey 2004; Ödalen et al. 2019), but little is known about the role of teacher regulation and learning patterns. Thus, the study aimed to shed light on the elements of successful pedagogical development of higher education teachers by constructing an integrative model of these multiple elements in teacher development.

## Pedagogical training to support a student-centred teaching approach

One of the universities' main formal channels for enhancing the quality of university teaching is pedagogical training. Contrary to lower educational levels, pedagogical qualifications are not necessarily required at universities (e.g. Quinn 2012). There is much variation between countries; generally, pedagogical training is voluntary, yet increasingly offered for academic staff (e.g. Noben et al. 2021). In pedagogical training, teachers become aware of their teaching approaches and underlying beliefs about teaching and learning, and with the help of this increasing pedagogical awareness, their habitual teaching practices may be developed and changed (e.g. Postareff, Lindblom-Ylänne, and Nevgi 2007; Vilppu et al. 2019).

Pedagogical training is seen as a tool to encourage teachers to adopt a student-centred teaching approach and help them to develop their teaching practices (e.g. Leuven and Louvain-la-Neuve Communiqué 2009). University teachers' teaching practices are often conceptualised as approaches to teaching, i.e. the strategies teachers adopt for their teaching (Trigwell and Prosser 2004). Usually, a difference is drawn between two qualitatively different approaches to teaching (Postareff and Lindblom-Ylänne 2008).

Teachers adopting a teacher-focused approach to teaching aim to transmit knowledge to students, who are seen as passive recipients, whereas teachers with a student-centred approach to teaching aim to facilitate students' deep learning by activating their knowledge construction (Postareff and Lindblom-Ylänne 2008; Trigwell, Prosser, and Waterhouse 1999). In the latter approach, the active role of students and interactions in teaching are emphasised. However, the relationship between the two approaches is not a matter of black and white; instead, teachers may adopt elements of both approaches in their teaching (Postareff and Lindblom-Ylänne 2008). The strict dichotomy between teacher-centred and student-centred teaching has also been criticised in more recent accounts (Case 2019; MacFarlane 2014). For example, Case (2019) suggested a third approach, evidence-based based practice, to foster high-quality student learning. In this approach, the focus is both on knowledge and engaging of students.

Despite the criticism, the dualistic view of teaching approaches seems to persist. The current views of high-quality teaching require teachers to focus on student learning instead of merely transmitting information, which is thus a student-centred approach to teaching. The importance of a teacher's teaching approach is justified with the implications that it has for students' learning. Although these implications are not straightforward, a general relationship has been documented between content-focused teaching and students' adoption of a superficial approach to learning (Trigwell, Prosser, and Waterhouse 1999; Uiboleht, Karm, and Postareff 2018), whereas a learning-focused approach to teaching seems to promote a deep approach to learning in students (Entwistle 2009). Student learning is, however, a complex phenomenon that cannot be fully explained only by teaching approaches (e.g. Åkerlind 2008).

The research results concerning the power of pedagogical training in changing teachers' pedagogical thinking and actions are controversial. While a shift in thinking towards a student-centred view has been identified (e.g. Gibbs and Coffey 2004; Hanbury, Prosser, and Rickinson 2008; Light and Calkins 2008; Postareff, Lindblom-Ylänne, and Nevgi 2007; Stewart 2014), no effect (Norton et al. 2005) and even a shift towards teacher-centredness (Ödalen et al. 2019) have also been reported. Overall, the effects of training seem to be positive but rather small (cf. Stes et al. 2012; Trigwell, Rodriguez, and Han 2012), and it has been suggested that profound changes will require relatively long training (Postareff, Lindblom-Ylänne, and Nevgi 2007). However, recent studies have shown that novice teachers, in particular, seem to benefit even from short training (Ödalen et al. 2019; Vilppu et al. 2019).

Owing to the positive impacts on teaching quality, some countries such as Norway and the United Kingdom have made the pedagogical training of university teachers compulsory (Chalmers and Gardiner 2015). In Finnish universities, pedagogical training is increasingly being offered, but participation is usually optional (Murtonen and Vilppu 2020); this leaves the development of teaching skills dependent on teachers' own initiative and interest. The situation is different in Finnish universities of applied sciences, where pedagogical studies were formerly required by law, but also today are usually required when appointing a new teacher. A teacher needs to either have the qualification when appointed, or the pedagogical studies (60 credits) must be completed in two or three years from the appointment. In Finnish universities, there have been attempts to foster

the more compulsory nature of pedagogical studies, for example by emphasising them when selecting teachers to tasks. The tool for this has been a teaching portfolio, where pedagogical studies and merits should be shown, and currently many universities are creating teacher tracks where pedagogical education is involved. Formerly, pedagogical excellence has typically not been an issue in evaluating staff for performance review and promotion in universities (Chalmers 2011). However, in promotion situations, many universities now have guidelines for assessing pedagogical excellence on many levels, such as education, teaching development projects and utilisation of feedback, evaluation of one's own development and possible pedagogical publications and awards (e.g. Chalmers 2011; Vardi and Quin 2011).

## Teacher regulation of their own learning

At least in countries where pedagogical qualification is not required, attending pedagogical training and developing one's teaching are initiated by the teachers themselves. This places emphasis on the deliberate development and regulation of one's learning. While there is an extensive body of research concerning students' regulation of learning, research on teachers' regulation of their learning has been scarce. In general, regulation of learning refers to learning activities used in steering and monitoring learning processes towards learning goals (e.g. Pintrich 2000; Vermunt 1998). In student learning, Vermunt (1988, 1996, 1998) distinguished among three strategies of learning regulation: self-regulation, external regulation and lack of regulation. Self-regulation of learning is associated with the student's activity in planning, monitoring and evaluating one's learning, whereas in external regulation, learning is regulated by the instruction, teacher, learning materials or other aspects of the learning environment. Students who experience a lack of regulation have problems in their learning and find the external support for their learning inadequate. Vermunt's definition of self-regulated learning shares similar features with other well-known theories of self-regulation (e.g. Pintrich 2000; Zimmerman 2000), although these seem to highlight motivational or environmental factors more, whereas Vermunt's model relies more on metacognitive learning activities (Vermunt and Verloop 1999).

In line with studies on student regulation of learning, some studies have identified similar kinds of regulation strategies in teacher learning. According to van Eekelen et al. (2005, 452), 'the core of self-regulated teacher learning is that the teacher independently and consciously directs the process of attaining learning goals'. However, according to their study, teacher learning in higher education is not necessarily planned, self-regulated, reflective and spiral, but more often spontaneous and non-linear, thus reflecting more externally regulated learning or both self-regulated and externally regulated learning. About a third of the teachers' self-reported learning experiences reflected self-regulation; in those, the teachers knew beforehand what and how they were going to learn, and thus, the learning was characterised by independent, deliberate and conscious interest in developing one's teaching (van Eekelen, Boshuizen, and Vermunt 2005).

Furthermore, Lindblom-Ylänne et al. (2011) confirmed that teachers differ in their skill in self-regulating their teaching. In addition to an externally regulated teacher group, they

identified two subgroups of self-regulative teachers. In one group, self-regulation was illustrated as a reaction to one's own negative experiences as a student, whereas the other group self-regulated their teaching by constructing their own approach to teaching that involved reflecting and analysing their study experiences and disciplinary teaching traditions. In contrast to the study of van Eekelen et al. (2005), self-regulation of teaching was more common than external regulation (Lindblom-Ylänne, Nevgi, and Trigwell 2011).

Endedijk et al. (2012) presented yet another characterisation of teacher regulation found amongst student teachers. They discovered two underlying dimensions in the regulation activities: passive versus active and prospective versus retrospective regulation of learning. The study showed that goal setting and planning (i.e. prospective regulation) are not necessary conditions for showing active regulation of learning to teach; this deviates from the active, deliberate view of teacher self-regulation by van Eekelen et al. (2005). Instead, the study suggests a different conceptualisation of self-regulated learning for learning to teach, which focuses more on retrospective aspects (monitoring, reflection, evaluation) of self-regulated learning and less on setting initial learning goals.

Considering that pedagogical development in universities is often dependent only on teachers' own interests (e.g. Murtonen and Vilppu 2020), it is vital to study the question of teachers' own pedagogical regulation in more depth. To enable continuous development of one's own pedagogical expertise throughout one's teaching career, the skills to actively and prospectively regulate (cf. Endedijk et al. 2012) this development are crucial. In the university context, skills such as searching for pedagogical support and communication, reading pedagogical literature and deliberately training oneself in pedagogical contents are central. In this sense, the concept of active regulation here approaches the concept of professional agency, which Eteläpelto et al. (2013, Fig. 2, 61) describe as being practised when 'subjects and/or communities exert influence, make choices and take stances in ways that affect their work and/or their professional identities'. Thus, in teachers' development of pedagogical expertise, it is important that they are aware of the direction in which they want to develop and make deliberate choices that support reaching these goals.

### Teacher learning patterns

In addition to teacher regulation of learning, the quality of teacher learning seems to play a role in developing teaching practices. Studying teacher learning at the university level from a learning pattern perspective is a relatively new approach. Teacher learning patterns refer to the coherent wholes of learning activities, beliefs about learning and motivation for learning in a certain period of time (Vermunt et al. 2019). The focus is more on mental and covert learning activities (such as cognitive, affective and regulative activities), in contrast with more observable learning activities (such as participation in training or discussions with a colleague).

In studies of teacher learning, several orientations or patterns have been found that correspond to those found in student learning (see Vermunt and Vermetten 2004). For example, three main categories of learning approaches among student teachers learning to teach have been discerned (Oosterheert and Vermunt 2001; Oosterheert, Vermunt, and

Denessen 2002): meaning directed, reproduction directed and a survival orientation, indicating that student teachers differ in the way they learn. Further, Bakkenes et al. (2010) reported three qualitatively different teacher groups in terms of learning among secondary school teachers: meaning-oriented teachers, performance-oriented teachers and teachers who struggled, experienced negative emotions and even avoided learning. Thus, among teachers, a reproduction-directed orientation was not found; instead, a performance orientation associated with applying new ideas was detected.

Based on earlier findings, three qualitatively different learning patterns were reported in a more recent study (Vermunt et al. 2019): meaning-oriented, application-oriented and problematic teacher learning. Teachers adopting an application-oriented learning pattern focus on applying what they have learned to improve their teaching immediately. Teachers adopting a meaning-oriented learning pattern want to know the reasons why certain things work in the classroom and try to extend their understanding of their own practices. The third learning pattern, the problematic one, describes teachers who experience friction between how they teach and how they want to teach or who have no idea how to teach differently than they do. They also experience negative emotions or even avoid learning about educational innovations (Vermunt et al. 2019). Even though learning patterns describe a characteristic approach to learning for a teacher during a certain period of time, they are not exclusive (Vermunt et al. 2019). Instead, a teacher may demonstrate features from different learning patterns simultaneously.

The relationship between students' learning patterns and their academic success has been widely studied, but there is less research on teacher learning patterns and their learning outcomes. In student research, a general picture has emerged in which a meaning-directed learning pattern mostly shows a positive association with academic success; an undirected learning pattern consistently has a negative association with study success; a reproduction-directed learning pattern demonstrates a mostly negative association; and an application-directed learning pattern has no connection to success (e.g. Vermunt 2005; Vermunt and Donche 2017; Vermunt and Vermetten). In a similar fashion, in teacher (Bakkenes, Vermunt, and Wubbels 2010) or student teacher learning (Oosterheert and Vermunt 2001), meaning-oriented learning seems to be an important aspect in terms of outcomes, while the practical application of new ideas and elements in teaching might act as a powerful motivator for teacher learning. Negative emotions and avoiding learning resemble the undirected learning pattern in student learning and thus can be problematic with regard to learning outcomes (Bakkenes, Vermunt, and Wubbels 2010).

## *The current study*

The aim of the study was to explore and identify the relationships among pedagogical training, the regulation of pedagogical development, teacher learning patterns and their teaching approach in one integrated model. Since teachers' own activity in developing their pedagogical expertise is crucial in countries that do not require the pedagogical education of university teaching staff, such as the target country of this study, the question of teachers' regulation of their pedagogical development becomes central. In this study, we hypothesised that teachers
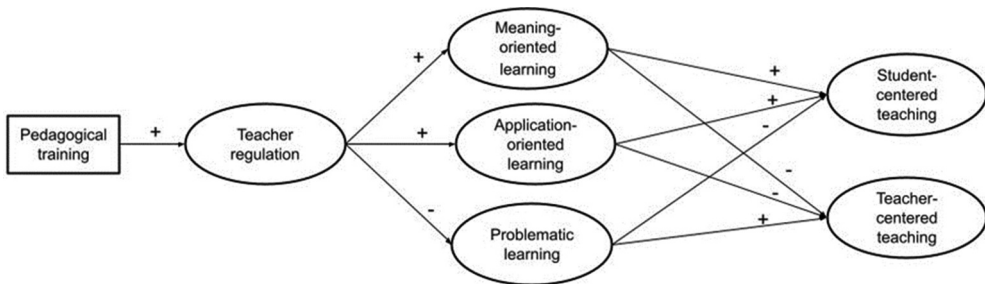
**Figure 1.** Factors of interest and hypothesised relations among them in the current study.

with more pedagogical training would be better at regulating their own learning, since they have had support for these skills (or knowledge of such) in the trainings (Murtonen and Vilppu 2020). Furthermore, we assumed that teachers who are skilled in regulating their pedagogical development, i.e. they actively search for places to develop their teaching, express a meaning-oriented teacher learning pattern (Vermunt et al. 2019) and a student-centred teaching approach (Trigwell and Prosser 2004). We used structural equation modelling to explore all the factors in the same model. The hypothesised relationships among the factors are illustrated in Figure 1.

## Materials and methods

### Measures and procedures

The questionnaire was developed using institutional Microsoft Office 365 Forms, and the link was distributed via email to all teachers and supervisors of the university in April 2020. The questionnaire included background questions and three independent Likert-scale inventories measuring teacher regulation, teacher learning patterns and teaching approaches. The questionnaires were available in both English and Finnish for the participants. Participation in the study was voluntary, and informed consent was obtained from the participants.

### Background variables

The questionnaire included background questions concerning the participant's previous pedagogical training, length of teaching experience in years, the amount of teaching hours per academic year and faculty information. The previous pedagogical training was measured with credit points. The maximum of 60 points were recorded in the data if the respondent clearly showed to have studied the Finnish pedagogical studies of 60 credit points or equivalent. Some reported to have many kinds of education studies, but these were recorded a maximum of 50 credits if there was no reference to pedagogical studies. Many had studied university pedagogy courses of 10 to 25 credits, which is a typical amount in Finnish universities for teachers to accomplish.

### Inventory of teacher regulation

This inventory was developed for the current study to measure teachers' skills in regulating their pedagogical development. It was piloted with another teacher group at another Finnish university, and, based on preliminary statistical analyses, it proved to be internally consistent. The items of the inventory explored teacher regulation of learning from the viewpoint of interest, self-directedness and engagement in concrete practices to develop one's teaching. Thus, we took a prospective and active view of teacher regulation (Endedijk et al. 2012). There were also nuances of agency (e.g. Eteläpelto et al. 2013), meaning that the teacher was an active agent of his or her own pedagogical development. We thus conceptualised teacher regulation and development practices broadly, ranging from informal pedagogical conversations with colleagues to deliberately searching for possibilities to participate in formal training. This scale was not so much about teachers' understanding of, for example, why certain teaching methods work; rather, it was about teachers' practical actions in searching for places and tools for pedagogical development. Examples of the items included: 'I try to develop my teaching by attending pedagogical training', 'I will gladly have a conversation about pedagogical issues with my colleagues' and 'I would rather use my time on something other than considering pedagogical issues' (scale reversed). The participants were asked to answer on a Likert scale (1 = *completely disagree* to 5 = *completely agree*) the degree to which they agreed with the statements.

### Inventory of teacher learning

Teachers' learning patterns were measured using the Inventory of Teacher Learning devised by Vermunt et al. (2019). The inventory comprised three subscales: meaning-orientated learning (14 items; e.g. 'I try to understand why certain teaching methods work'), application-oriented learning (9 items; e.g. 'I want to apply new ideas in my teaching'), problematic learning (9 items; e.g. 'I struggle with new ways of teaching'). A Likert scale was used, ranging from 1 (*completely disagree*) to 5 (*completely agree*). The questionnaire was translated into Finnish from the English version, and a back translation was ordered from an independent company to ensure the accuracy of the translation.

### Approaches to teaching inventory

We used Trigwell and Prosser's 2004 Approaches to Teaching Inventory (ATI) to measure teachers' approaches to teaching. The inventory comprised two subscales, with eight items for each: (1) student-centred approach (e.g. 'I make opportunities available for students in this course to discuss their changing understanding of the subject matter'); and (2) teacher-centred approach (e.g. 'I feel it is important to present a lot of facts to students so that they know what they have to learn'). A Likert scale was used, ranging from 1 (*rarely*) to 5 (*always*). A widely used Finnish translation of the questionnaire (Lindblom-Ylänne and Nevgi 2003, 78) was used in addition to the original English version.

## Sample

The data were collected via an online self-report questionnaire in a large Finnish university community with 3000 university and university of applied science staff members, of whom the teaching faculty comprised about 50–60%. Finland is a country of 5.5 million people and only 13 universities, which all work under the authority of the government. All universities are multidisciplinary, and the target university is one of the largest, consisting of many faculties from medicine and technology to languages, education, economics and social sciences. The sample university includes the local multidisciplinary university of applied sciences which makes the staff better educated in pedagogics compared to a university community without a university of applied sciences. The university teaching force includes approximately 75% of the whole university community teaching staff, while the university of applied science teaching staff is around 25% of the whole. This university was selected because of its size and wide representativeness of Finnish higher education institutions.

A total of 381 responses were received, resulting a response rate of approximately 25%. Of the responses, 378 were deemed valid and were used for the analysis. The majority of the respondents, 73%, were from the university, and a minority, 27%, from the university of applied sciences, which corresponds to the ratio of teaching staff of each unit in the university community. The majority, 80% of participants, had taken some pedagogical courses (73% of the university staff, 99% of the university of applied sciences staff). The mean for university staff's credit points in pedagogical studies was 26.9, with the variation from 0 to 60, and many having only few credit points. The credit point mean in the university of applied sciences was 52.6, meaning that almost all of them had already completed the 60-credit official teacher training. Participants reported their teaching experience as follows: 12% had less than two years of experience, 16% had from two to less than five years of experience, 15% had from five to less than 10 years of experience, 19% had from 10 to less than 15 years of experience and 38% had 15 or more years of experience. While some teachers had only few hours teaching annually, 31% reported having over 301 hours. The participants represented multiple faculties of the university and university of applied sciences, and these were combined to larger entities: engineering and natural sciences (23%), technology and communication (17%), business (14%), medicine and health (14%), social sciences and services (11%), education, art and culture (10%) and other units, such as the Language Centre (10%).

## Analysis

Exploratory factor analysis (EFA) using Principal Axis Factoring method with Varimax rotation was first conducted to screen and refine the data. Items with a factor loading less than 0.32 or cross-loaded with coefficients greater than 0.40 on more than one factor were discarded as recommended by Tabachnick and Fidell (2007). Next, we used structural equation modelling (SEM) to test the hypothesised model with the AMOS software, version 26. To estimate model parameters and assess the significance of mediation, we used the bootstrap ML method with 2000 bootstrap samples and 95% bias-corrected

confidence intervals (CIs) (Preacher and Hayes 2008). Green (2016) reviewed the methods and tools for conducting SEM analysis in higher education studies and identified boot-strapping as a robust technique for managing violations in data multivariate normality. To assess the model fit, we used well-established indices, such as CFI, IFI, RMSEA, SRMR and chi-square test statistics. According to Hu and Bentler (1999), generally acceptable values included those greater than .90 for the CFI and IFI indices, less than .06 for RMSEA and less than .08 for SRMR. For the ratio of $\chi 2$ to $df$, values of less than 3 represented adequate fit (Schreiber et al. 2006).

Prior to analysis, we used Harman's one-factor test (Podsakoff et al. 2003) to examine the common method variance (CMV). Since the responses for all study variables were collected from the same individuals through one questionnaire, the data could have suffered from CMV. All items of our variables were entered into an unrotated exploratory factor analysis using SPSS and forcing a one-factor solution. The results indicated that the single factor accounted for only 16.8% of the variance. These results suggest that common method variance was not a major concern in this study.

## Results

### Descriptive statistics, reliability and validity (measurement model)

To assess the dimensionality of our measures, a six-factor measurement model was specified and tested using confirmatory factor analysis (CFA). The measurement model comprised the following latent variables: one teacher regulation variable (REGU), three teacher learning pattern variables (meaning-oriented learning – MEAN, application-oriented learning – APPL and problematic learning – PROB) and two teachers' teaching approach variables (student-centred teaching – STUD and teacher-centred teaching – TCHR). In this model, we freely estimated the loadings of the indicators (items) on their corresponding latent variables. All latent variables were free to correlate with each other. Items showing low loading coeffi-cients (<.30) on their corresponding factor were removed. All variables showed significant covariances with each other except for the teacher-centred teaching approach, which showed insignificant covariances with other variables and close to insignificant covariance with teacher regulation. Thus, it was excluded from the model and from further analyses. The model showed a good fit to the data ($\chi 2 = 736.955$, $df = 424$, $p < .001$, $\chi 2/df = 1.738$, CFI = .915, IFI = .916, RMSEA = .044, SRMR = .055), and all items loaded on their respective latent variable and had significant standardised factor loadings (Table 1).

Pearson correlations among factors, descriptive statistics and reliability were computed and are presented in Table 2.

### Hypothesis testing (structural model)

According to our hypotheses, we set regression paths among variables. Teaching experi-ence, university and faculty were set in the model as control variables (Figure 2). As expected, the pedagogical training showed a positive effect on teacher regulation ($\beta$ = .39, $p < .001$). Teacher regulation positively contributed to the teachers' meaning-

**Table 1.** Structural coefficients for the five-measurement model (after excluding the teacher-centred teaching approach and items loaded poorly on their corresponding factor).

|  | REGU | MEAN | PROB | APPL | STUD |
|---|---|---|---|---|---|
| **Teacher regulation** |  |  |  |  |  |
| REGU1 | **.526** | .442 | −.313 | .373 | .297 |
| REGU2 | **.694** | .582 | −.412 | .492 | .391 |
| REGU3 | **.595** | .499 | −.353 | .422 | .336 |
| REGU4 | **.420** | .352 | −.249 | .298 | .237 |
| REGU5 | **.464** | .389 | −.275 | .329 | .262 |
| REGU6 | **.508** | .426 | −.302 | .360 | .287 |
| **Meaning-oriented learning** |  |  |  |  |  |
| MEAN1 | .536 | **.639** | −.283 | .519 | .358 |
| MEAN2 | .343 | **.409** | −.181 | .332 | .229 |
| MEAN3 | .581 | **.692** | −.306 | .562 | .388 |
| MEAN4 | .580 | **.691** | −.306 | .561 | .387 |
| MEAN5 | .454 | **.541** | −.240 | .440 | .303 |
| MEAN6 | .530 | **.632** | −.280 | .513 | .354 |
| MEAN7 | .516 | **.615** | −.272 | .499 | .344 |
| MEAN8 | .377 | **.450** | −.199 | .365 | .252 |
| MEAN9 | .345 | **.411** | −.182 | .334 | .230 |
| MEAN10 | .304 | **.362** | −.160 | .294 | .203 |
| **Problematic learning** |  |  |  |  |  |
| PROB1 | −.286 | −.213 | **.482** | −.228 | −.185 |
| PROB2 | −.392 | −.292 | **.661** | −.312 | −.253 |
| PROB3 | −.186 | −.139 | **.314** | −.148 | −.120 |
| PROB4 | −.351 | −.261 | **.590** | −.279 | −.226 |
| **Application-oriented learning** |  |  |  |  |  |
| APPL1 | .255 | .292 | −.170 | **.360** | .176 |
| APPL2 | .530 | .607 | −.353 | **.748** | .366 |
| APPL3 | .389 | .446 | −.260 | **.550** | .269 |
| APPL4 | .338 | .388 | −.226 | **.478** | .234 |
| APPL5 | .389 | .446 | −.259 | **.549** | .269 |
| APPL6 | .484 | .555 | −.323 | **.684** | .335 |
| **Student-centred approach** |  |  |  |  |  |
| STUD1 | .230 | .229 | −.156 | .200 | **.408** |
| STUD2 | .452 | .449 | −.307 | .392 | **.801** |
| STUD3 | .298 | .296 | −.202 | .258 | **.528** |
| STUD4 | .370 | .368 | −.252 | .322 | **.657** |
| STUD5 | .417 | .414 | −.283 | .362 | **.740** |
| STUD6 | .395 | .392 | −.268 | .343 | **.700** |

oriented learning (β = .81, *p* < .001) and application-oriented learning (β = .67, *p* < .001), while negatively contributing to the teachers' problematic learning (β = −.59, *p* < .001). In line with our hypotheses, meaning-oriented learning had a positive effect on a student-centred teaching approach (β = .47, *p* < .001), while problematic-oriented learning had a negative effect on a student-centred teaching approach (β = −.19, *p* < .05). Unexpectedly,

**Table 2.** Means, standard deviations, reliability coefficients and correlations among study variables.

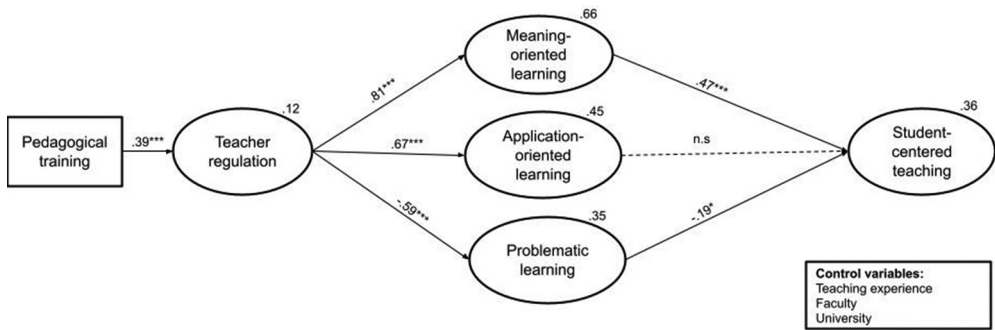|  | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Teacher regulation | 1 | .554** | .466** | −.371** | .409** | .374** |
| 2. Meaning-oriented learning |  | 1 | .605** | −.259** | .482** | .204** |
| 3. Application-oriented learning |  |  | 1 | −.238** | .363** | .175** |
| 4. Problematic learning |  |  |  | 1 | −.211** | −.191** |
| 5. Student-centred teaching approach |  |  |  |  | 1 | .237** |
| 6. Previous pedagogical training |  |  |  |  |  | 1 |
| M | 3.39 | 3.95 | 4.38 | 2.04 | 3.93 | – |
| SD | .738 | .534 | .474 | .629 | .702 | – |
| Alpha | .740 | .820 | .740 | .610 | .800 | – |

$**p < .01$, two-tailed.



**Figure 2.** Structural model of the relationship among teacher regulation, learning patterns and student-centred teaching approach.

application-oriented learning showed an insignificant effect on a student-centred teaching approach. The model fit the data well ($\chi2 = 918.217$, $df = 550$, $p < .001$, $\chi2/df = 1.669$, CFI = .913, IFI = .915, RMSEA = .042, SRMR = .0578) and accounted for 36% of the variance in a student-centred teaching approach.

## Mediation tests

The significance of mediation was assessed using the bootstrapping method. The results showed a significant full mediation of meaning-oriented learning between teacher regulation and a student-centred teaching approach (estimate = .409, 95% CI = [.170, .753], $p < .01$) and a significant full mediation of problematic learning between teacher regulation and a student-centred teaching approach as well (estimate = .122, 95% CI = [.027, .264], $p < .01$).

We also tested serial multiple mediation from the pedagogical training to the student-centred teaching approach. Table 3 shows that the two paths from pedagogical training to a student-centred teaching approach through regulation and learning patterns were significant.

Table 3. Serial multiple mediation test.

| Path | β | S.E | p | 95% confidence interval | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| *Pedagogical training -> REGU -> MEAN -> STUD* | .004 | .001 | .001** | .001 | .007 |
| *Pedagogical training -> REGU -> PROB -> STUD* | .001 | .001 | .005** | .000 | .002 |

(teacher regulation – REGU, meaning-oriented learning – MEAN, problematic learning – PROB, student-centred teaching – STUD).
**$p < .01$ level.

## Discussion

The current study presented a theory-based model illustrating the relationships among previous pedagogical training, teacher regulation, teacher learning patterns and teaching approaches. The findings indicated that previous pedagogical training was related to teachers' own ability to regulate their pedagogical development. Further, the more teachers showed ability to regulate their pedagogical development, the more they adopted a meaning-oriented learning pattern, and the more they expressed a student-centred approach to teaching. Contrarily, the findings suggest that the less teachers showed a willingness to regulate their learning, the more they adopted a problematic learning pattern, and the less their teaching focused on students. High regulation skills were also connected to an application-oriented learning pattern, but this was not further connected with a student-centred approach to teaching.

The question of the effectiveness of pedagogical training has not been fully clarified by previous research literature (e.g. Gibbs and Coffey 2004; Norton et al. 2005; Ödalen et al. 2019; Postareff, Lindblom-Ylänne, and Nevgi 2007). Based on the current study, prior pedagogical training seems to have wide-ranging, important implications for teachers' pedagogy-related thoughts and actions, since it was connected to good skills in regulating one's own learning and having a meaning-oriented teacher learning pattern and student-centred approach to teaching.

The regulation of teachers' own pedagogical development was considered here broadly, ranging from informal pedagogical conversations with colleagues to purposely looking to participate in formal training. Teacher regulation is thus seen here as prospective and active (Endedijk et al. 2012), meaning that the teacher is an active agent of his or her own pedagogical development (e.g. Eteläpelto et al. 2013). A questionnaire was developed to measure these factors, and the results show that this type of regulation is associated with a meaning-oriented teacher learning pattern and a student-centred approach to teaching. The close relation between meaning-oriented learning and self-regulation has also been reported in other studies (Fryer and Gijbels 2017; Pyhältö, Pietarinen, and Soini 2015). The connection between regulation and earlier pedagogical training in our study indicates that training seems to go together with the development of this type of regulation.

When working as a teacher, one should constantly develop one's pedagogical skills. Vermunt et al. (2019) found that teachers differ in their methods of learning as teachers. Meaning-oriented teachers try to understand why and how certain teaching solutions work, while application-oriented teachers are mainly interested in, for example, easily applicable teaching tips. Those possessing a problematic learning pattern have a weak understanding of what they could change in their teaching as well as negative feelings about teaching. In this study, teacher regulation skills were positively connected to both meaning-oriented and application-oriented patterns, and negatively to problematic learning patterns. This means that regulation skills are very important with respect to teachers' actions and thoughts. If there are problems at the regulation level, the teacher likely also has problems in terms of teaching development.

The goal of high-quality teaching is to foster and support students' learning. This is best done if the teacher has a student-centred approach to teaching (Trigwell and Prosser 2004), meaning that the teaching is not centred around the content to be learned, but instead on understanding what the learner knows about the subject and how the student can be supported in their learning. In our analyses, there were clear connections between pedagogical training and teacher regulation, and further, between meaning-oriented teacher learning and a student-centred approach to teaching. The less pedagogical training the teachers had, the less they were able to regulate their learning and more likely to develop a problematic teacher learning pattern. This all was connected to being less likely to approach teaching in a student-centred way. Additionally, if teachers were practically oriented in their learning patterns, they were maybe not able to support their students' learning.

A noteworthy outcome of this study is the importance of the quality of teacher learning and the kind of learning pattern that teachers adopt in their professional development. This also accords with our earlier observations (Aldahdouh et al. 2023) which showed that teachers' learning approaches are essential to embrace instructional changes. Pedagogical training and teacher regulation seemed to be important factors both in meaning-oriented and application-oriented teacher learning, but only meaning-oriented teacher learning was positively connected to the adoption of student-centred teaching practices. Stimulating teachers to think about the reasons why and how teaching impacts student learning is therefore the key to increase their student-centred teaching. If professional learning is aimed at fast application of practical hints and tips, it may have no impact at all on increasing student-centred teaching.

As with every study, this study also has its limitations. One limitation is that as the study was a one-timepoint correlational study utilising only self-report measures, the proposed model is theory based. Thus, only connections between different constructs can be suggested, but not causal relationships between them. In further studies, additional data should be collected using different methods and designs, such as a longitudinal design and measures of actual teaching behaviour or measures of student learning in addition to teacher self-reports. Secondly, one of the constructs in the hypothesised model, teacher-centred teaching, had to be omitted from the structural model owing to statistical problems. This means that the studied constructs are

connected to student-centred teaching, but nothing can be implied about their relationship to teacher-centred teaching. This might suggest that teacher-centred and student-centred teaching are not mirror images of each other, nor the opposite ends of a single continuum (see Case 2019; MacFarlane 2014). Another limitation is a typical problem of surveys: the issue of response rate. Although the response rate of approximately 25% is not high, it is also not low for typical survey research. This may leave room for misinterpretation, although the sample represented different disciplines quite evenly, and corresponded well to the proportion of teaching staff in each unit. A further limitation concerning the sample is that the voluntary respondents may have had more pedagogical training than the non-respondents. In our sample, 73% of university teachers had previous pedagogical training, indicating that the sample might be skewed and the results should thus be considered with caution. However, our sample also included respondents without pedagogical training who expressed lower regulation and more problematic learning. Future research could consider an experimental design to robustly examine the effect of pedagogical training. Despite these limitations, this study provides significant new notions to the current literature.

The results of this study suggest that pedagogical training is associated with the kind of teaching that best supports students' learning and development. A practical implication is that pedagogical training is a profitable investment for universities. A question for further study is why some teachers who participate in pedagogical training and regulate their learning develop a meaning-oriented pattern while others develop an application-oriented teacher learning pattern. Only the meaning-oriented teacher learning pattern was associated with a student-centred teaching approach, while application-orientation, i.e. interest in practical teaching tips and tricks, had no such connection. A hypothesis is that it is specifically the quality of pedagogical training that is associated with the outcomes of teacher professional development. Thus, universities should offer the kind of pedagogical training that promotes teachers' meaning-oriented learning, i.e. high-quality research-based training, which further fosters the quality of student learning.

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