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Phases in novice university teachers' development of self-efficacy across and within teacher tasks: a Rasch Analysis

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ABSTRACT

Supporting academics' initial development as university teachers is important for improving their ability to contribute to high-quality education and for reducing anxiety and stress around teaching. Focusing on tasks experienced as challenging is considered a key principle for organising effective teacher professional development. To apply this principle in practice, more knowledge is needed about the development of novice university teachers' self-efficacy in their teacher tasks. Therefore, this study aims to investigate phases in the development of novice university teachers' self-efficacy. Data were collected amongst 201 novice university teachers at a Dutch research-intensive university and associated university medical centre, using a questionnaire measuring self-efficacy in different teacher tasks. Polytomous Rasch analyses were performed on novice university teachers' self-efficacy scores, both across and within teacher tasks. Results suggested three developmental phases in novice university teachers' self-efficacy across teacher tasks: (1) development in 'teaching and supporting learning', (2) development in 'assessment and feedback' and 'educational design', (3) development in 'educational leadership and management' and 'educational scholarship and research'. Two or three phases for the development of self-efficacy were found within each of these teacher tasks. These results expand our knowledge of the development of academics' self-efficacy related to specific teacher tasks. They also provide suggestions for how pedagogic training and workplace learning may be shaped in such a way that they focus novice university teachers' learning on teacher tasks that are difficult but not overchallenging.

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Introduction

Although the combination of research and education is considered core to academic functioning, research and teaching are distinct tasks which each require specific expertise development. Taking up teaching is often considered challenging by academics. Academics, especially those with doctorates, often consider themselves experts in their disciplines, but relative novices in teaching (Nicholls 2005). For some academics, teaching may even become a source of concern, anxiety and stress (Greer, Cathcart, and Neale 2016; Iglesias-Martínez, Lozano-Cabezas, and Martínez-Ruiz 2014). Moreover, neither graduate- and doctoral studies in their disciplines nor teaching experience alone

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equip academics with the expertise needed for good teaching (Barlow and Antoniou 2007; Gibbs 2013; Matthews, Lodge, and Bosanquet 2014). Supporting academics in their initial development as university teachers is therefore important, both for improving their ability to contribute to high-quality education and for reducing negative emotions around teaching.

Ideally, support provided to novice university teachers in their workplaces or in pedagogic training is attuned to their self-efficacy: their beliefs in their capabilities to perform specific teacher tasks (Dellinger et al. 2008). In primary and secondary education this is even considered a key principle in effective curriculum design for teacher education: combining workplace learning and learning from theory, and thereby focusing teachers' learning on tasks they experience as difficult in their teaching practice (Korthagen et al. 2001; Stokking et al. 2003). To apply this principle to teacher professional development in higher education, more knowledge must be gained about whether novice university teachers develop their self-efficacy in some tasks before others. In previous research different tasks and subtasks of university teachers have been identified (van Dijk et al. 2020), but further research is needed to understand the development of university teachers' self-efficacy in these (sub)tasks.

In this study, we therefore investigated phases in the development of self-efficacy of novice university teachers using a questionnaire conducted at one research institution and one related university medical centre. In this context, we considered novice university teachers to be academics in all positions engaged in teaching tasks at course level who had not yet or only recently evidenced sufficient expertise in these tasks in the form of obtaining a basic teaching qualification. We investigated developmental phases by applying a Rasch analysis to novice university teachers' self-efficacy scores for different teacher tasks and respective subtasks, as this analysis results in an ordering of (sub) tasks from easiest to hardest for novice university teachers to feel self-efficacious in.

Theoretical framework

Teacher self-efficacy

Studying teacher self-efficacy provides insight into how teachers experience carrying out their tasks. We define teacher self-efficacy as 'a teacher's individual beliefs in their capabilities to perform specific teaching tasks' (Dellinger et al. 2008, 752). By using this definition, we connect with Bandura (1977, 2018) seminal work on self-efficacy, which he describes as 'people's beliefs in their capabilities to produce given attainments' (Bandura 2006, 307). Bandura's work on self-efficacy is grounded in Social Cognitive Theory. This theory assumes that human functioning is a product of inter- and intrapersonal influences, behaviours and the environmental factors that affect these (Bandura 2018).

Numerous studies in primary, secondary and higher education have shown that strong teacher self-efficacy is associated with higher teacher well-being. This is both because of a positive relationship between self-efficacy and factors underlying well-being (e.g. job satisfaction), and because of a negative relationship with teacher burnout and burnout factors (e.g. job-related stress) (Ismayilova and Klassen 2019; Lazarides and Warner 2020; Matos, Iachite, and Sharp 2021; Zee and Koomen 2016). Strengthening novice university teachers' self-efficacy may thus be a way to make novice university teachers feel more comfortable in carrying out their teacher tasks.

Additionally, studies in primary, secondary and higher education have found positive associations between teacher self-efficacy and teaching quality (e.g. classroom processes, evaluated teaching performance, student adjustment, student achievement) (Klassen and Tze 2014; Lazarides and Warner 2020; Matos, Iachite, and Sharp 2021; Zee and Koomen 2016). We assume that the development of self-efficacy can therefore also provide an indication of the development of teacher expertise.

Based on the literature about self-efficacy, we argue that insight into the development of self-efficacy can help focus support for novice university teachers on those tasks in which they feel most uncertain about their capabilities. Insight into the development of self-efficacy could

thereby contribute to offering support that helps to reduce university teachers' anxiety and stress around teaching as well as help to improve their ability to contribute to quality education.

Self-efficacy of novice university teachers in different tasks and subtasks

In line with Bandura's conceptualisation of self-efficacy, we consider self-efficacy to be specific for a domain (i.e. university teaching) as well as for the activities within that domain (i.e. tasks and subtasks related to university teaching) (Bandura 2006). In order to investigate the self-efficacy of novice university teachers, we thus need an overview of tasks and subtasks that university teachers carry out. We find this overview in previous research that systematically reviewed teacher expertise frameworks (van Dijk et al. 2020).

Tasks identified in this review study were 'teaching and supporting learning', 'educational design', 'assessment and feedback', 'educational leadership and management', 'educational scholarship and research'. For each of these tasks, there were four to seven corresponding subtasks. All five teacher tasks and corresponding subtasks are described in Table 1. 'Professional development' was identified as a sixth teacher task. This task is different from the other tasks because it concerns the activities teachers engage in to improve in the other five tasks and is therefore not relevant for the present study. Based on the two levels in this overview of tasks (i.e. tasks and subtasks), development of university teachers' self-efficacy is investigated at two levels: development across tasks (task level) and development across subtasks within each task (subtask level).

Expectations about novice university teachers' development of self-efficacy across and within tasks

Although empirical studies into the development of university teachers' self-efficacy in different teacher tasks are scarce, related literature does provide suggestions for how this self-efficacy develops. In this section, we discuss expectations for development of university teachers' self-efficacy across- and within their teacher tasks based on this literature.

Development of self-efficacy across tasks

The review study of teacher expertise frameworks that defined teacher tasks also showed that some tasks were positioned as being more advanced than others within the frameworks (van Dijk et al. 2020). This is relevant for this study because it is plausible that it will be harder for university teachers to feel self-efficacious in tasks that are characterised as advanced, and vice versa.

Table 1. Overview of Teacher tasks and Subtasks.

Task	Description	% of total excerpts for this task indicated as advanced by the frameworks
Teaching and supporting learning	This task concerns how teachers guide the learning process through learner-teacher interactions to achieve learning goals.	14
Educational design	This task concerns the development of goals, content, structure, activities and materials for education and combining these into a coherent whole.	25
Assessment and feedback	This task concerns the design, construction, execution and evaluation of assessment of learning and performance.	24
Educational leadership and management	This task concerns how teachers exert intentional influence on education through their relationships with others.	36
Educational scholarship and research	This task concerns acquisition, application, contribution to, and dissemination of knowledge about teaching and learning.	37

In the review study, frameworks were broken down into excerpts: unique parts of the framework at the lowest aggregation level. Each excerpt received two codes: one code that indicated the subtask and task it belonged to and one code that indicated whether the excerpt was positioned as *advanced* within the framework. If excerpts were positioned as advanced, they were presented as being successive to or more complex than other excerpts in the framework. The percentage of advanced excerpts of all excerpts for each task was then calculated (see Table 1). Based on these percentages, we expect the following developmental phases: (1) development in 'teaching and supporting learning', (2) development in 'educational design' and 'assessment and feedback', (3) development in 'educational leadership and management' and 'educational scholarship and research'.

One of the frameworks included in the review that directly reflects these results is the 'Career Framework for University Teaching' (Graham 2018; Figure 1). In this framework, 'institutional leader in teaching & learning' and 'scholarly teacher' are presented as distinct profiles at level three and four of the framework (see Figure 1). Teachers proceed to these levels only after meeting the promotion criteria at level one and two, which mostly concern 'teaching and supporting learning', 'educational design' and 'assessment and feedback'.

Literature in primary and secondary education also supports the expectation that university teachers' self-efficacy starts to develop in 'teaching and supporting learning', 'educational design' and 'assessment and feedback' first. Based on a literature review of models for expertise and career development in primary and secondary education, Raduan and Na (2020) conclude that teachers most often become principals and educational researchers only after they have developed as proficient teachers. Closer inspection of the models included in the review reveals that this level of

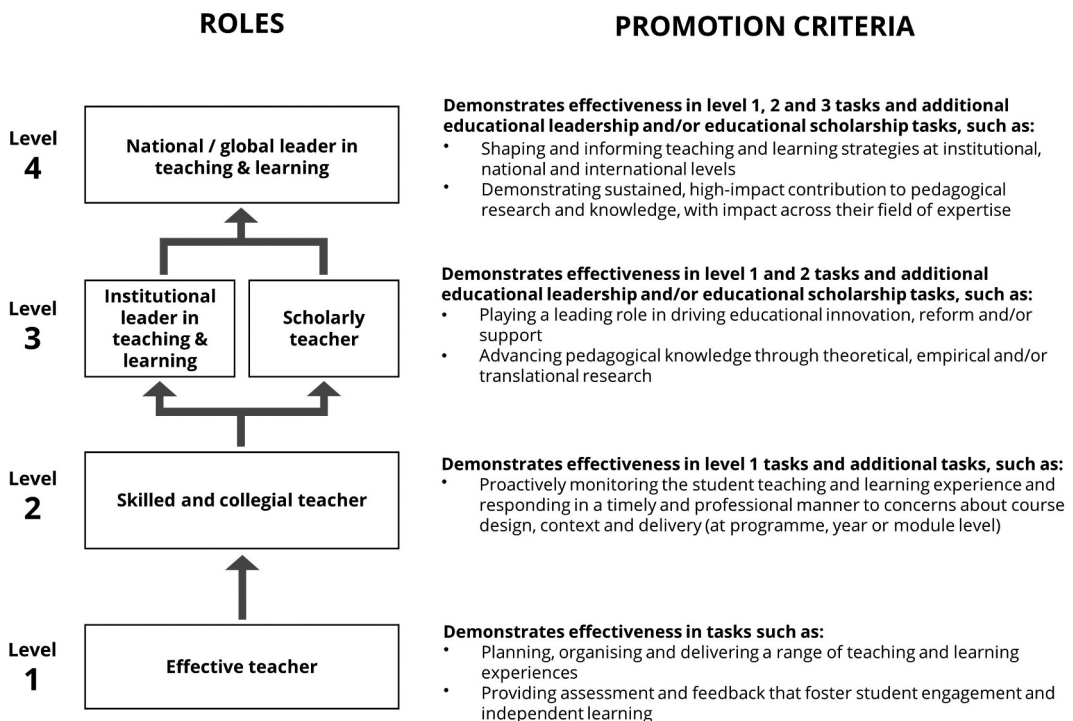


Figure 1. Career framework for university teaching. *Note.* Promotion criteria for each level as defined in the Career Framework for University Teaching were added to the figure. Adapted from the Career Framework for University Teaching, by Career Framework for University Teaching, 2020, (<https://www.teachingframework.com/framework/>). Copyright 2020 by Career Framework for University Teaching. Reprinted with permission.

proficiency involves expertise in ‘teaching and supporting learning’, ‘educational design’ and ‘assessment and feedback’.

Development of self-efficacy within tasks

There is a body of literature focusing on development in ‘teaching and supporting learning’. In a recent study, a Rasch analysis of observations of university teacher behaviour showed that university teachers develop their expertise in tasks related to clarity of instruction, and intensive and activating teaching before they develop their expertise in tasks related to teaching learning strategies and differentiation (Noben et al. 2020). In the review study into teacher tasks (van Dijk et al. 2020), subtasks about teaching learning strategies and differentiation of ‘teaching and supporting learning’ were also defined as most advanced by the included frameworks, together with a subtask about mentoring learners.

These findings are in line with studies in primary and secondary education: both with the foundational work of Fuller (1969) about the development of teacher concerns as well as with recent studies that investigated teacher development using Rasch analyses of observed teacher behaviour (van der Lans, van der Grift, and van Veen 2017, 2018) and student evaluations (Maulana, Helms-Lorenz, and van de Grift 2015). Thus, based on this body of literature, we expect that it is hardest for university teachers to feel self-efficacious in the subtasks about teaching learning strategies, differentiation and mentoring.

For the other four teacher tasks identified in the review by van Dijk et al. (2020), there does not seem to be sufficient theoretical and empirical research to form expectations about the development of university teachers’ self-efficacy.

The present study

This study aims to investigate phases in the development of novice university teachers’ self-efficacy in the full range of different teacher tasks to complement earlier research into self-efficacy that only focused on some of these tasks (see Matos, Iachite, and Sharp 2021, for an overview). We investigate the development of self-efficacy by distinguishing developmental phases based on an ordering of tasks from easiest to hardest for university teachers to feel self-efficacious in. The research is guided by the following research question: What phases can be distinguished in the development of self-efficacy of novice university teachers across and within teacher tasks?

Materials and methods

Participants and procedure

After obtaining ethical approval for the study from Ethics Review Board of the Faculty of Social and Behavioural Sciences at Utrecht University (#21-0291), novice university teachers in all academic positions from Utrecht University and affiliated medical centre University Medical Center Utrecht were invited to participate in the study. We invited 633 current and recent participants of pedagogical training programmes for novice academic teachers to fill out the questionnaire. This yielded 75 initial responses which were insufficient for the intended analyses. Therefore, we also recruited participants in the same target group by posting invitations to fill out the questionnaire via online communication channels accessible to all university teachers at both institutes and by asking people in our network to send targeted invitations to individuals and groups of university teachers to fill out the questionnaire. This increased the total number of participants to 201.

Our questionnaire was only accessible to novice university teachers: those university teachers that did not obtain a University Teaching Qualification (UTQ) or obtained it less than one year ago. Since 2008, the UTQ is a recognised by all Dutch research-intensive universities as a proof of competence of academics’ teaching skills in: student supervision, teaching, course design, student assessment

and evaluation of your own teaching. UTQs are obligatory for academics in tenured positions at all Dutch universities (Vereniging van Samenwerkende Nederlandse Universiteiten 2018). The Netherlands is one of the few countries that have implemented requirements for university teachers' professional development and teaching competence (Irby & O'Sullivan, 2018). Given the status of the UTQ in the Netherlands, we consider it justified to regard academics that have not yet obtained a UTQ or have obtained it less than one year ago as novice university teachers.

Of the participants ($n = 201$), 160 filled in the demographic questions at the end of the questionnaire: 31% self-identified as male, 65% as female, and 4% indicated they did not want to answer the question. The average age was 33 years ($SD = 8$ years, range: 23–63 years). Thirty-one participants stopped after answering half of the self-efficacy questions and ten did answer all self-efficacy questions but did not answer the demographic questions. For these 41 participants, no descriptive information is available.

Instrument

Available instruments for measuring self-efficacy only cover part of all teacher tasks and subtasks under investigation in this study. For an overview of instruments, see Matos, laochite, and Sharp (2021) and Zee and Koomen (2016). Therefore, we designed our own instrument based on the five tasks identified in the systematic review by van Dijk et al. (2020): 'teaching and supporting learning', 'educational design', 'assessment and feedback', 'educational leadership and management' and 'educational scholarship and research'. Subtasks for each of these five tasks were used as foundation for the items of the questionnaire. Subtasks were transformed into items at course level in multiple rounds by the research team, which included several members with expertise in questionnaire development and experience with the target group. Items were created by simplifying the wording of subtasks, providing examples and splitting subtasks that could not be covered in one item into two items. To exclude order effects, items were presented in a random order that was different for each participant.

For each item, academics were asked to indicate whether they had or had not carried out the activity described in the item as well as how self-efficacious they felt about carrying out this activity. The scale by Dellinger et al. (2008) was used as a basis to construct the scale to measure self-efficacy. Minor changes were made to the wording to better fit the items in our study: ('in my capability to ...' was changed to 'in your capabilities to carry out the following tasks') and the four-point scale for self-efficacy was adjusted to a five-point scale in line with recommendations by Weijters, Cabooter, and Schillewaert (2010). The following labels were used within the five-point answer-scale: (1) not confident, (2) slightly confident, (3) somewhat confident, (4) quite confident and (5) completely confident.

Questions to describe the sample were included at the end of the questionnaire, in line with recommendations from Cohen, Manion, and Morrison (2018). Participants were asked about their age, gender, faculty of employment, years of experience with teaching in higher education, and previous teaching-related work experience. Teachers' interest in teaching and invested effort in teaching were investigated using two scales developed and validated in higher education by Visser-Wijnveen et al. (2012) measured with items rated on a five-point labelled Likert scale. Participants were also asked how often they participated in professional development activities using an adaptation of an item by Connolly et al. (2018) with labelled endpoints of 1 (never) and 5 (at every opportunity).

A small-scale pilot study was used for validation of the items and rating scale. In the pilot, the items and rating scale were tested in two rounds. In the first round, items were reviewed by three university teachers from our target population using a think-aloud protocol. This round focused on verifying whether all items were understood correctly. Based on the university teachers' reflections and suggestions wording of some of the items was changed to clarify their meaning. To check whether a five-point scale indeed worked best, both a five-point scale and seven-point scale were

used in the pilot. The university teachers found it too difficult to distinguish between categories on the seven-point scale, which confirmed the five-point scale was best. In the second round of the pilot, the questionnaire was checked in writing by three other university teachers. These university teachers confirmed that the items as well as the answer scale were clear to them and identified some small issues pertaining to the lay-out of the questionnaire. After these issues were resolved, a final version of the questionnaire with thirty-two self-efficacy items measured on a labelled five-point scale was established. The subtasks and final questionnaire items for each subtask are included in Appendix A and the full final questionnaire is available on Dataverse (<https://doi.org/10.34894/KEIQRD>). Based on the results of the pilot study, we assumed sufficient evidence for validity of the items and answer scale to conduct our analyses.

Analyses

Developmental phases in self-efficacy were distinguished using a Rasch analysis of academics' self-efficacy scores at task and subtask level. Rasch analysis is a method of psychometric analysis that was developed for analysis and development of tests and questionnaires (Bond, Yan, and Heene 2020; Boone 2016). As described in various handbooks (e.g. Andrich and Marais 2019; Boone, Staver, and Yale 2014), a variety of insights about tests and questionnaires can be gained from Rasch analysis. In this study, we use Rasch analysis to identify cumulative patterns. We consider these cumulative patterns to be indicative for the development of self-efficacy. A cumulative pattern is found, for example, when university teachers in the sample rate their self-efficacy for task A above the lowest level only when they have rated their self-efficacy for task B at the highest level. We would then conclude that two phases in the development of self-efficacy could be distinguished, where self-efficacy in task B (i.e. phase 1) would develop before university teachers develop self-efficacy in task A (i.e. phase 2).

In recent studies, Rasch analysis has been used to investigate the development of effective teacher behaviour for in-class student–teacher interactions (Noben et al. 2020; R. M. V. D. van der Lans, Grift, and Veen 2018; R. M. van der Lans, van der Grift, and van Veen 2017). Data for the Rasch analyses in these studies were scores for specific teacher behaviours. The scores were produced by trained observers who observed secondary education and higher education teachers during their lessons. In this study, we build on and extend this use of Rasch analysis by investigating the development of self-efficacy. We do so by using Rasch analysis to generate *item difficulty scores* for each task and subtask. In the context of our study, these scores provide information about how difficult it is to feel self-efficacious in a (sub) task. The scores are expressed on linear scale in units called *logits*, so that tasks with higher logit scores are more difficult for teachers to feel self-efficacious in.

There are both dichotomous Rasch analyses (for data with two categories) and polytomous Rasch analyses (for data with more than two categories). We conducted a polytomous Rasch analysis, because a rating scale with more than two categories was used. A total of six polytomous Rasch analyses were performed: one at task level (development of self-efficacy across tasks) and five at subtask level (development of self-efficacy within each of the five tasks). The analysis at task level was conducted with mean self-efficacy scores of participants who reported their self-efficacy for all subtasks of each task ($n = 170$). Eight categories were defined based on half point scores between the minimum (1) and maximum (5) possible score. The analyses at subtask level were conducted with participants' self-efficacy scores for the subtasks. In all analyses at subtask level, we included data from participants with fully and partly completed questionnaires ($n = 201$), because missing data at item level is not problematic for Rasch analysis (Boone, Staver, and Yale 2014).

All Rasch analyses were performed in Winsteps version 5.2.1.0 (Linacre 2021) using a Rating Scale Model. This model assumes that all items share the same rating scale, which is appropriate for labelled five-point scales (Linacre 2000). Assumptions of unidimensionality (only one trait is measured) and local independence (response to an item is independent of that to any other items) were checked before proceeding with the analyses (Boone, Staver, and Yale 2014; Linacre 2022). No

indications of violation of these assumptions were found. To check the functioning of the items, we investigated Differential Item Functioning (DIF) for gender. This indicates whether male and female teachers responded differently to particular items. No DIF was found.

After checking the assumptions and presence of DIF, model quality was examined using different measures. Model fit was examined by looking at the percentage of explained variance by the model: >40% indicates sufficient model fit (Linacre 2022). Item and person outlier-sensitive fit (outfit) were investigated to explore how well the items and participants conformed to the Rasch model. Two fit statistics were used to determine unacceptable item and person outfit, namely the mean squared mean (MNSQ) and the z-standard (ZSTD). Item and person outfit was deemed unacceptable if the MNSQ values were lower than 0.5 or higher than 1.5 and if the ZSTD values were also lower than -2 or higher than +2 (Boone, Staver, and Yale 2014). In line with guidelines by Boone, Staver, and Yale (2014), 5% of the university teachers in the sample were expected to show misfitting observations by chance.

Rasch models for all analyses are presented in tables with their item difficulty scores and respective standard errors. These tables hereby present an ordering of tasks from easiest to feel self-efficacious in (lowest logit values) to tasks hardest to feel self-efficacious in (highest logit values). The ordering is based on patterns found in the data that reflect cumulation of self-efficacy scores, for example, when teachers are observed to only rate themselves as more than somewhat confident in one task A (i.e. more than two on the five-point scale) when they have rated themselves as completely confident (i.e. five on the five-point scale) in task B. We interpret these cumulative patterns as indications for development of self-efficacy.

Developmental phases are distinguished by clustering groups of tasks based on their item difficulty scores. We cluster tasks that do not differ more than 0.5 logits, as more than 0.5 logits is considered a meaningful difference between item difficulty scores in guidelines in education and healthcare (Hudgens et al. 2004; Lai and Eton 2002). We started to distinguish phases from the task with the lowest logit value as this task is easiest for university teachers to feel self-efficacious in. Important to note is that the meaning of a logit is unique in each analysis, which means that logit scores cannot be compared across the six analyses.

Results

Description of the sample

The participants had an average of 3.7 years of experience with teaching in higher education, with a standard deviation of 4.4 years (range: one month to 25 years). Participants spent between less than one day and five days per week on teaching tasks. Teaching-related previous work experience was reported by 63% of participants. Participants' average scores for the scales about interest in teaching ($M = 4.4$, $SD = 0.5$, Cronbach's alpha .76) and time investment in teaching ($M = 4.7$, $SD = 0.5$, Cronbach's alpha .77) were close to the upper end of the five-point Likert scale that was used. On average, the participants reported active engagement in professional development ($M = 3.1$, $SD = 1.0$), measured on a scale from 1 (never) to 5 (at every opportunity). The majority of participants had started with obtaining their Basic Teaching Qualification (44%) or had already obtained it (20%).

Development of university teachers' self-efficacy across tasks

Raw variance explained by the model was 71%, indicating sufficient model fit. Based on the cut-off criteria for MNSQ and ZSTD values, no misfitting items were found. This allows the Rasch model to include all five teacher tasks. Review of person misfit revealed 11 respondents with misfitting observations, which is more than the 9 respondents that were expected by chance in the sample. Guidelines for Rasch analyses recommend to only remove one or more scores from people with misfitting observations when they are suspected to be the reason for a misfitting

item (Boone, Staver, and Yale 2014). As no misfitting items were found in the analyses, no further action was taken.

In Table 2 we present the scores that estimate how hard it was for teachers to feel self-efficacious in a task as well as the standard error for the estimates. We present tasks by their measure from low to high, indicating a transition from tasks that are easier for university teachers to feel self-efficacious into tasks that are harder to feel self-efficacious in. Three phases for development could be distinguished: (1) development in ‘teaching and supporting learning’; (2) development in ‘assessment and feedback’, and ‘educational design’; (3) development in ‘educational leadership and management’, and ‘educational scholarship and research’. Important to note is that self-efficacy in tasks from the second phase does not only start to develop after teachers feel fully self-efficacious in tasks from the first phase, and so on. Instead, self-efficacy in tasks from all developmental phases can develop in parallel, but stronger self-efficacy in tasks from a previous phase can be expected first.

Table 2. Rasch analysis of university Teacher self-efficacy in Teacher tasks.

Teacher task	Measure (logits)	Model S.E. (logits)	Phase
Teaching and supporting learning	−1.29	0.10	1
Assessment and feedback	−0.34	0.09	2
Educational design	0.04	0.09	2
Educational leadership and management	0.65	0.08	3
Educational scholarship and research	0.93	0.08	3

Development of university teachers’ self-efficacy within tasks

Raw variance explained by the models ranged between 50% and 65%, meaning there was sufficient model fit in all analyses. MNSQ and ZSTD values were within acceptable ranges for all subtasks, and thus all analyses could include all subtasks. In four out of five analyses, person misfit was higher than expected by chance. The number of people with misfitting observations in these analyses ranged between 17 and 25. Again, because there were no misfitting items, no further action was taken.

In Table 3 we present the item difficulty scores and standard errors in logits for the subtasks from each of the five analyses. The developmental phases and corresponding subtasks are again presented in the table, from easier to feel self-efficacious in (lower logit values) to harder to feel self-efficacious in (higher logit values). A note about the interpretation of these phases can be found in the previous section.

Teaching and supporting learning

For ‘teaching and supporting learning’, three phases could be distinguished: a first phase with subtasks concerning learning climate (lowest logit values), a second phase with subtasks that concern organisation, instruction, active learning and mentorship (intermediate logit values), and finally a third phase with subtasks concerning differentiation, learning strategies and steering student behaviour (highest logit values).

Educational design

For ‘educational design’, three developmental phases were found: a first phase with subtasks concerning learning activities and teaching and learning materials (lowest logit values), a second phase with subtasks concerning the design of a course (intermediate logit values), and a third phase with one subtask about aligning a course with other courses in a programme (highest logit values).

Assessment and feedback

For ‘assessment and feedback’, three developmental phases could be distinguished: a first phase with one subtask about providing feedback (lowest logit values), a second phase with subtasks

Table 3. Rasch analysis of university teachers' self-efficacy in Teacher subtasks per Teacher task.

Items	Measure (logits)	S.E. (logits)	Phase
Teaching and supporting learning			
Engage with students in a motivating and supportive way ¹	-1.08	0.13	1
Create a safe, motivating and inclusive learning climate ¹	-0.69	0.13	1
Clearly communicate goals, the subject matter and how to proceed to students	-0.33	0.12	2
Ensure my classes proceed in a well-organised, smooth manner ^a	-0.20	0.13	2
Support and mentor students in their personal and academic development	-0.07	0.12	2
Stimulate active learning during class ^a	0.17	0.13	2
Adapt to different student levels and needs during teaching ^{a,*}	0.62	0.12	3
Support students in reflection and developing learning strategies [*]	0.70	0.11	3
Steer student behaviour during class ^{a,1}	0.89	0.12	3
Educational design			
Design learning activities for a course ^a	-0.72	0.13	1
Compose teaching and learning materials for a course	-0.63	0.12	1
Align learning goals, learning activities and assessment for a course ^{a,2}	-0.04	0.13	2
Define learning goals for a course	0.02	0.12	2
Use evaluations and other information for designing a course ^a	0.14	0.13	2
Align the design of a course with other courses in a program ²	1.23	0.11	3
Assessment and feedback			
Give feedback on student performance ³	-1.32	.13	1
Develop parts of exams (e.g. an exam question) ^{a,4}	-0.34	.12	2
Accurately assess student performance ^{a,3}	-0.20	.12	2
Be responsible for how students will be assessed in a course ^a	0.31	.12	2
Develop full exams for a course (e.g. entire test or assignment) ⁴	1.54	.10	3
Educational leadership and management			
Engage with all relevant stakeholders in a course (e.g. students, teachers, community partners, program director, etc.)	-0.67	.09	1
Support my colleagues in their teaching-related development	-0.14	.09	2
Realise innovation of education within a course	-0.09	.09	2
Coordinate and organise a course ^a	-0.06	.10	2
Carry out evaluations and quality assurance for a course	0.00	.09	2
Participate in and contribute to education-related committees and fora ^a	0.36	.10	3
Contribute to policy and culture related to education ^a	0.61	.10	3
Educational scholarship and research			
Apply knowledge, theories and models about teaching and learning to my own teaching practice ⁵	-0.65	.11	1
Share and disseminate my ideas and knowledge about teaching and learning ^a	-0.51	.12	1
Gain and maintain an understanding of educational theories and models ^{a,5}	-0.27	.12	1
Engage in educational research to contribute to the knowledge base about teaching and learning	0.60	.11	2
Engage in practice-based research to improve my own or colleagues' teaching practices ^a	0.83	.12	2

Note. The meaning of a logit is unique for each analysis of subtasks because subtasks were separately analysed.

^aItems with data from 170 respondents due to partial completion of the questionnaire.

^{1,2,3,4,5}Items that were used to capture a single subtask. Numbers correspond to the subtasks in Appendix A.

about activities related to responsibility for student assessments (intermediate logit values) and a third phase with one subtask about developing full exams for a course (highest logit values).

Educational leadership and management

For 'educational leadership and management', three developmental phases were found: a first phase with one subtask about engaging with stakeholders (lowest logit value), a second phase with subtasks concerning organisation and management of a course (intermediate logit values) and a third phase with subtasks related to contributing to fora, committees, policy and culture (highest logit values).

Educational scholarship and research

For 'educational scholarship and research', two phases could be distinguished: a first phase with subtasks that concern acquiring, applying and sharing knowledge (lowest logit values) and a second phase related to creating knowledge through research (highest logit values).

Discussion

Findings and contribution to the literature

Supporting academics in their role as university teachers is important for teacher well-being and teaching quality. To inform the design of support for novice university teachers, this study set out to explore whether phases in the development of teacher self-efficacy across and within teacher tasks could be distinguished. Our analyses showed that it was possible to fit Rasch models and that there were meaningful differences between groups of tasks and subtasks in these models that indicated phases in the development of self-efficacy. We have thereby uncovered a general pattern for self-efficacy development of university teachers that shows university teachers feel more self-efficacious in some tasks before others. Our study is, to the best of our knowledge, one of the first to empirically investigate the development of university teachers within tasks other than 'teaching and supporting learning' and thereby expands current insights.

Three phases could be distinguished for development of self-efficacy across tasks. In line with expectations from models in the literature and in practice (Raduan and Na 2020; van Dijk et al. 2020), 'educational leadership and management' and 'educational scholarship and research' were included in the third and final developmental phase. Additionally, our results suggest that strong self-efficacy in 'teaching and supporting learning' can be expected before strong self-efficacy in 'educational design' and 'assessment and feedback'.

For university teachers' development of self-efficacy within teacher tasks, two to three phases could be distinguished within each task. Some of these phases do not have clear-cut boundaries, as some subtasks at the lower and upper ends of two phases have less than 0.5 logits difference. However, the phases help to provide a better overall understanding of how teachers' development of self-efficacy in the subtasks is structured. The developmental phases found for 'teaching and supporting learning' are in agreement with findings from previous studies that identified differentiation and teaching learning strategies as subtasks teachers develop expertise in after they have developed expertise in the subtasks for 'teaching and supporting learning' (Maulana, Helms-Lorenz, and van de Grift 2015; Noben et al. 2020; van der Lans, van der Grift, and van Veen 2017, 2018).

One unexpected finding in the analysis of subtasks was that novice university teachers' self-efficacy in 'steering student behaviour during class', as part of the task 'teaching and supporting learning', had a higher logit score than we had expected compared to the other subtasks in 'teaching and supporting learning'. Our expectation was based on observational studies in primary and secondary education which showed that teachers demonstrate their effectiveness in steering student behaviour, before showing effective instructional behaviour (van der Lans, van der Grift, and van Veen 2017, 2018). In these studies, it is concluded that being able to manage a classroom, which according to these authors includes being able to steer student behaviour, is conditional for being able to instruct students effectively.

The discrepancy between the results from our study and results from these studies in primary and secondary education may be explained by different foci (teacher self-efficacy versus teacher behaviour) and different research contexts (higher education versus primary and secondary education). The most likely explanation, however, is that the university teachers in our study interpreted 'steering student behaviour' not as a regular aspect of classroom management when reporting their self-efficacy for this subtask. This hypothesis is supported by the lower logit score for self-efficacy in the subtask 'ensure my classes proceed in a well-organised, smooth manner', which is typical for effective classroom management in primary, secondary, and higher education. To confirm this hypothesis, further research is needed into how the item about steering student behaviour is perceived by university teachers in universities with varying teaching philosophies.

Implications for practice

The developmental phases that were found in our study can help to enact a key principle for effective teacher training programmes in primary and secondary education (Brouwer and Korthagen 2005; Stokking et al. 2003) and for professional development in general (i.e. zone of proximal development; Vygotsky 1978), which is to focus on tasks that are experienced as difficult, but not as overchallenging. It thereby provides information that can help optimise the content and structure of professional development activities and other practices aiming to support academics in the development of their teaching.

Our results suggest that pedagogical training programmes will benefit if within the programme there is a shift in focus on tasks from subsequent developmental phases over time (see Table 2). This means that, ideally, pedagogic training should first focus novice university teachers' learning on 'teaching and supporting learning' (phase one), then on 'educational design' and 'assessment and feedback' (phase two) and lastly on 'educational leadership and management' and 'educational scholarship and research' (phase three). Our results suggest a similar shift in focus on specific subtasks during pedagogic training (see Table 3). For example, for 'assessment and feedback', our results imply that focusing on developing full exams (phase three) in pedagogic training is most effective when novice university teachers have already developed some self-efficacy in the other subtasks (phase one and two).

How soon the shift in focus should take place will of course depend on how fast novice university teachers develop their self-efficacy in various (sub)tasks, which may be different for specific individuals and groups. What (sub)tasks are most relevant to focus on first will also depend on initial self-efficacy levels of novice university teachers. This level of self-efficacy may be influenced by previous teaching-related work experience (63% in our sample) as well as experiences after having started teaching at university. The higher than expected number of people with misfitting observations indicates that novice university teachers may have different pathways for developing their self-efficacy. These differences may be caused by a variety of reasons, including personal qualities and job profiles. We therefore suggest paying attention and adapt to these individual differences in supporting novice university teachers' professional development.

The shift in focus described for pedagogic training could also be applied to the allocation of teaching responsibilities amongst novice university teachers. However, a challenge in higher education is that university teachers often start teaching with no or little teacher training and may also be assigned substantial responsibilities in course design and student assessment early on in their academic careers. In these cases, our results may provide guidance for the areas in which most support is needed by novice university teachers. For example, for 'educational design', novice university teachers are likely to need most support with the subtask of aligning the design of a course with other courses (phase three).

The results of our study are relevant for novice university teachers themselves as well. The developmental phases provide information about the order in which novice university teachers are expected to have strong self-efficacy in their teacher tasks and subtasks. This information can help university teachers to identify the (sub)tasks that are just challenging enough for them and to focus their learning on these specific (sub)tasks, for example, through deliberate practice, attending a course or consulting a colleague.

Limitations and further research

This study is the first investigation of developmental phases of novice university teachers' self-efficacy across and within tasks. While collecting data amongst novice university teachers at a single point in time was suitable for this purpose, we would like to stress that these initial findings need to be verified and further detailed by longitudinal research following teachers' individual self-efficacy development over time. Although we did take first steps for

validation of the questionnaire used in our study (i.e. literature-based items, items developed by a team of experts, a small-scale pilot study, analysis of factor structure and reliability for all analyses), we cannot exclude the possibility that items were misinterpreted by participants. We therefore recommend further validation when using the questionnaire in other studies.

We included a substantial number of teachers from different faculties, including a university medical centre. However, they were all from a single university in one country. The educational vision of this university may therefore have affected our findings. For example, the importance of active learning in university policy and professional development may have influenced the results of the study by increasing self-efficacy for items such as 'simulate active learning during class'. Utrecht University is also a research-intensive university. This could be an explanation for the moderate engagement in teaching-focused professional development activities ($M = 3.1$, $SD = 1.0$) that was reported by participants. In teaching intensive universities, academics could be more engaged in teaching-focused professional development activities, which could in turn influence their teacher expertise development. We therefore recommend replication or follow-up studies with teachers from different institutes and countries to see whether the phase patterns are consistent across different sociocultural contexts.

Finally, our results warrant further investigation into how and why individual teachers and groups of teachers deviate from the developmental phases that were found. This will extend the insights of the present study and add to the guidance for supporting novice university teachers we have provided so far.

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Data availability statement

The data that support the findings of this study are openly available in Dataverse at <https://doi.org/10.34894/KEIQRD>.

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Appendix A. Items in the questionnaire

Table A1. Items in the questionnaire and their corresponding teacher tasks and subtasks.

Tasks	Subtasks	Items
Teaching and supporting learning	Stimulates a safe, motivating and inclusive learning climate ¹	Create a safe, motivating and inclusive learning climate Engage with students in a motivating and supportive way Steer student behaviour during class
	Organises learning situations	Ensure my classes proceed in a well-organised, smooth manner
	Provides instructions, explanations, and demonstrations and acts as a role model	Clearly communicate goals, the subject matter and how to proceed to students
	Uses activating teaching methods	Stimulate active learning during class
	Supports learners in reflection and developing learning strategies	Support students in reflection and developing learning strategies
	Adapts to different learner levels and learner needs	Adapt to different student levels and needs during teaching
	Supports, advices, and mentors learners	Support and mentor students in their personal and academic development
Educational design	Uses evaluations of education and other information to inform educational design	Use evaluations and other information for designing a course
	Defines learning goals	Define learning goals for a course
	Selects and/or designs learning activities	Design learning activities for a course
	Selects, organises, and designs teaching and learning materials	Compose teaching and learning materials for a course
Assessment and feedback	Realises alignment in educational design ²	Align learning goals, learning activities and assessment for a course Align the design of a course with other courses in a program
	Performs assessments and gives feedback ³	Give feedback on student performance Accurately assess student performance
	Designs, selects, constructs, implements, and evaluates (part of) an assessment instrument ⁴	Develop parts of exams (e.g. an exam question) Develop full exams for a course (e.g. entire test or assignment)
	Designs, implements, and evaluates an assessment plan or strategy	Be responsible for how students will be assessed in a course
Educational leadership and management	Engages with relevant stakeholders	Engage with all relevant stakeholders in a course (e.g. students, teachers, community partners, program director, etc.)
	Organises, coordinates and manages education and all resources involved	Coordinate and organise a course
	Engages in evaluations of education, quality assurance, accreditations, and audits	Carry out evaluations and quality assurance for a course
	Participates and contributes to education-related committees and fora	Participate in and contribute to education-related committees and fora
	Supports, mentors, and promotes colleague teachers' professional development	Support my colleagues in their teaching-related development
	Influences, establishes and implements policies and culture	Contribute to policy and culture related to education
	Initiates, leads and implements educational change and innovation	Realise innovation of education within a course
Educational scholarship and research	Acquires and maintains an understanding of educational theories and models and applies these to teaching practice ⁵	Gain and maintain an understanding of educational theories and models ⁵ Apply knowledge, theories and models about teaching and learning to my own teaching practice ⁵
	Engages in inquiry into own or local teaching practice	Engage in practice-based research to improve my own or colleagues' teaching practices
	Engages in (discipline-based) educational research	Engage in educational research to contribute to the knowledge base about teaching and learning
	Shares and disseminates knowledge, experience, innovation and research with regards to teaching and learning	Share and disseminate my ideas and knowledge about teaching and learning