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The dimensions of approaches to teaching in higher education: a new analysis of teaching profiles

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Abstract
The exploration of higher education (HE) teachers' approaches to teaching has mainly been done using quantitative instruments which have been criticised for being too narrow in examining the dimensions of teaching. *Higher education approaches to teaching* (HEAT) inventory is a recently developed instrument to capture the dimensions of HE teaching more broadly. Moreover, teacher self-efficacy has been shown to be an important element influencing approaches to teaching, but still, the research on it has been scarce. The aims of the study are thus (1) to validate the HEAT inventory and (2) to explore what kind of individual teaching profiles can be identified among higher education teachers and their relation to teachers' self-efficacy. The results showed that HEAT is a valid instrument to measure various dimensions of approaches to teaching and that several profiles of approaches to teaching can emerge among HE teachers. These profiles also differ in terms of teachers' self-efficacy.

Keywords Approaches to teaching · Dimensions of teaching · Self-efficacy · Questionnaire validation · University teaching · Teacher profiles

Introduction

Teachers' approaches to teaching in higher education have been explored since the early 1990s. This line of research has increased the understanding of the intentions teachers have concerning their teaching and how they implement their teaching to achieve those aims in the higher education (HE) context. Researchers have also been interested in how approaches to teaching are related to disciplinary differences (Lindblom-Ylänne et al., 2006; Stes et al., 2007), teaching experience (Stes et al., 2008), conception of subject matter (Mladenovici et al., 2022), participation in pedagogical development (Cassidy & Ahmad, 2021; Kálmán et al., 2020; Postareff et al., 2007; Postareff & Lindblom-Ylänne, 2008; Shum & Fryer, 2019), teaching-related emotions (Chen, 2019; Kordts-Freudinger,

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2017; Postareff & Lindblom-Ylänne, 2011; Trigwell, 2012), goal orientations (Yin et al., 2017), and students' learning approaches (Trigwell et al., 1999; Uiboleht et al., 2018). This shows that there is an ongoing need to explore HE approaches to teaching from a range of perspectives.

Previous research on teachers' approaches to teaching has mainly been examined using quantitative instruments (see, e.g. Chen, 2019; Meyer & Eley, 2006; Shum & Fryer, 2019). The quantitative measurement of approaches to teaching has focused on the variation between an information transmission/teacher-focused view of teaching and a conceptual change/student-focused view of teaching (Trigwell & Prosser, 2004). Sometimes, these measures have been conceived as not reflecting the full range of dimensions in teachers' approaches to teaching (Meyer & Eley, 2006). Thus, this might have had on effect on how the approaches to teaching have often been conceptualised as dichotomic variables. Since the development of the commonly used quantitative instruments, qualitative research on approaches to teaching with large numbers of participants has increased, which has deepened and broadened the understanding of the nature of and variation in approaches to teaching through identifying a broad range of dimensions in teachers' approaches to teaching (Postareff & Lindblom-Ylänne, 2008). So far, this new research information has not been utilised in the development of the quantitative instruments, and there has been no new instrument to address the variety of teachers' approaches to teaching.

Earlier studies indicate that HE teachers' self-efficacy is related to their approaches to teaching (Cao et al., 2018; Kaye & Brewer, 2013). Self-efficacy has also shown to be an important element of schoolteachers' wellbeing (e.g. Gastaldi et al., 2014; Helms-Lorenz et al., 2011); still, the role of self-efficacy in HE teaching has been under-examined. The present study responds to the need to have an instrument to address approaches to teaching with a strong foundation from the qualitative data. It also aims to examine the teaching-related self-efficacy in relation to approaches to teaching. Thus, the aim is twofold. First, it focuses on validating an instrument for examining teachers' approaches to teaching in the contexts of research-based universities and universities of applied sciences. Second, the aim is to explore what individual teaching profiles can be identified among higher education teachers and how these profiles are related to the teachers' teaching-related self-efficacy.

Approaches to teaching among higher education teachers

A vast body of research on approaches to teaching has investigated the nature and dimensions of the approaches (e.g. Trigwell et al., 1994; Postareff & Lindblom-Ylänne, 2008; Prosser & Trigwell, 2014). The best-known categorisation illustrating the dimensions of approaches to teaching is probably the one created by Trigwell et al. (1994), which addresses the strategies teachers adopt for their teaching as well as the intentions underlying the strategies. The intentions range from those addressing transmission of the subject and content to the student to those where the teacher's intention is to help the students to develop their conceptions of the content. The strategies range between student- and teacher-focused ones, including a strategy focusing on student-teacher interaction in between them. The understanding of approaches to teaching comprising of the intention and strategy components led to the development of the Approaches to Teaching Inventory (ATI; Trigwell & Prosser, 2004). The ATI measures approaches to teaching through *information transmission/teacher-focused (ITTF)* approach scale, which captures the teachers' intention to transmit information to the students without attempting to reinforce students' own knowledge construction and active engagement. Typical in teacher-focused teaching is inflexible use of teaching and assessment methods—instead, teaching is often characterised

by repeating familiar methodologies across contexts. In the *conceptual change/student-focused (CCSF) approach scale*, the teachers' intention is to activate students' prior knowledge and their own thinking through paying attention to the amount and quality of teacher-student and student-student interaction. They use a wide range of teaching and assessment methods to engage and activate their students according to the situation and reflect on their own actions in the teaching-learning situation. On the basis of this categorisation, Trigwell and Prosser developed the Approaches to Teaching Inventory with 16 items addressing the ITTF and CCSF approaches (ATI; Trigwell & Prosser, 2004) and its revised version which included 22 items in total (ATI-R; Trigwell et al., 2005), which have been widely adopted in quantitative investigations of approaches to teaching.

In one of the few qualitative investigations of approaches to teaching (Postareff & Lindblom-Ylänne, 2008), the approaches were classified into two broad categories, the learning- and content-focused approach to teaching based on interview data. Enhancing the students' learning process forms the core of the learning-focused approach and therefore was labelled learning-focused instead of student-focused. The second category was also relabelled as content-focused rather than teacher-focused due to the heavy reliance in teaching to transmit the content from the teacher to the students (Postareff & Lindblom-Ylänne, 2008).

Several sub-categories or characteristics typical for the learning-focused and content-focused approaches to teaching have been identified (e.g. Postareff, Lindblom-Ylänne, & Nevgi, 2008; Trigwell et al., 1994; Uiboleht et al., 2016). Firstly, the core of the approaches to teaching depends on whether the teachers' teaching processes are based on interactive or transmissive elements. In the qualitative study by Postareff, Katajavuori, et al. (2008), the role of *interaction* between the teacher and the students, highlighted especially in the learning-focused approach to teaching, clearly emerged as the teachers described how they aimed to enhance the students' learning process by ensuring that there is time and space for discussions and active processing of the learned topics. Even though the student is at the core of the learning process, the teacher has a central role in facilitating the learning process. On the contrary, some teachers described their aim as being to deliver the information from the teacher to the students. *Transmitting the information* was found to be an important element of the content-focused approach (Postareff, Lindblom-Ylänne, & Nevgi, 2008).

In addition to the two core dimensions of approaches to teaching acknowledged in several studies (interactivity vs. information transmission), interview studies have revealed that a teacher's ability to *reflect* on their own teaching and student learning is a significant dimension of approaches to teaching (Postareff & Lindblom-Ylänne, 2008). This reflective component is referred to as *pedagogical awareness*, and it has been shown that the reflective component is typically attached to the learning-focused approach to teaching. It is typical for teachers who are developing their teaching from content- to learning-focused approaches to deeply reflect on their own teaching and the consequences of their teaching for student learning (Postareff, Katajavuori, et al., 2008). Other studies have confirmed that reflection is important if one wishes to develop as a university teacher (see, e.g. Åkerlind, 2007). Finally, a teacher's ability to *plan and organise* their teaching has also been detected from the interviews as a central dimension of university teaching (Postareff & Lindblom-Ylänne, 2008; Uiboleht, 2019). This dimension can emerge in a positive or negative way in teachers' teaching, regarding whether it is accompanied by the content- or learning-focused approach. For example, if a teacher adopts a more content-focused approach to teaching, planning and organising typically mean stricter lecture plans that are built around the teachers' own interests (Postareff & Lindblom-Ylänne, 2008). In the learning-focused approach, planning is more flexible, and organising is more about being well prepared

for teaching situations and finding out the students' prior understanding and interests. Recently, Uiboleht (2019) highlighted that the theory of approaches to teaching could be expanded by adding a dimension which captures the elements that structure, guide, and support students' learning. Without these elements, the learning-focused approach may lose its benefits (Uiboleht, 2019).

Previous studies adopting a person-oriented approach have shown that teachers can combine the learning- and content-focused in diverse ways; i.e. they may adopt *dissonant* combinations of the approaches to teaching (Cao et al., 2019; Postareff, Katajavuori, et al., 2008; Shum & Fryer, 2019; Stes & Van Petegem, 2014). For example, Postareff, Katajavuori, et al. (2008) showed that a clear minority adopted the content-focused approach exclusively, while the majority of teachers adopted the learning-focused approach exclusively or even more commonly, a mix of the learning- and content-focused approaches. Another qualitative study conducted at the course-level showed that the learning- and content-focused approaches can co-exist and that dissonance may also appear within a single aspect of teaching. This means that while teaching a specific course, a teacher can adopt teaching practices including more or less interactive or transmissive elements and therefore reflect both the learning- and content-focused approaches (Uiboleht et al., 2016). However, more research is needed to reveal how reflectivity and organised teaching emerge in the consonant and dissonant teaching approaches.

Teacher's self-efficacy

Self-efficacy refers to the belief in one's own ability to perform a given task (Bandura, 1997). According to the original definition by Bandura (1997), self-efficacy is defined as being task- and situation-specific. However, some studies also suggest that it may be considered as a more general construct referring to a generally optimistic sense of own personal competence in a certain domain or profession, such as teaching (e.g. Chen et al., 2004; Luszczynska et al., 2005). When applied to the teaching context, teaching-related self-efficacy refers to 'an individual teacher's beliefs in their own ability to plan, organise, and carry out activities that are required to attain given educational goals' (Skaalvik & Skaalvik, 2010). Teaching-related self-efficacy is an important factor to consider as it has been shown to be related both to a student's academic achievement and motivation (Thoonen et al., 2011), teacher's own work commitment, job satisfaction and wellbeing (Aloe et al., 2014; Klassen & Chiu, 2011; Viel-Ruma et al., 2010), and teaching performance (Klassen & Tze, 2014).

Based on a review by Zee and Koomen (2016), teachers with higher teaching-related self-efficacy are likely to use more student-focused strategies in classroom and trust in their ability to establish good relationships with students and engage in interaction (see also Temiz & Topcu, 2013). Similarly, Kaye and Brewer (2013), as well as Cao et al. (2018), showed that higher teaching-related self-efficacy is associated with a more student-focused approach to teaching. In contrast, teachers with low teaching-related self-efficacy tend to use more teacher-focused strategies and have less trust in their students and own capabilities as a teacher (Pitkäniemi, 2002). However, teachers whose teaching is systematically or mainly content-focused may not recognise the challenges in their teaching and the need to develop their teaching practices, and therefore, they might display strong teaching-related self-efficacy beliefs. Their inability to reflect on their own teaching seems to prevent them from recognising their own challenges which contribute to strong teaching-related self-efficacy (see Postareff, Katajavuori, et al., 2008; Postareff & Lindblom-Ylänne, 2011).

Since teacher teaching-related self-efficacy has been shown to be an important element influencing teaching (Temiz & Topcu, 2013), it is an important aspect to investigate in relation to higher education teachers' approaches to teaching.

Developing an instrument to examine approaches to teaching

As mentioned above, the previously available instruments for examining approaches to teaching, ATI (Trigwell & Prosser, 2004) and ATI-R (Trigwell et al., 2005), have captured approaches to teaching through the student/learning-focused and the teacher/content-focused approaches to teaching, which largely capture the focus on interactivity of teaching vs. information transmission. However, further in-depth interview research has shown that in addition to these dimensions, there is a need to broaden the scope and include additional dimensions to capture the approaches more holistically (Postareff & Lindblom-Ylänne, 2008; Uiboleht, 2019). To address the variety in teachers' approaches to teaching, the authors and their research group developed a new inventory, HEAT (higher education approaches to teaching). The aim of the HEAT inventory (Parpala & Postareff, 2021) is to capture the dimensions of teaching broadly by using the previous quantitative (Trigwell & Prosser, 2004; Trigwell et al., 2005) and qualitative research on approaches to learning (Postareff, Katajavuori, et al., 2008; Postareff & Lindblom-Ylänne, 2008). During the development process, the items related to the student/learning-focused and teacher/content-focused approaches in ATI and ATI-R (Trigwell & Prosser, 2004; Trigwell et al., 2005) were examined item by item and contrasted to previous sub-scales found in the study by Postareff and Lindblom-Ylänne (2008). As a result, two scales were created, the *interactive approach* and the *transmissive approach*, which share similar items as ATI and ATI-R. Moreover, two new dimensions were added based on the author's previous qualitative research on approaches to teaching, *unreflective approach* to teaching and *organised teaching*, as these phenomena emerged as important dimensions in previous interview data (Postareff et al., 2008; Postareff & Lindblom-Ylänne, 2008; Uiboleht, 2019). To sum up, based on previous theory and in-depth interview studies on approaches to teaching, they could be captured through four dimensions: *interactivity*, *information transmission*, *reflectivity*, and *organised* teaching (see 'Approaches to teaching among higher education teachers'). This categorisation is used as a basis for the development of the HEAT instrument described in the current study. In this vein, the HEAT instrument aims to comprehensively capture the diverse range of teachers' perceptions of their approaches to teaching. The content of the instrument is described in more detail in the 'Methods' section.

Aims and research questions

The validity of the new items addressing approaches to teaching (HEAT inventory) and teaching-related self-efficacy has not been examined in the wider context. Therefore, in the present study, we investigated the construct validity of the HEAT inventory and the teaching-related self-efficacy scale in the contexts of both sides of Finland's binary higher education system of research-based universities and universities of applied sciences. Moreover, we explore higher education teaching profiles and how they are related to teaching-related self-efficacy. The research questions are the following:

1. What is the construct validity of the dimensions measuring teachers' perceptions of their approaches to teaching and teaching-related self-efficacy?
2. Based on approaches to teaching, what teaching profiles can be detected among higher education teachers?
3. How are the various teaching profiles related to teachers' teaching-related self-efficacy beliefs?

Methods

Context

The present study focuses on teachers' approaches to teaching and their teaching-related self-efficacy in Finnish research-intensive universities (UNI) and universities of applied sciences (UAS). Finnish higher education institutions (13 universities and 22 UAS) teach nearly 300,000 students, and they have 26,000 staff members. Historically, the main differences have been that while UAS have aimed to provide education for professionals in the workforce, such as nurses and engineers, research-based universities have aimed to promote research-based expertise in professional (such as medical doctors and lawyers) and non-professional fields (such as history and behavioural sciences). Furthermore, academic research has been traditionally conducted only in UNIs. However, this difference has diminished in recent years as UAS have also started to promote research activities.

In research-based universities, teachers are typically experts in their fields and have qualified for the positions through their research activities. Additionally, many university teachers lack pedagogical qualifications. In contrast, teachers in UAS typically have both work experience from their field and a pedagogical qualification. Besides these differences, the different institutional expectations for education in UNI and UAS influence teachers' work. For example, in UNIs, it is often believed that teaching is less valued than research (Van Lankveld et al., 2017); this is also evident in the Finnish UNIs. In the Finnish UAS, teachers experience challenges in collaborations with the world of work and face increasing demands to develop their research competencies (Töytäri et al., 2019). However, both types of higher education institutions offer bachelor's and master's degrees in various majors.

Data collection

The data were collected between April and December 2019. In UNI, the data was mainly collected from teachers who had enrolled in a pedagogical development programme. They were sent a link to an online survey via email at the beginning of the programme. A minority of the teachers filled in a paper version of the questionnaire. Moreover, in some UNI faculties, the survey was sent through email to all teaching staff. The same procedure was adopted while collecting data in UAS. Participation in research was completely voluntary. The teachers gave their active consent to participate in the research. The research design was approved by the Ethical Review Board in Humanities and Social and Behavioural sciences, University of Helsinki.

Participants

The data for the present study were collected from the research-intensive universities (UNI) and universities of applied sciences (UAS). The participants' background information is presented in Table 1. The final sample sizes were *N*=158 from four Finnish UNIs and *N*=139 from two Finnish UAS. The participants are relatively balanced in terms of gender. In both UAS and UNI data, natural sciences, engineering and technology, and medical and health sciences are well represented (over 20 teachers). In addition, agricultural sciences are well represented in the UAS data. However, in both UAS and UNI data, there are only a few teachers representing the humanities. It is notable that the UNI teachers are more likely to hold a licentiate or a doctoral degree, whereas the UAS teachers hold more typically hold a bachelor's or a master's degree. Furthermore, the UAS teachers often have more than 10 years of teaching experience.

Instruments

In the present study, we used the HEAT inventory (see Table 8 in Appendix) developed in the HowUTeach project (Parpala & Postareff, 2021). Our aim was to test and develop the questionnaire further to be a valid research instrument in a wider higher education context. The questionnaire was originally created in Finnish and then translated into English. For the present study, the Finnish items were translated into English and, after this, back-translated from English to Finnish. Then, it was compared whether the original meaning of the original and back-translated items had changed, and some slight modifications were made to the English items. Both the Finnish and the English versions of the questionnaire were used in the data collection.

The HEAT inventory measuring the perceptions of higher education teachers' approaches to teaching included four scales labelled as interactive approach, unreflective approach, transmissive approach, and organised approach (Parpala & Postareff, 2021). The development and the content of the four scales are described in the paragraph 'Developing an instrument to examine approaches to teaching'. The scale addressing the *interactive approach* includes three items, in which the focus is on providing opportunities for the students to deal with the subject and topic through discussions, which is seen as a central means of creating interaction between the teacher and the students as well as among the students. The *transmissive approach* is also addressed through three items, which focus on delivering the information of the subject and the teachers' knowledge to the students. The scale addressing the *unreflective approach* captures if the teacher is unable to reflect on and understand the students' learning process and how they as teachers could help their students to learn. Teachers could easily agree on items on reflectivity, even if they faced difficulties in reflection. For this reason, it was assumed that compared to a reflective scale, more variation would be captured when using the reversed reflectivity scale. Three items on the *organised approach* to teaching scale capture how teachers invest time and effort in their teaching and how organised and systematic they are as teachers. In addition, teachers' teaching-related self-efficacy beliefs, e.g. their beliefs in their own ability to cope with the teaching tasks, were addressed using items developed in the same HowUTeach project from which HEAT was developed (Parpala & Postareff, 2021). The self-efficacy items were contextualised to the teaching context, and teachers were asked to think about a typical teaching situation while answering the items. A five-point Likert scale was used in every item (from strongly disagree to strongly agree).

Table 1 The participants' background information categorised by institution type, as well as each group's means, standard deviations, and between-group comparisons for the factors measuring approaches to teaching and self-efficacy

Background variables		# of participants			Approaches to teaching				Self-efficacy	Between-group comparisons
		UNI	UAS	Total	F1 interactive approach	F2 transmissive approach	F3 unreflective approach	F4 organised approach		
Gender	Woman	76	82	158	4.02 (.78)	2.35 (.82)	1.80 (.66)	4.08 (.63)	4.02 (.72)	Women score statistically significantly higher on F1 interactive approach (U=7894.5, p=.003) and lower on F2 transmissive approach (U=12796.0, p<.001) compared to men
	Man	75	50	125	3.76 (.80)	2.79 (.86)	1.87 (.65)	4.00 (.71)	4.18 (.61)	
Degree	Bachelor's or master's	23	104	127	4.04 (.69)	2.40 (.80)	1.80 (.65)	4.02 (.60)	4.14 (.63)	Participants with a bachelor's or a master's degree score statistically significantly higher on F1 interactive approach (U=8855.5, p=.022) and lower on F2 transmissive approach (U=12123.5, p=.021) compared to participants with a licentiate or a doctorate degrees
	Licentiate or doctorate	133	32	165	3.80 (.86)	2.63 (.89)	1.84 (.65)	4.08 (.72)	4.04 (.71)	

Table 1 (continued)

Background variables		# of participants			Approaches to teaching				Self-efficacy	Between-group comparisons
		UNI	UAS	Total	F1 interactive approach	F2 transmissive approach	F3 unreflective approach	F4 organised approach		
Teaching experience (years)	0–5	59	39	98	3.99 (.74)	2.46 (.81)	1.96 (.70)	4.06 (.65)	3.96 (.69)	Teaching experience interacts statistically significantly with the self-efficacy factor (χ^2=6.361, df=2, p=.042); participants with 0–5 years of experience score lower compared to the participants with 10+ years of experience (Bonferroni-corrected p=.038)
	5–10	40	17	57	3.70 (.88)	2.67 (.88)	1.84 (.62)	4.03 (.64)	4.04 (.74)	
	10+	57	75	132	3.95 (.79)	2.57 (.85)	1.74 (.65)	4.07 (67)	4.19 (.68)	
Total		158	139	297	3.91 (.79)	2.54 (.86)	1.83 (.65)	4.06 (.67)	4.09 (.67)	

Analyses

The data were analysed with IBM SPSS 27, AMOS 27, and R Studio 3.6.1. The present study used two sets of data; the first data set (N=158) was collected from four research-intensive universities (UNI) and the second data set (N=139) from two universities of applied sciences (UAS). The instrument validation procedure consisted of two phases. First, the UNI data were subjected to an exploratory factor analysis to identify the factor structure of the questionnaire. Then, the factor structure was validated through a confirmatory factor analysis with the UAS data. Finally, the data sets were merged to investigate the teachers' approaches to teaching profiles and their relation to teaching-related self-efficacy.

At first, both data sets were screened for repetitive response patterns and missing values. In both data sets, one respondent was removed because of disengagement in answering the items. The data sets contained less than 1% of missing values, and based on Little's MCAR test (Little, 1988), the values were missing completely at random in all scales. Because of the small number of missing values and a need for a complete data set (required later in bootstrapping), a single imputation method was convenient. The missing values were imputed using the expectation maximisation method preserving the relationships with other variables in the scale. The UNI data did not include any extreme outliers, but for the UAS data, seven multivariate outliers were identified through the Mahalanobis distance and consequently were removed from the data. The normality of the items was assessed through skewness and kurtosis and multicollinearity through both the bivariate correlations and variance inflation factor.

To identify the factor structure, the UNI data were analysed with an exploratory factor analysis procedure. Exploratory factor analysis is a statistical procedure used to extract factors from a collection of items, enabling the investigation of latent variables that cannot be measured directly. A principal axis factoring was chosen as the extraction method as it is more robust with small sample sizes compared to the maximum likelihood estimation. The principal axis factoring was accompanied with direct oblimin rotation; an oblique rotation was chosen over orthogonal rotation as there was no reason to assume that the latent factors were linearly independent. The data suitability for factor analysis was investigated through the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO), the Bartlett's test of sphericity, and the item communalities. The proposed factor structure was analysed with a scree plot, explained total variance, and factor loadings. The factor scores were eventually computed as the mean of the corresponding items. All factors were also checked for internal consistency with Cronbach's alpha.

To confirm the factor structure identified in the exploratory factor analysis, the UAS data were analysed with a confirmatory factor analysis using the maximum likelihood estimation. The validity of the scales was assessed through multiple fit indices. The chi-squared statistics were used to assess the overall model fit. For supporting the model fit, the chi-squared statistics should return a non-significant p-value. However, the chi-squared test is artificially inflated with increasing sample sizes. Also, the violation of multivariate normality assumption can possibly inflate the chi-squared test statistics. To accommodate for the small sample size, the chi-squared statistics was supplemented with bootstrapping (Bollen-Stine, 5000 iterations). In bootstrapping, the null hypothesis is that the resampling provides a similar conclusion as the original chi-squared test; non-significant p-values indicate that the multivariate normality violation and/or the small sample size did not statistically significantly inflate the original chi-squared test statistics. In addition to overall model fit, the comparative fit index (CFI), sometimes referred to as the 'goodness-of-fit' test, was

used to analyse the discrepancy between the data and the hypothesised model. Here, values range from 0 to 1, and values over .95 are considered ideal (Hu & Bentler, 1999). Also, the root mean square error of approximation (RMSEA), which analyses the discrepancy between the hypothesised model and the population covariance matrix and is sometimes referred to as 'badness-of-fit' test, was employed. Here, values range from 0 to 1, with a preference for values below .06 (Hu & Bentler, 1999). When analysing the factor structure of the teaching-related self-efficacy scale, two items (in the one factor) were allowed to covary. The factor scores were eventually computed as the mean of the corresponding items. All factors were then checked for internal consistency with Cronbach's alpha.

After the instrument validation procedures, the two data sets were merged together for a latent profile analysis using the tidyLPA package in R (Rosenberg et al., 2018). In the latent profile analysis, class-varying diagonal parameterisation was used indicating that the variance was not constrained, but covariances were constrained to zero across profiles. The profile solutions were compared with four fit indices, namely, the Akaike information criterion (AIC; Akaike, 1987), Bayesian information criterion (BIC; Schwarts, 1978), sample-adjusted BIC (SABIC; Sclove, 1987), and entropy. For AIC, BIC, and SABIC, lower values indicate better profile solution; for entropy, the values range between 0 and 1, higher values indicating a better classification of individuals (Clark & Munthén, 2009). In addition to these fit indices, the profile sizes and interpretability were also considered when selecting the final profile solution. Because the profiles were of different sizes, their teaching-related self-efficacy beliefs were compared using the non-parametric Kruskal-Wallis test by ranks. The profiles were also compared in terms of the background variables using the χ^2 test.

Results

The results are reported in two sections. The first section reports on the exploratory and confirmatory factor analysis conducted for *t* validation purposes. The second section reports on the teachers' approaches to teaching profiles and their connection to teaching-related self-efficacy.

The HEAT instrument construct validity

The instrument validation is reported in two parts. The first part reports the results from the exploratory factor analysis on the UNI data and the second part from the confirmatory factor analysis on the UAS data.

Exploring the factor structure in the university context

The instrument's factor structure was first investigated with the UNI data through exploratory factor analysis. The results for the items measuring teachers' perceptions of their approaches to teaching and teaching-related self-efficacy are presented in Table 2.

For the items examining approaches to teaching, the Kaiser-Meyer-Olkin test value (KMO=.717) and the Bartlett's test of sphericity (χ^2 = 598.920, df=66, p<.001) indicate that the values in the correlation matrix statistically significantly deviate from zero, which supports the performing of the factor analysis. The communalities are above the .3 level supporting the retention of all items in the analysis. The factor analysis suggested a four-factor solution explaining 54.65% of the total variance within the items. For the items

Table 2 The descriptive statistics and factor loadings for the items measuring approaches to teaching and teaching-related self-efficacy (factor loadings with absolute value below .200 are not shown)

Item	Mean	SE	Communality	Factor loadings			
				F1 interactive approach	F2 transmissive approach	F3 unreflective approach	F4 organised approach
HEAT_1	2.93	.079	.504		.691		
HEAT_2	3.95	.080	.799	.910			
HEAT_3	2.06	.068	.569			.779	
HEAT_4	2.68	.093	.626		.718		
HEAT_5	3.48	.091	.582	.648	-.214		
HEAT_6	3.97	.067	.376				−.512
HEAT_7	2.09	.069	.355			.559	
HEAT_8	3.96	.076	.581	.760			
HEAT_9	4.30	.064	.534				−.678
HEAT_10	1.64	.058	.507			.683	
HEAT_11	2.40	.088	.466		.702		
HEAT_12	4.05	.074	.647				−.839
				Self-efficacy			
SE_1	4.29	.064	.394	.799			
SE_2	3.92	.079	.587	.730			
SE_3	3.77	.083	.532	.628			
SE_4	3.98	.058	.361	.601			

examining teaching-related self-efficacy, the Kaiser-Meyer-Olkin test value (KMO=.751) and the Bartlett's test of sphericity (χ^2=166.052, df=6, p<.001) support the performing of the factor analysis. Again, the communalities are above the .3 level supporting the retention of all items in the analysis. The factor analysis suggests a one-factor scale explaining 46.87% of the total variance. The factors are described in Table 3. The Cronbach's alpha values demonstrate that the factors' internal consistency is good.

Confirming the factor structure in universities of applied sciences

The instrument's factor structure was then subjected to a confirmatory factor analysis using the UAS data. The results from the confirmatory factor analysis are presented in Tables 4 and 5. Overall, the χ^2 and the accompanying bootstrapping, CFI, and RMSEA fit statistics, as well as the factor loadings and R^2 values, support the factor structure identified in the previous part. As an exception, the proposed model shows a low factor loading and explanatory power for the item 'I am organised and systematic as a teacher' (ATI_6). Furthermore, the item lowers the Cronbach's alpha value for the organised approach factor. However, the item was kept in the analysis, and this decision is reflected upon in the 'Discussion' section.

Approaches to teaching profiles

The fit indices for the different profile solutions are presented in Table 6. The fit indices favour either a four- or a five-profile solution.

Table 3 The factors' Cronbach's alphas (diagonal), bias-adjusted two-tailed Pearson correlations with 95% confidence intervals, and means with standard errors (UNI data)

	F1 interactive approach	F2 transmissive approach	F3 unreflective approach	F4 organised approach	Self-efficacy
F1 interactive approach	.824				
F2 transmissive approach	−.374*** [−.500, −.230]	.753			
F3 unreflective approach	−.139 [−.288, .018]	.185* [.029, .331]	.716		
F4 organised approach	.104 [−.054, .255]	−.058 [−.212, .099]	−.320*** [−.452, −.171]	.718	
Self-efficacy	.144 [−.044, .269]	−.061 [−.212, .097]	−.382*** [−.507, −.239]	.209** [.054, .353]	.771
Mean	3.80	2.67	1.93	4.11	3.99
SE	.071	.071	.052	.055	.055

Asterisks are used to denote the *p*-values: * for $p<.05$, ** for $p<.01$ and *** for $p<.001$

Table 4 The results from the confirmatory factor analysis

Scale	Chi-squared test	CFI	RMSEA	Factor	Item	Standardised regression weights	R^2
Approaches to teaching	χ^2=54.258, df=48, p=.248 (bootstrapped[1] p=.248)	.980	.031	Interactive approach	HEAT_2	.633	.400
					HEAT_5	.567	.321
					HEAT_8	.629	.396
				Transmissive approach	HEAT_1	.698	.487
					HEAT_4	.762	.580
					HEAT_11	.591	.349
				Unreflective approach	HEAT_3	.814	.663
					HEAT_7	.607	.370
					HEAT_10	.604	.365
				Organised approach	HEAT_6	.227	.052
					HEAT_9	.801	.641
					HEAT_12	.799	.638
Teaching-related self-efficacy	χ^2=1.180, df=1, p=.277 (bootstrapped[1] p=.318)	.999	.036	Self-efficacy	SE_1	.737	.543
					SE_2	.954	.910
					SE_3	.586	.344
					SE_4	.596	.355

[1]Bollen-Stine, 5000 iterations

Table 5 The factors' Cronbach's alphas (diagonal), bias-adjusted two-tailed Pearson correlations with 95% confidence intervals, and means with standard errors (UAS data)

	F1 interactive approach	F2 transmissive approach	F3 unreflective approach	F4 organised approach	Self-efficacy
F1 interactive approach	.635				
F2 transmissive approach	−.241** [−.391, −.077]	.724			
F3 unreflective approach	−.234** [−.385, −.069]	.233** [.069, .384]	.692		
F4 organised approach	.100 [−.068, .262]	−.082 [−.086, .384]	−.016 [−.182, .150]	.598	
Self-efficacy	−.096 [−.258, .072]	−.125 [−.285, .043]	−.085 [−.248, .083]	.064 [−.103, .228]	.824
Mean	4.03	2.39	1.72	4.00	4.20
SE	.055	.068	.053	.054	.054

Asterisks are used to denote the p-values: ** for $p<.01$

Table 6 The fit indices for the latent profile solutions

# of profiles	AIC	BIC	SABIC	Entropy
1	2656.619	2686.169	2660.799	1
2	2590.365	2653.159	2599.246	.47
3	2560.974	2657.011	2574.556	.59
4	2522.419	2651.700	2540.703	.74
5	2518.488	2681.012	2541.473	.68

Table 7 The mean values of the four teaching profiles in the approaches to teaching and self-efficacy factors

	Profile			
	P1 interactive (n=60)	P2 interactive-organised (n=57)	P3 mixed (n=144)	P4 transmissive (n=36)
Interactive approach	4.23	4.25	4.02	2.49
Transmissive approach	1.75	2.63	2.60	3.39
Unreflective approach	1.18	1.60	2.07	2.18
Organised approach	3.99	4.79	3.84	3.97
Self-efficacy	4.22	4.28	3.98	4.01

Relying on BIC and entropy, as well as interpretability, the four-profile solution was chosen. These profiles are described in Table 7. The first profile was named interactive profile as it consisted of 60 teachers whose dominant approach to teaching is the interactive approach; furthermore, they score low on the transmissive factor. The second profile consisted of 57 teachers with two dominant approaches to teaching, namely, the interactive and organised approaches; this profile was named interactive and organised profile. The third profile, named a mixed profile, was the largest profile with 144 teachers who reported mixed approaches to teaching. The fourth transmissive profile consisted of 36 teachers who scored the highest on the transmissive factor and the lowest on the interactive factor. Based on the Bonferroni-corrected p-values computed from the adjusted standardised residuals from the χ^2 test (the z-scores), the four teacher profiles did not differ statistically significantly in terms of the background variables (gender, degree, teaching experience). Based on the Kruskal-Wallis test on ranks, the profiles differed statistically significantly in the factor examining teaching-related self-efficacy (χ^2=13.141, df=3, p=.004). The pairwise comparisons showed that the interactive profile and the interactive-organised profile reported statistically significantly higher teaching-related self-efficacy values compared to the mixed profile with Bonferroni-corrected p-values of .05 and .016 respectively. The transmissive profile did not differ statistically significantly from the other three teacher profiles.

Discussion

The present study aimed to examine the construct validity of a recently developed instrument called HEAT which includes dimensions measuring teachers' perceptions of their approaches to teaching and teaching-related self-efficacy. The results support the

construct validity of the instrument and indicate that the HEAT enables to capture the teachers' approaches to teaching more broadly than the previous, widely used quantitative instruments (ATI (Trigwell & Prosser, 2004); ATI-R (Trigwell, & Prosser,, & Ginns, P., 2005)). Similarly, the results from the present study imply the construct validity of the scale measuring teachers' perception of their teaching-related self-efficacy. Thus, the HEAT is a robust instrument which may be used in a higher education context to explore the variety of teachers' approaches to teaching.

The present study also examined the teaching profiles that can be found among higher education teachers. Four profiles were identified: interactive, interactive-organised, mixed and transmissive approaches. The results interestingly show how the reflective and organised dimensions are related with the interactive and transmissive dimensions. Teachers belonging to the interactive profile who scored the highest on the interactive approach scale, and lowest on the transmissive approach, also scored the lowest on the unreflective approach. Alternatively, those belonging to the transmissive profile scored lowest on the interactive approach and highest on the transmissive and unreflective approaches. This result shows the relationships between approaches to teaching and teachers' ability to reflect how their teaching influences student learning and what learning is all about (Bliuc et al., 2012). It appears that teachers who are able to reflect on their own teaching also aim to activate students' learning through integrating interactive elements in their teaching. On the other hand, teachers who were unable to reflect on their teaching often resort to a more information transmission approach in their teaching. According to our understanding, this is the first study to show the relationship between the interactive vs. transmissive components and reflectivity in a quantitative manner. The results show the importance of including the reflective component in examining teachers' approaches to teaching. The unreflective approach scale differs from the other scales in that it captures more of the conceptual aspect of teachers' teaching instead of actual teaching processes which are captured in the other scales.

Regarding the *organised approach*, interesting results emerged when looking at the various teacher profiles. A group of teachers scoring high on the interactive approach scored the highest on the organised approach compared to other profiles (although the organised approach was on a relatively high level among all profiles). Moreover, their transmissive approach was higher than in the interactive profile. This profile was labelled interactive-organised. For these teachers, their organised and systematic approach in preparing and conducting their teaching supports them in carrying out interactive teaching in a well-prepared manner. Well-planned teaching may also enable them to do both, transmit knowledge and create interaction in a teaching session. This result could be interpreted in several ways. The learning-focused approach often includes careful planning of teaching in a way that teachers leave space for changes and design their teaching to be flexible so that they can adjust their teaching according to the students' needs (Postareff & Lindblom-Ylänne, 2008) and, thus, create 'teachable moments' (Entwistle & Walker, 2002; Woods & Jeffrey, 1996). Therefore, this profile might represent a learning-focused approach. However, organised teaching can take a range of forms in teaching, and thus, those with a more interactive approach might systematically plan more flexible ways of teaching, while those with a more transmissive approach might make very strict and non-flexible plans for their teaching (see Postareff & Lindblom-Ylänne, 2008). The result that these teachers scored low on the unreflective approach as well would support the first interpretation that these teachers are more learning-focused than content-focused. However, more research would be needed to examine this conclusion. Still, the results from the present study confirm the importance

of including a scale addressing the systematic and organised aspect of teaching, as previously suggested by Uiboleht (2019).

The third profile was labelled mixed, as these teachers scored high on the interactive approach and higher than interactive group on transmissive approach. Especially interesting was that this group of teachers scored the second highest on unreflective approach and lowest on teaching-related self-efficacy. Previous research has suggested that dissonant teaching profiles may include high scores on both learning-focused (i.e. interactive) and content-focused (i.e. transmissive) approaches in teaching (Postareff & Lindblom-Ylänne, 2008; Stes & Van Petegem, 2014). The present study indicates that a dissonant profile might involve lack of pedagogical awareness, i.e. unreflective approach in teaching. This combination may also lower teachers' teaching-related self-efficacy beliefs. Therefore, the combination of high scores only on the interactive and transmissive approach or learning-focused and content-focused approach does not yet reveal the dissonance of the profile. Elements of reflectivity in teaching and organised approach need to be considered.

The literature has reported interesting results on the relationships between different teacher profiles and teaching-related self-efficacy (see e.g. Cao et al., 2018; Chen, 2019). In the profiles, where the teachers scored highest on the interactive approach, the scores for teaching-related self-efficacy were the highest. This result is in line with Cao et al. (2018) who showed that university teachers adopting the student-focused approach had stronger teaching-related self-efficacy beliefs than teachers adopting the teacher-focused approach. Studies conducted among teachers at other educational levels have shown similar results (e.g. Kaye & Brewer, 2013). The teachers scoring high on teaching-related self-efficacy belonged to the profile groups which also had the highest scores on the organised approach. This seems logical, since according to Skaalvik and Skaalvik (2010), teachers' teaching-related self-efficacy includes a belief in one's own ability to plan, organise, and carry out activities that are essential in obtaining the goals set for teaching (Skaalvik & Skaalvik, 2010). What was surprising was that teaching-related self-efficacy scores were also rather high in the transmissive profile. This could be explained through a previous finding by Postareff and Lindblom-Ylänne (2011) that showed that teachers adopting the content-focused approach to teaching might be very confident about their own way of teaching, which might be related to their inability to reflect on their own teaching. This assumption is supported by the fact that the teachers in the transmissive profile also scored highest on the unreflective approach. Shum et al. (2021), 1558) suggest that 'some proficiency in teacher-focused teaching may be required prior to meaningful teaching self-efficacy development'. The results of the present study imply that the relationship between teacher-focused teaching and high teaching-related self-efficacy could be better explained through the lack of reflectivity and inability to recognise that the teacher-focused elements in one's own teaching do not necessarily support students' deep learning. In other words, when teaching-related self-efficacy is related with the teacher-focused approach, it might prevent the teachers to recognise the challenges in their teaching and relate to their inability to understand that their teaching should be developed towards more learning-focused approaches.

Limitations of study and future research

The present study could not address disciplinary differences in the teacher profiles, because the data included large variations in the participants' disciplines. Another limitation

concerns the HEAT inventory. Regarding the interactive approach scale, all the items of the scale address discussions to enhance student learning. However, there are several other ways the interaction could be enhanced (for example, by encouraging students to take an active role), which were included in the pilot version of the instrument. Unfortunately, these items had weak factor loadings, or they did not load at all to the interactive approach scale, and thus, they were removed. Items addressing tangible acts functioned better than those referring to more implicit behaviour, such as encouraging the students to do something. It was also a conscious decision not to include items about the teachers' intentions (as in ATI) because it was considered that items focusing on the actions would better capture the teachers' approaches. Moreover, studies conducted in other national contexts are needed to prove the validity of the instrument in different contexts. So far, it has been successfully used in studies with elementary schoolteachers in Finland (e.g. Postareff et al., 2021). Thus, HEAT might also be an appropriate tool to be used at a range of educational levels.

Finally, it is good to acknowledge that in the present study, Likert scale was treated as continuous instead of ordinal. This convention could be criticised (e.g. Jamieson, 2004) although it is a common practice in higher education research. The statistics theory suggests that Likert scales should be treated as ordinal; however, the convention of treating them as continuous is not without empirical evidence. For instance, previous research by Sullivan and Artino Jr (2013) suggests that treating Likert scales as continuous is likely to provide similar empirical results as non-parametric tests and that parametric tests are robust to violating the normal distribution assumption. The present study has also relied on skewness and kurtosis values when evaluating the normality of the Likert scale items. By following the convention of using Likert scale as continuous, we hope that other educational researchers can utilise and understand our instrument more easily.

Practical implications

The present study suggests that both interaction in teaching and pedagogical awareness are important elements in supporting teachers' teaching-related self-efficacy. The present study indicates that it is important to help and support teachers to recognise the possible lack of pedagogical awareness. Moreover, teachers' ability to create interaction in the teaching situation is related to stronger teaching-related self-efficacy beliefs. Therefore, teachers should have more opportunities to train both their pedagogical awareness and their ability to create student-student and student-teacher interaction. However, in order for the teachers to be able to recognise their lack of pedagogical awareness, they should have an opportunity to reflect on their own teaching. This in turn would require time and place for reflection as well as ways of monitoring their teaching (Chan & Lee, 2021). Student self-reflection has shown to benefit from using an inventory regarding their learning processes as the instrument helps the students to be acquainted with their own study processes (Backhaus & Liff, 2007). Similarly, teachers' self-reflection might benefit from the instrument focusing on their teaching processes. In line with this, the authors have developed the HowUTeach self-reflection tool (Parpala & Postareff, 2021), which includes the items of the HEAT inventory and provides counter feedback to the teachers based on their responses for the various scales focusing on teaching processes and teachers' self-efficacy beliefs. The purpose of the tool is to support teachers' self-reflection and their teaching processes, i.e. the use of interactive teaching methods. Its use therefore allows teachers to reflect on their

own teaching broadly and develop it further. The HowUTeach self-reflection tool can be used, for example, in pedagogical development programmes organised for higher education teachers, to enhance their awareness of their own teaching and enhance reflection on their own teaching.

From the practical perspective, it is also important to recognise that different teacher profiles exist among higher education teachers. For example, some teachers need to expand further the repertoire of interactive elements in their teaching, while others would need support in adopting the very basics of interactive teaching. Therefore, it would be important to provide support for teachers at different phases of their pedagogical development. However, it is important for all teachers to reflect on their own teaching on a regular basis and keep on reflecting on how their own teaching processes support students' deep and reflective learning. Thus, the reflective component is important to include in any pedagogical development efforts to enhance the pedagogical awareness of higher education teachers.

Appendix

Table 8 HEAT inventory

Interactive approach	
HEAT_2	In my teaching, I create situations where I encourage students to discuss their thoughts and opinions about the topic
HEAT_5	I set aside teaching time so that the students can discuss among themselves about the key concepts of the subject
HEAT_8	In teaching situations, I provide an opportunity for students to deepen their understanding about the subject through discussion
Transmissive approach	
HEAT_1	The majority of my teaching time is spent transmitting information to the students about the topic
HEAT_4	My teaching is focused on the good presentation of information to the students
HEAT_11	The most important goal of my teaching is to deliver what I know to the students
Unreflective approach	
HEAT_3	I have trouble understanding how I can help the students learn
HEAT_7	The students' learning process is so complicated that it is challenging for me to understand how I can support it as a teacher
HEAT_10	It is difficult for me to understand what learning is all about
Organised approach	
HEAT_6	I am organised and systematic as a teacher
HEAT_9	I put a lot of effort into my teaching
HEAT_12	I spend a lot of time to prepare my teaching
Teaching-related self-efficacy	
SE_1	I believe I can cope with my teaching tasks
SE_2	I am confident that I can manage even in the most difficult teaching situations
SE_3	I am certain that I have the necessary pedagogical skills to manage in teaching tasks
SE_4	I am confident that the students learn from my teaching

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Declarations

Conflict of interest The authors declare no competing interests.

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