

Linking research and teaching: Are research-active staff members different teachers?

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Abstract In the global competition of higher education, research intensity has become the key indicator of the quality of universities. This raises the issue of how, and whether at all, a research-intensive environment offers a better learning experience for students. One potential answer to this dilemma lies in research-related teaching. In this empirical paper we examine whether research-active staff members are indeed different teachers and whether they are more likely to use research-related teaching practices. Using data from a national survey of academic staff in Estonia ($N = 679$), we observe that research-active teachers are more likely to incorporate research outcomes into teaching, to engage students in research groups, and co-publish with students. The effects vary across disciplines, types of institutions, and different practices. Furthermore, it is not only the research intensity of the teachers that matters, but it is their intrinsic interest in *both* teaching and research that seems to contribute most to the use of such practices. The results show the benefit of protecting the research-teaching nexus for individual academics and the need to cultivate a commitment to both research and teaching in order to capitalise on the research-intensive environment.

Keywords Research-related teaching · Research-led teaching · Research–teaching relationship · Teaching practice · University teaching

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Introduction

The link between research and teaching activities among academic staff has been studied extensively during the last decades, from different angles and with conflicting results (see, e.g., Hattie and Marsh 2004; Halliwell 2008 for review). Recent developments in the higher education landscape have made the issue even more relevant. While needs of the ‘knowledge society’ encourage a strong link between research and teaching, counterpressures in the form of globalisation and marketisation rather pull the two functions apart (Arimoto 2015; Beerkens 2013). Global competition between universities as expressed in university rankings, seems to promote a single model of the good university, a model that to a large extent can be reduced to research excellence (Dill and Soo 2005; Marginson and van der Wende 2007). We can observe initiatives for creating research havens through various excellence initiatives at the national level (Shin and Kehm 2013), and we also see attempts to strengthen the research-teaching link in teaching-oriented higher education institutions (Weert and Beerkens 2009).

Tensions around combining research and teaching tasks affect not only the profile of universities but also the task portfolio of individual academics. A recent international study on the academic profession (CAP) demonstrates a clear trend towards a research-centred task definition at the expense of teaching-centred or a balanced research-teaching model (Arimoto 2015). In many countries there is an increasing tendency to use research grants for ‘buying out’ of teaching tasks (Bak and Kim 2015; Smith and Smith 2012). Major multi-year research grants free academics from most or all teaching. Furthermore, increasing proportion of adjunct staff in several countries (Bettinger and Long 2010) means that teaching tasks may get ‘contracted out’ and such positions rarely include a research component. On the other hand, it is increasingly difficult to retain an academic position without some research output, which means that the majority of academics nowadays have indeed both teaching and research in their portfolio.

The Humboldtian University ideal represents a holistic combination of teaching and research. Our current environment, thus, both strengthens the ideal but also creates challenges for maintaining the model. The conflicting pressures also inspire a critical look into the issue of how research exactly contributes to teaching, both from a practical and scholarly point of view. The group of research-intensive universities in the UK, for example, has attempted to formulate explicitly why their research-excellent environment is beneficial to undergraduate learning (see, e.g., Russell Group 2009). However, the potential benefits of studying in a research-active environment include not only access to research facilities and excellent researchers, but also transmitting norms and values of scientific inquiry, engaging students in a variety of research-based activities, and applying different pedagogical practices for deeper learning (Brew 2010). Research-related teaching practices are gaining increasing attention in the academic literature.

With this paper we want to contribute to the discussion about dividing teaching and research tasks by taking a step back and collecting evidence at the level of individual academics. Having active researchers in front of the classroom does not mean automatically research-related teaching. We wish to test the assumption that research-active academic staff members are indeed different teachers than their less research-active colleagues. Do they incorporate their own research experience into their teaching practice? And how do they do that? The empirical analysis aims to answer two questions: (1) whether and how academic staff members apply research-related teaching practices, and (2) how teachers’ intrinsic interest in teaching versus interest in research affects the use of

such practices. We use an existing data set from a national survey of academic staff members in Estonia and consider potential differences in the linkages across disciplines and the types of universities. Being constrained by the available data, we cannot examine a full range of different practices. Nevertheless, our results will offer insights into linkages between different research activities and teaching practices and we will also see the importance of intrinsic motivation on the use of the practices.

The research-teaching nexus

Even though most academics are engaged in both research and teaching activities, the link between the two is complex and debated. Some studies show a positive, mutually reinforcing relationship between teaching and research (Brew 2010; Robertson and Bond 2001); others describe them as separate enterprises (Benton and Cashin 2010; Marsh and Hattie 2002; Neumann 1994; Jenkins 2004), and under some circumstances they seem to turn into competing activities (Coate et al. 2001; Hacker and Dreifus 2010; Pascarella and Terenzini 2005). In this paper we do not examine whether research-active teachers are ‘better’ or ‘worse’ teachers, but we want to explore the extent to which they incorporate their own research experience in their teaching and whether they engage students differently.

The link between research and teaching can take a different form in the learning process and several typologies attempt to categorise the variety of approaches. Neumann (1994) proposes a symbiotic three-level nexus, distinguishing the tangible, the intangible, and the global nexus. The tangible nexus concerns explicit transmission of knowledge from a teacher to students, which includes sharing a teacher’s own research outcomes. The intangible nexus is more implicit integration of research in teaching, expressed in designing an inquisitive study atmosphere and enhancing students’ disposition towards knowledge. The global nexus has a focus on the structural unit and it represents the impact of a unit’s research agenda on the curriculum. Griffiths (2004) follows a similar line of categorisation and he identifies more specifically three approaches to how research can be incorporated into teaching in the classroom. The *research-led* teaching represents a weakly embedded link where research is presented as information through references to research results or inclusion in a reading list. The teaching process in this case reflects the traditional information transmission model and the character of the relationship is rather unidirectional. *Research-oriented* teaching focusses on understanding the processes of knowledge-production and teachers focus on developing the skills needed for inquiry. *Research-based* teaching is designed around inquiry-based activities and learning occurs through research experience. The two-way interaction reduces the role division between a teacher and a student, and it enables a partnership in knowledge production. Visser-Wijnveen et al. (2010) in their systematic empirical study have refined these categories and they propose five profiles of the research-teaching nexus, based on teachers’ orientation (towards research or teaching), approach, curriculum and the perceived role of the teacher. According to these five profiles, teachers teach research results, make research known, show what it means to be a researcher, help to conduct research and/or provide research experience.

Various research-related teaching practices thus differ in the extent to which they focus on transmitting the content of research or on the process of doing research, but they also differ in whether they see students more as participants or as an audience in this process. In this paper we use the term *research-related teaching* to signify the forms of teaching and interacting with students that make use of teachers’ own research experience. In the literature there are various terms that sometimes convey a specific form of research-related

teaching and sometimes are used interchangeably for the same broad notion: ‘research-enhanced teaching’ (Brew 2010), ‘research-led teaching’ (Mayson and Schapper 2012), ‘teaching-research relationship’ (Jenkins 2004), ‘teaching-research nexus’ (Neumann 1994), and ‘research-based learning’ (Brew 2013). In this paper we see research-related teaching practices on a continuum from being primarily a way to transmit knowledge to making students part of knowledge creation. However, since in our empirical analysis we are limited to practices that are included in our data, we do not attempt to categorise each of the practices on this continuum in great detail.

The proponents of research-related teaching point to its various benefits (Simons and Elen 2007). From an idealistic perspective, common pursuit of knowledge is the value of university education for its own sake and participation in research is thus justified on normative grounds. More often, though, the justification for research-related teaching follows a functional reasoning. A learning society and knowledge economy require specific competences, such as capacity for independent learning, critical thinking, and understanding the process of knowledge creation; and all this presumes some exposure to the research process. Accordingly, education is enhanced when the curriculum is designed to engage students in a variety of research-based activities and/or induct them into research community (Brew 2010).

Studying in a research-active environment appears to benefit students directly, as evidenced by higher student satisfaction (Jenkins 2004) and improved motivation (Durning and Jenkins 2005; Healey 2005). Trigwell (2005) found that students in a research-led environment demonstrate a higher quality learning experience and they are more likely to adopt a deep rather than a surface approach to their learning. Benefits of research activities on student development have been well documented in the literature (Justice et al. 2007; Pascarella and Terenzini 2005) and a research-related teaching approach has been found to benefit student learning (Brew 2010, 2013; Healey 2005; Ozay 2012). Critical notes are rather rare (see Brew 2010, Gresty et al. 2013 or Pan et al. 2011 though). The challenges of research-related teaching in higher education can be divided into three categories: (1) intrinsic risks related to the actual teaching practice (e.g. curriculum design, lesson planning, classroom delivery), (2) extrinsic risks that impact the teacher from outside of the explicit teaching process (e.g. institutional policy, economic climate) and (3) learning risks identified from the student perspective (e.g. research engagement impact on overall learning experience).

Although the nature and benefit of research-related teaching have received considerable attention in recent years (Malcolm 2014), its place in higher education policy and practice still tends to be vague. A stronger link between research and teaching may also benefit academics. Academics seem to value the combination between research and teaching (Jensen 1988) and they recognise even under a strong research performance pressure that ‘together they are more than just the sum of the parts’ (Smith and Smith 2012). Nevertheless, it does not mean that any research-active teacher would automatically incorporate its research experience into his or her teaching practice, and it is perhaps not necessary to be research-active in order to use research-led practices. Examining the link between one’s own research and teaching is the focus of this paper.

What influences the use of research-related teaching practices?

Previous research suggests many factors that influence whether and how teachers use research-related teaching practices. One set of factors concerns teachers’ attitude and self-identity: their conceptualisation of the research and teaching task (Brew and Boud 1995;

Griffiths 2004; Robertson and Bond 2005), their attitude and beliefs regarding teaching, the subject matter, and students (Hativa 2000; Remmik and Karm 2013; Kember 1997; Prosser and Trigwell 1999), but also teachers' experience in being a teacher and expectations to the role of a teacher (Åkerlind 2004). The other set of factors includes external aspects. The discipline determines the culture of knowledge production and the mode of knowledge dissemination, and this influences the types of commonly used teaching activities, expected outcomes and the emphases in teaching (Brew 2003; Griffiths 2004; Healey 2005; Neumann 1994; Schapper and Mayson 2010). The seniority of students (e.g. first year undergraduate vs. master level) also influences the opportunities for linking research to teaching (Brew 1999; Healey 2005; Robertson and Bond 2005).

In this paper we will examine how teachers' various research activities and their motivation influences their teaching practice. Nevertheless, the discipline is an important contextual factor to understand the linkage. For example, engaging students in the research process may be easier in natural sciences where it is more common to work within research groups and with different levels of researchers. In contrast, in humanities the dominant mode of research is highly individual and engaging students is significantly harder. On the other hand, opportunities to share research results with students may be easier in humanities than in natural sciences. The linear, cumulative nature of knowledge in natural sciences creates a challenge for integrating the latest research findings into undergraduate classes (Healey 2005). Linking research to teaching is applicable in all disciplines because of its generic academic orientation (Ozay 2012), but the form of the linkage is likely to differ across disciplines. Furthermore, disciplinary differences in terms of collaboration, networking and publishing patterns have decreased over time. Many work forms that were originally characteristic to natural sciences have been quickly spreading to social sciences and other fields: research is increasingly conducted in groups, joint authorship of articles is increasingly common, and networking processes, including conference attendance, have become more similar across fields (Kyvik 2013).

The link between teachers' own research and their teaching is not straightforward. Research activities indeed seem to inform teaching, more so than teaching informs research, but usually the link is limited to transmitting the content of research. A qualitative study in Scottish universities attempted to map how teachers incorporate their research (Grant and Wakelin 2009). The most common examples show the effect of personal academic articles and conference papers on the content of teaching and the effect of bibliography lists in the articles informing the reading list in the class. Teachers themselves say that their research tends to service only a small fraction of their teaching practice. The main link is thus in the form of transmitting knowledge and the practice rarely goes into engaging students in the research process and making students co-creators of their learning outcomes.

Furthermore, researchers differ in how they see their own research. They vary in their intentions and in their approach to the research process, to the questions they pose, and to the outcomes they seek. All in all, researchers have diverse frames of incentives for doing research (Åkerlind 2008). Brew (2001) explains the variation in research orientation and practice by distinguishing two dimensions of how research is experienced among academics: researcher's awareness (researcher is present in or absent from research) and orientation of research (an external product with the intention to produce an outcome or internal processes with the intention to understand). Researchers' intentions and their interest in doing research are likely also to influence their orientation in incorporating research into teaching.

In addition to the attitude towards research, the attitude towards teaching is also highly important in establishing the link. Moving on the continuum from weakly embedded research to strongly integrated research also means a shift in teaching from a teacher-centred to a student-centred approach. While teacher-centred/content-oriented conception is focussed on knowledge transfer, a student-centred/learning-oriented approach focusses on the learning process (Kember 1997). The choice of a teaching approach and related teaching practice is significantly affected by a teacher's attitude and beliefs regarding teaching, the subject matter, and students (Hativa 2000; Remmik and Karm 2013; Kember 1997; Prosser and Trigwell 1999).

Research-related teaching may also require that teachers transform their conception of teaching and research as strictly distinct activities (Brew and Boud 1995; Griffiths 2004; Robertson and Bond 2005). Academic staff members' experience of teaching should be viewed as part of their larger experience of being a teacher, especially in terms of his/her underlying intentions in approaching professional development as a teacher, views of the nature of teaching in their discipline and their role as teachers (Åkerlind 2004). When teachers perceive that the teaching process is potentially extending their own understanding of content, it is likely that time spent on teaching is perceived to benefit research. On the other hand, going beyond the weak link of transmitting research content to the class and trying to engage students in doing research may mean exiting the comfort zone. The risks involved in adapting a research-related teaching practice, such as the uncertainty and unpredictability of the process (Badley 2002; Gresty et al. 2013) and having to 'benefit from opportunities as they rise' (Grant and Wakelin 2009), may lead teachers to stick to the traditional approaches they are prepared for and used to and that are familiar to students. Research-related teaching practice encourages teachers to approach teaching from a non-traditional point of view. This means allowing opportunities for dialogue and co-creation rather than operating in a strictly planned environment and following a predetermined teaching plan.

This suggests that in addition to external factors that influence the organisational culture in which academic staff members work, personal preferences and attitudes strongly shape the nature of their teaching practice. In this paper we wish to explore the link between teachers' own research activities and their use of research-related teaching. It is expected that staff members who are actively engaged in research are also more likely to practice research-related teaching because researchers then teach from personal experience rather than from second-hand knowledge (Robertson and Bond 2001; Coate et al. 2001). Active researchers are probably more inclined to value the research process as such as well as the norms and values incorporated in the process. However, different research activities as an indication of different research orientations are likely to lead to different teaching practices. Therefore in this paper we will consider different research activities of academic staff, including individual and group projects and participation in professional networks. On the other hand, since research-related practices also require a certain view on teaching, we explore how the division of interest between research and teaching tasks influences the adoption of research-related practices.

In our empirical analysis we will look specifically at five research-related practices. Engaging students in research groups and co-authoring publications with students represent an active engagement of students in the research process. Incorporating one's own research results into teaching and using the knowledge obtained through conferences into teaching represents content-oriented teaching. The fifth practice concerns discussing (research-related) ideas with students in an informal environment. We will explore empirically whether

the practices are linked to teachers' research background and their interest in research vs. teaching.

Data and method

We make use of data from a national survey of academic staff in Estonia, collected in 2012. The survey was distributed among academic staff in all higher education institutions with the aim of getting an overview of their teaching experience, research, scholarly activities, time allocation, motivation, and professional and personal backgrounds. The data were collected by using an online questionnaire that consisted of 40 questions with several sub-items.

The questionnaire was distributed to all higher education institutions, but in this study we focus only on public institutions, and we analyse separately two types of universities. Estonia has a binary higher education system consisting of 'universities' that have an academic orientation, and 'universities of applied sciences' (UAS), which have a vocational orientation. The UAS are primarily teaching organisations with rather low research expectations for their staff, and only a minority of staff holds a doctoral degree. Approximately 70 % of Estonian students are enrolled in universities and 30 % in UAS (in 2013/14, HTM 2014).

In the cleaned data set we have responses from 577 university teachers and 92 UAS teachers. Considering that the total number of academic staff in these institutions is 3200 and 800, respectively (HTM 2012), our response rate is about 20 %. This is comparable to similar surveys [i.e. Changing Academic Profession (CAP) surveys] in other countries (Teichler et al. 2013).

Using secondary data for the analysis limits us in defining research-related teaching practices. From the existing questionnaire we use the following five activities as proxies for such practices: *engaging students in research groups*, *co-publishing with students*, *changing the content of teaching based on research results*, *incorporating new information from conferences into teaching*, and *discussing research and ideas with students in informal environment*. The dependent variable is a binary variable indicating for each practice whether the teacher uses the practice at least sometimes or rarely/never. We have examined the inter-correlation between all the items to test whether these are indeed independent items. The first two dimensions—engaging students in research groups and co-publication—demonstrate a strong correlation with each other (0.67) and the rest show a weak correlation. It is interesting to point out that while all research-related practices demonstrate at least a weak positive correlation, their correlation with traditional pedagogical practices that are encouraged in universities, such as clearly defining learning outcomes, discussing teaching with colleagues, using various types of assignments, and group work, are insignificant but without exception with a negative sign. We can thus say that research-related activities come on top of the core pedagogical tasks and do not replace them, but there seems to be some indication that teachers lean slightly towards one or the other approach.

With respect to interest in teaching vs. research, we use teachers' self-indication of whether they are primarily *interested in teaching or research*, or equally in both with a slight preference for either one or the other. As shown by the descriptive statistics (Table 1), the biggest group of teachers in universities are interested in both but slightly

Table 1 Descriptive statistics: frequencies (%)

	Universities	UAS
Male	39.25	35.58
PhD	46.42	9.65
Research engagement		
Engaged in an international project	24.18	5.26
Engagement in a national project	51.64	27.19
Engagement in individual research	44.18	21.93
Engaged in professional networks	34.18	16.67
Preference for teaching versus research		
Research	13.28	4.39
Both, but research slightly more	35.73	23.68
Both, but teaching slightly more	25.95	27.19
Teaching	16.03	29.82
Not able to answer	8.79	14.92
Discipline		
Humanities	26.27	
Social sciences	22.24	
Natural sciences	18.81	
Other (technical, teacher training, etc.)	32.68	
Teaching primarily upper level students	28.66	
Age	Mean: 45 SD: 12	Mean: 45 SD: 13

more in research (36 %), while in UAS the biggest group is interested primarily in teaching (30 %).

With respect to research background, we look at the *PhD degree* as the basic threshold criterion. To capture how research-active teachers are, we consider whether within the last year teachers have participated in an *international research project, a national research project, individual research, or professional networks*. We do not use the self-reported number of publications because the values in the data set appear unrealistically high and thus unreliable. As expected, all research activities are more common in universities than in UAS (Table 1) Research qualifications are also clearly different in the two types of institutions. While 46 % of university teachers hold a PhD degree, only 10 % of UAS teachers have the degree. For *disciplinary differences* we use the categories of humanities (26 % of respondents), social sciences (22 %), natural sciences (19 %), and other (mostly technical and other applied fields). We include *age* and *gender* as demographic characteristics.

The secondary data set also imposes some other limitations. The questionnaire does not specify whether the teachers reply in the context of undergraduate or graduate-level teaching. This is likely to create some bias if research-active teachers are more likely to teach at the higher level where research-related practices may be easier to use. We try to reduce the bias, albeit imperfectly, by controlling for the fact that a teacher teaches *primarily at the master level or higher*.

In the following section we will first describe the extent to which academic staff link their research to teaching. We further test the assumption that research intensity of

academic staff as well as their interest in teaching has a considerable effect on the linkage by using a logistic regression model. Logistic regression is a form of regression for a binary outcome variable, such as using a specific research-related teaching practice (yes/no). The regression coefficients in the model (when transformed into ‘odds ratios’) can be interpreted as an effect of the explanatory variable on increasing or decreasing the odds of using such a practice. An odds ratio equal to one means no effect, a value above one means a higher likelihood of using the practice, and a value below one means a lower likelihood of using the practice.

Results

Prevalence of research-related teaching practices

Based on the survey results, many academics seem to link their teaching with research (Table 2). Most widespread practices are the ones that link teaching with research in a broad sense, such as *incorporating information from conferences into teaching*, and *discussing research and ideas in an informal environment*. More than three out of four teachers report that they are engaged in such activities at least sometimes. Discussions in an informal environment are more common in UAS than in universities (88 and 76 %, respectively).

Practices that engage students in doing research are somewhat less common but still widely reported. The practice of *co-publishing with students* is expectedly most challenging; 34 % of university teachers co-publish either often or sometimes. *Engaging students in a research group* is reported by 54 % in universities. These practices are less spread in UAS where 14 % of staff at least sometimes publishes together with students and 41 % engages students in research groups. *Adjusting teaching content based on one’s research outcomes* is also somewhat more common in universities—68 and 44 %, respectively. A stronger link between research and teaching in universities compared to UAS is an expected result considering the nature of teaching (academic vs. vocational),

Table 2 Respondents’ engagement in research-related teaching activities (%)

	Academic universities (<i>N</i> = 577)				Universities of applied sciences (<i>N</i> = 92)			
	Often	Sometimes	Rarely	Never	Often	Sometimes	Rarely	Never
Engaging students in research groups	20	34	23	24	11	30	17	41
Co-publishing with students	9	25	25	40	1	13	19	67
Revising teaching based on research activities	31	37	18	14	24	20	27	29
Incorporating new information from conferences into teaching	45	39	10	4	48	40	8	4
Discussing research and ideas with students in informal environment	35	41	18	6	40	44	13	3

different student groups (UAS limited to undergraduate teaching), and, most importantly for this paper, research intensity of academic staff. In the next section, we will use multivariate analysis to understand how teachers' own research engagement and attitude towards research and teaching influence their use of different research-related practices.

The use of research-related teaching practices in universities

As discussed above, we expect that the use of research-related teaching practices is influenced by teachers' own research engagement, by their interest in teaching vs. research activities, and potentially also by their demographic characteristics. Furthermore, disciplines have different modes of generating and disseminating knowledge, which is likely to have an effect on the prevalence of certain practices. Since the use of research-related practices is likely to have a different dynamic in universities and UAS, we analyse the two types of institutions separately.

The results show that in general terms research engagement and interest in research indeed have a significant effect on research-related teaching practices. Much of the effect is mediated through the type of students that academics face. When we control for teaching primarily upper-level students, the effects decline but do not disappear. Below we discuss the results after controlling for the level of students and the demographic characteristics (Table 3).

The most challenging type of research-related teaching practice, *co-publishing with students*, is highly dependent on researchers' backgrounds. Having a PhD degree is essential. It increases the odds of co-publishing with students 3.5 times. Engagement in research activities—participating in an international project, national project, individual research, and professional networks—clearly has a positive effect, even though some of the effects do not quite meet the desired confidence level for statistical significance. Participation in national projects and professional networks is clearly significant, suggesting that such types of activities may be more accessible for engaging students than international projects or individual research. Teachers' own interest also matters. Unlike in the case of other practices, teachers who are primarily interested in research are considerably more likely to co-publish with students (odds ratio 2.4), and those who like both but slightly more research are somewhat less likely to co-publish (odds ratio 1.7) but still significantly more than other groups. In terms of disciplinary differences, teachers in humanities are less likely and in natural sciences more likely to co-publish, which reflects expected differences in publishing patterns.

Engaging students in research groups follows a pattern similar to co-publishing. Having a PhD degree is clearly important. Teachers' research activities have a significant positive effect. Participation in national projects in particular increases the likelihood of engaging students, but international projects also have a significant impact. Evidence about teachers' interest is somewhat weaker. It seems that teachers who are interested in both teaching and research, but slightly more in research, are most likely to engage students, followed by those who have a clear interest in research. The coefficients, however, do not quite reach the desired confidence level. Expectedly, student engagement in research groups is significantly less common in humanities and thus more common in natural sciences.

Incorporating one's own research results or material from conferences into teaching shows a somewhat different pattern. The effects of research background and preference for teaching and research are less clear here. *Incorporating research results into teaching* is somewhat closer to the first two practices. A PhD degree shows some positive effect, although not quite above the critical significance level. Individual research increases the

Table 3 Likelihood of using different research-related teaching practices in academic universities (odds ratios, logistic regression)

	Engaging students in research groups	Co-publishing with students	Adjusting teaching content based on research results	Incorporating new information from conferences into teaching	Discussing research and ideas with students in informal environment
Age	0.997	1.019*	1.001	1.008	1.001
Male	0.703*	0.525***	0.563***	0.382***	1.04
PhD	2.241***	3.595***	1.372	0.938	0.747
Research engagement					
Engaged in an international project	2.079***	1.043	1.343	1.678	2.274***
Engagement in a national project	2.531***	2.524***	1.37	1.289	1.543*
Engagement in individual research	1.818***	1.422	2.646***	1.213	0.77
Engaged in professional networks	1.635**	2.212***	1.595**	3.418***	1.347
Preference in teaching versus research					
Teaching (base category)					
Both, but teaching slightly more	0.761	1.4	0.73	1.78*	1.12
Both, but research slightly more	1.36	1.753*	0.929	2.115**	1.213
Research	1.012	2.446**	0.61	1.103	0.482**
Discipline					
Humanities	0.403***	0.549**	0.799	2.108**	2.287***
Social sciences	0.835	0.765	1.583*	1.421	0.83
Natural sciences	1.319	1.701*	0.663	0.787	1.486
Other (base category)					
Teaching primarily upper-level students	1.899***	1.42	1.835***	2.513***	1.642***
N	577	577	577	577	577
Pseudo-R ²	0.21	0.23	0.10	0.14	0.07

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

odds by 2.6 times and being engaged in professional networks increases the odds by 1.5 times. Preference for teaching vs. research has no effect on this practice and interestingly teachers with a research interest are rather less likely to report incorporating research results into their teaching than teachers who are interested primarily in teaching (as evidenced by all coefficients below 1). In terms of disciplinary differences, academics in social sciences are significantly more likely to incorporate research results. Academics in natural sciences, in comparison, are less likely to incorporate research results.

Incorporating information from conferences is significantly higher among academics who are engaged in professional networks (odds ratio 2.92). Other activities demonstrate a positive, but not statistically significant effect. In terms of interests, particularly academics who like both teaching and research incorporate conference material into teaching, with a bigger effect of slight research preference (2.53) over slight teaching preference (1.92). Expectedly, academics in humanities but also in social sciences are the most active in incorporating new information from conferences into teaching.

Discussing research and ideas with students informally is most poorly explained by the model, with explanatory power below 0.10 (pseudo R^2), and the results suggest a somewhat contrary dynamic compared to other practices. Academics with a clear research interest are considerably less likely to interact with students in such a way, indicating that an informal interaction presumes a strong commitment to teaching. Academics in humanities are considerably more likely to interact with students, suggesting that the traditional ideal of an out-of-classroom conversation is indeed more present in humanities. Somewhat surprisingly, while a PhD degree is not important, academics engaged in international and national projects are more likely to interact informally. The role of professional networks, however, is not important here. This suggests that active involvement in research is important also for more informal linkage, perhaps indicating a more pro-active attitude that also attracts students.

In terms of demographic characteristics, age seems to have no effect on adopting research-related practices, with the exception of some marginal positive effect of age on co-publishing with students. Gender, however, is significant. Women are more likely to be engaged in various research-related activities, particularly incorporating information from conferences into teaching. Discussing research and ideas with students in an informal environment is the only category that is equally reported by men and women.

In sum, teachers' own research engagement is an important factor in linking their research to teaching. We see some significant disciplinary differences here and such differences in the research culture probably also explain why some practices are more associated with engagement in international or national projects or with individual research. We can also observe that the intrinsic interest of teachers matters. With the exception of co-publications, teachers who are interested in both teaching and research but with a slight preference for research tend to be most active in linking their research with their teaching.

The use of research-related teaching practices in universities of applied sciences

We now turn to Universities of Applied Sciences (Table 4). We will use a reduced model here. We drop the discipline groups because such pure disciplines are rare in UAS and most observations count for the group 'other'. Similarly, since UAS only in exceptional cases offer master-level degrees, controlling for upper-level students is not applicable. Less than 10 % of teachers in our sample have a PhD, which in combination with a small

Table 4 Likelihood of using different research-related teaching practices in universities of applied sciences (odds ratios, logistic regression)

	Engaging students in research groups	Co-publishing with students	Adjusting teaching content based on research results	Incorporating new information from conferences into teaching	Discussing research and ideas with students in informal environment
Age	0.978	0.945	0.966	1.007	0.978
Male	0.816	1.329	0.471	0.426	0.879
Research engagement					
Engaged in an international project	10.288	4.789	0.823	0.372	0.378
Engagement in a national project	0.79	0.543	6.979***	6.079	0.184***
Engagement in individual research	2.184	3.654	7.732***	2.695	2.947
Engaged in professional networks	32.334***	7.23*	0.553	4.446	8.846*
Preference in teaching versus research					
Teaching (base category)					
Both, but teaching slightly more	6.187***	11.364***	4.785***	5.592***	1.38
Both, but research slightly more	15.318***	3.686	18.006***	1.34	8.687*
Research	0.14	1.63	6.214	0.235	0.365
N	92	92	92	92	92
Pseudo-R ²	0.34	0.25	0.40	0.17	0.14

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

sample size ($N = 92$) makes the estimation in some cases impossible. Therefore we omit the PhD from the model. Although the sample size is much smaller, which makes it more difficult to achieve the desired significance level, the model demonstrates a better fit in the case of UAS than academic universities.

In UAS, teachers' own research engagement predominantly has a positive effect, but compared to universities the effect is less clear. Engagement in international projects is not an important factor in UAS, and it is also rather rare as shown in the descriptive statistics. Engagement in national projects, however, greatly increases the likelihood that teachers incorporate information from conferences as well as from their own research into teaching. Engagement in individual research increases the likelihood of incorporating one's own research results into teaching, but it also increases the likelihood of all other practices even though the coefficients do not quite reach the significance level. Engagement in professional networks, however, has the broadest effect, increasing most clearly the likelihood of engaging students in research groups, but also on co-publishing and interacting with students in an informal environment, and weakly suggesting the effect on incorporating conference material in teaching.

In terms of teachers' interest, having some research interest next to interest in teaching indeed has a positive effect on all practices. Being interested in both with a slight preference of research greatly increases the likelihood of engaging students in research groups, incorporating one's own research in teaching, and interacting with students in free environment. A slight preference for teaching increases the likelihood of co-publishing with students and incorporating new information from conferences into teaching.

In sum, interest in research does increase the likelihood of incorporating research in the teaching process also in UAS. The interest in research in some cases appears to be even a stronger predictor than actual research engagement of a teacher. This suggests that in UAS where teachers are less research-intensive, interest in research might distinguish teachers more with respect to their attitude towards research than actual engagement in research.

Conclusion and discussion

A symbiosis between teaching and research tasks in universities is a classic issue in higher education. The current environment not only strengthens the ideal but also creates pressures for separating research from teaching. With this paper we hope to contribute to the discussion by analysing whether research-active teachers are different in their teaching practice and whether it therefore is important that students are exposed to active researchers.

The survey results from Estonia indicate that research-active teachers are indeed more likely to report various research-related practices. In general terms they are more likely to engage students in research groups, co-publish with students, and use information from their own research and conferences in their teaching. There are expected differences based on discipline. Teachers in natural sciences are more likely to include students in research groups and co-publish with students, while teachers in humanities and social sciences are more likely to incorporate the content of research into teaching. There are also some differences between academic universities and universities of applied sciences. Expectedly, research-intensive practices such as co-publishing with students and engaging students in research groups are more common in academic universities.

These conclusions are based on a survey among academics and we need to be aware of potential biases in answers. Research-active teachers may be valuing research-related activities more and they may see more potential or need for using such practices, which may lead to over-reporting the activities in their own work. Even if the more frequent use of research-related practices is partially due to survey biases, the difference may still be interpreted as higher awareness and inclination to use such practices. Such practices may come more naturally to research-active staff, even if some external pressure or motivation may be necessary for putting such practices into use.

The results also indicate that it is not excellence in research that is needed for an effective link between research and teaching. Participation in international projects, which in this context can be interpreted as world-class research, demonstrates a positive but often statistically insignificant effect. This may be related to the fact that academics involved in international-level research may need to divert their attention from teaching or that international projects themselves may be too demanding or sophisticated for engaging students. Being involved in national-level projects and in professional networks seems to have the most extensive effect. Being engaged in individual research also has a positive effect, particularly on the content of teaching. Universities of applied sciences show a somewhat different dynamic and participation in professional networks seems to create an avenue for various research-related practices.

Next to research activities, it is a teachers' interest in teaching and in research that has an effect on the linkage. The academic staff that indicates that their primary interest lies in teaching (as opposed to research) is less likely to engage in almost any of the studied research-related practices. In the universities of applied sciences it is particularly evident that interest in research encourages research-related practices in teaching. However, interest only in research also does not lead to research-related practices. Co-publications with students is the only practice that is most prevalent among research-oriented staff. The most active staff members to practice research-related teaching are the ones that have an interest in both teaching and research, with a slight preference for research.

The ideas of research-related teaching are rather unknown in Estonia and they are not encouraged within universities or by external policies. The reason why research-active teachers seem more prone to such practices can probably be explained by the fact that they are more familiar with the research process. The effects we observe here are probably driven by teachers' skills, knowledge, norms, and interests, and not so much by a conscientious teaching philosophy. But even if this is the case, we can say that research-active teachers do approach teaching somewhat differently. We do not examine whether these teachers are more effective in achieving certain learning outcomes, but they are more prone to research-related teaching practices. Second, being active in research may also create opportunities for engaging students in the research process. Teacher's participation in national projects and professional networks may offer fruitful opportunities for linking students to these activities.

Interest in research-related teaching practices is growing. The link between research-active teachers and their teaching practice is not automatic. Research-active staff does not necessarily link their research to their teaching, and also teachers who are not research active can create a research-related teaching environment. Our results suggest that research-active teachers seem to have an advantage in adopting such practices, either because of their interests, knowledge, and norms or by being engaged in activities that offer opportunities for engaging students. What is important though is teachers' commitment to their teaching task, next to their research task. These interests and preferences are not exogenous. They are part of socialisation and are cultivated in the new generation of

academics. A strong focus on research performance at the expense of teaching may undermine the potential for research-related teaching even in a research-intensive environment. Research-related teaching is thus truly the combination of the two: it requires that a teacher is actively engaged in research but also that the teacher is committed to education.

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