TEACHING-RESEARCH NEXUS IN ENGINEERING EDUCATION

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ABSTRACT

The aim of this paper is to study the teaching-research nexus in a research intensive technical university. The research questions are (i) How are the links between research and teaching perceived by faculty?, and (ii) How are the links performed in practice? We use a mixed methods design including a survey, interviews with top management, case studies, and documentary studies of policy documents. The results show that faculty believe in the occurrence of a teaching-research nexus, primarily based on the idea that all faculty members do both research and teaching. Some informants in the study address the need for flexibility in terms of division of tasks. The results also show that faculty learn themselves as a result of teaching. For some, it is more challenging to include research on bachelor level, while some present examples of how it can be done. All informants agree that the teaching-research links are obvious on master level. The low value given in academia to the nexus is identified as one of the preventing factors. Regarding how the links are performed in practice, the results show that beside traditional courses and master theses, other options include project courses, some in cooperation with industry. There seem to be few courses on research methodology, while integrating learning of research processes in other courses seem to be more common. Generally, the research included comes from the department or from the faculty member's own research. In this study, there are no indications of an academic drift in which engineering education lose the connections to industry; on the contrary, the results indicate reciprocity between links to research and to industry.

KEYWORDS

Teaching-research nexus, Engineering education, Teaching and learning activities, Links to industry, Standards: 3, 5, 7, 8.

INTRODUCTION

In academia, there is a widespread belief that there is a symbiotic link between research and teaching of mutual benefit (Neumann, 1992; Robertson, 2007). This link involves a number of aspects, as for instance promotion structures and incentives in academia (Kasten, 1984) and the division of labour among different categories of staff (Geschwind & Broström, 2014). Other facets relate to how research is integrated into teaching activities as whether there are tangible or less obvious aspects of research that are included (Neumann, 1992) and, additionally, whether there are the results or the processes of the research that are integrated into teaching and learning activities (Healey, 2005). Divergently, it has been argued that there is no reinforcing relationship between research and teaching, at least not in terms of research productivity and teaching effectiveness (Hattie & Marsh, 1996; Marsh & Hattie, 2002; Ramsden & Moses, 1992).

Efforts have been made to improve the teaching-research link, on institutional, disciplinary and departmental level (Commission, 2008; Jenkins & Healey, 2005; Jenkins, Healey, & Zetter, 2007). However, there are studies that raise concerns about this process, thus indicating that

the process of moving towards more theoretical and academic values have caused an academisation (Kyvik, 2009) or an academic drift in engineering education (Christensen & Erno-Kjolhede, 2011; Harwood, 2010). Harwood defines academic drift as "the process whereby knowledge which is intended to be useful gradually loses close ties to practice while becoming more tightly integrated with one or other body of scientific knowledge" (Harwood, 2010). This process of engineering education becoming more science-based influenced the evolvement of the CDIO initiative (Crawley, Malmqvist, Ostlund, & Brodeur, 2007), aiming to educate engineers with deep knowledge in technical fundamentals *and* the skills required in engineering practice.

Hence, there are tensions involved in the teaching-research nexus including, on the one hand, efforts made to improve the link and, on the other hand, concerns raised regarding the risk of losing connections to engineering practice. This leads us to question how the link between teaching and research is realised in a research intensive technical university which also is member and co-founder of the CDIO initiative. In this study, we focus on attitudes and activities in relation to the nexus, synergies between research-teaching and teaching-research, and additionally, synergies in relation to connections to industry. The research questions we pose in this study are: (i) How are the links between research and teaching perceived by faculty?, and (ii) How are the links performed in practice?

THE TEACHING-RESEARCH NEXUS

There are several frameworks and models describing the nexus from somewhat different perspectives (Griffiths, 2004; Healey, 2005; Neumann, 1992; Robertson, 2007). In order to study the links between research and teaching, we chose two of them as our theoretical framework, i.e., the ideas developed by Neumann (1992) and Healey (2005) respectively. Their work focuses on different types of teaching activities, but also on other more comprehensive aspects of the nexus.

In the framework by Neumann, there are three types of links between research and teaching: (i) *the tangible connection*; (ii) *the intangible connection*; and (iii) *the global connection* (Neumann, 1992, p. 162). The first type, the tangible nexus, relates to the researchers' knowledge, based on their own research but also on knowledge obtained in their field of research, which they include in their teaching. The second, the intangible nexus, relates to several aspects as the approaches and attitudes one has towards knowledge including having a critical view and being positive towards learning. Additionally, this type of nexus includes what Neumann denotes "the broadening effect" since preparing for teaching means that you have to review and reflect upon your own subject or discipline, and "the youthful contact" that relates to the positive influence that interaction with students can offer (Neumann, 1992). The third type, the global nexus, entails a perspective on all the research conducted at a department and all the teaching offered, thus this third type describes how the educational programmes and curricula are influenced by the research at departmental level.

In the other framework we use in this paper, Healey (2005) presents a model illustrating different ways of including research in teaching activities, a model based on the work by Griffiths (2004). The model, presented in Figure 1, describes how either research content/results or research processes and problems are in focus. Additionally, the model shows how students can be regarded as either participants or audience. The two axes in the model lead to four different types of teaching activities: *research-tutored, research-based, research-led* and *research-oriented* (Healey, 2005).

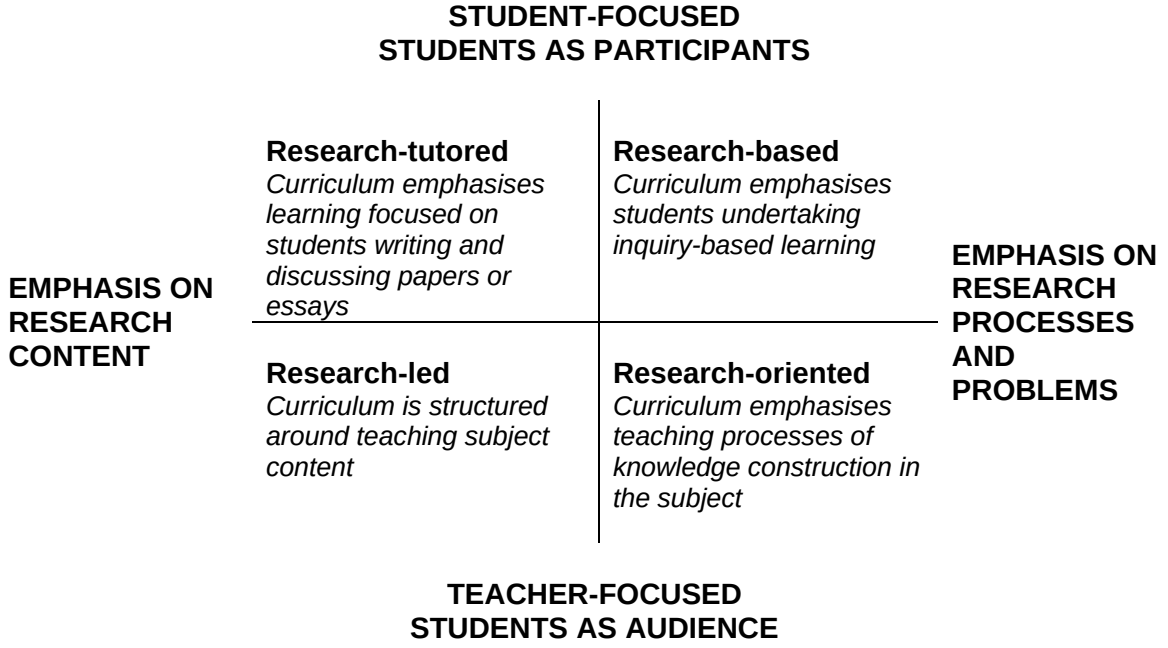

Figure 1. Curriculum design and the research-teaching nexus (Healey, 2005).

METHODOLOGY

Mixed Methods

The overall aim of this project was to examine how the links between research and teaching are perceived by faculty and how the links are realised in practice in a research intensive technical university. We intended to get an overview of these aspects on an overall institutional level, but additionally to obtain a deeper understanding of the views of a selected group of faculty members. Thus, we decided to conduct our study using a mixed methods design (Creswell, 2009) with initial interviews with key members of faculty, a survey to all faculty members, and case-studies of two schools. Additionally, the study contained an analysis of policy documents. The following themes were covered in the project: leadership and management, funding structures, career paths and incentives, and pedagogical issues. For the purpose of this paper, we focus on how the links between research and teaching are perceived and performed by faculty members, e.g. in teaching and learning activities.

The study started with six initial interviews with five key members of faculty and an additional interview with two student representatives from the KTH Student Union. The purpose of these interviews was both to capture the views of top management on the nexus, but also to find whether there were aspects that we should look further into in the survey and during case study interviews. These interviews were semi-structured and focused on themes as their view on the nexus, obstacles, strategies and policies, financial structures, and issues related to promotion and incentives. For the purpose of this paper, we have performed a tentative analysis of the results based on these themes.

Based mainly on literature, and to some extent on results from the initial interviews, a survey was constructed. A link to the survey was sent by e-mail to 1 433 faculty members and they had three weeks in total to respond. After one reminder, we received in total 302 responses, thus the response rate was 21%. Among the respondents, 81% was during 2014 teaching at master level and 61% at bachelor level. 92% was doing research during 2014 and 91% was teaching. Thus a majority do both research and teaching, while a few are involved in either

research or teaching. For the purpose of this paper, we present tables with percent distributions on results concerning attitudes and activities related to the teaching-research nexus. A more thorough analysis will be performed and presented further on.

Regarding the case studies, we selected two schools which both require all faculty members to do both research and teaching (CS1 and CS2). The case studies included interviews with faculty members, 13 in total. The interviews were semi-structured and were based on the themes in the study, the policy documents, to some extent the initial interviews, and on the chosen theoretical frameworks. These interviews were tentatively analysed, partly based on the chosen frameworks and models (Healey, 2005; Neumann, 1992) and in this paper, we present these tentative results and a number of quotes from the interviews. Further on, the interviews will be more thoroughly analysed. Additionally, the case studies included documentary studies in which we analysed the policy documents by searching for text segments describing the nexus.

Furthermore, we analysed a number of policy documents on institutional level, by searching for text segments describing the nexus.

KTH Royal Institute of Technology - Our case university

Our case university, KTH Royal Institute of Technology, is a single faculty research intensive technical university, organised in ten different schools (This is KTH). In terms of ranking, KTH was in 2014 ranked as no. 126 on the Times Higher Education list of universities in the world, and as no. 18 among the engineering and technology universities in the world (Ranking placement for KTH). In 2014, KTH had a total turnover of 4,637 MSEK. 31% of the income is related to education in first and second cycle, and 69% is related to research and doctoral studies (Annual Report 2014). However, the different schools differ in a number of aspects, e.g. in terms of the division of incomes related to education and research. The case-study schools have a strong research focus; in both schools the income related to research is about 85% (KTH School Organisation Evaluation Report).

In several policy documents on institutional level, it is stated that educational programmes at KTH should be characterised by e.g. a solid research base and that contact with research should be established already in an early stage. Additionally, research is assumed to have a positive influence on the educational programmes since all faculty members will be involved in both research and teaching. Furthermore, the policy documents stipulate that teaching and pedagogical skills will be more highly valued. (KTH Strategic plan; Quality Policy for KTH; Vision 2027). In one of the case studies, it is mentioned how research can influence the students' interest in both undergraduate and graduate studies and, consequently, the importance of the research-teaching nexus is emphasised in the document.

RESULTS

How the links between research and teaching are perceived by faculty

The initial interviews with top managers reveal a common belief in the existence of a teaching-research nexus, primarily in terms of a positive impact originating from faculty members doing both research and teaching. The student representatives confirm the view that faculty should do both teaching and research. However, the top managers also address the need for being flexible since all faculty members cannot excel in teaching, research and additional tasks at all times, but on team or unit level, they see this aim as viable. A few of them acknowledge that having faculty doing both research and teaching is not enough in itself, and there are

suggestions that the link must be included in both evaluations and promotions/career systems to be obtained.

Results from the survey regarding attitudes towards the teaching-research nexus are presented in table 1. A majority, 59%, agree either totally or strongly with the statement “It is important that teaching staff are active researchers”. 39% do not agree to “Those who primarily do research should participate less in teaching”, while merely 8% totally agree with this statement. 69% do either totally or strongly agree with the statement “The research conducted increases quality in the educational programmes”. Thus, it seems as if most of the respondents think it is important that all faculty do both research and teaching and, additionally, that this aspect increases quality in the curricula.

Table 1. Attitudes towards the teaching-research nexus, %

In your opinion, how well do these statements match the situation in your environment?	Totally agree	Strongly agree	Partially agree	Do not agree	Cannot determine
It is important that teaching staff are active researchers (research with the aim to publish in scientific fora)	31	28	26	14	1
It is important that teaching staff has a doctoral degree	25	26	31	18	1
Those who primarily do research should participate less in teaching	8	16	27	39	9
The research conducted increases quality in the educational programmes	32	37	20	6	4
Education increases the quality in the conducted research	11	23	42	14	9

In the case study interviews, none of the informants question whether there is a link between research and teaching. Furthermore, they refer to a number of less obvious aspects of the nexus, defined by Neumann as “the intangible connections” (1992). In the case study interviews, the informants bring up several examples of such intangible aspects, for instance “the broadening effect” (Neumann, 1992). One of the informants states: “it promotes your research when you keep up with the basic knowledge” (CS2-2) and another informant admits: “as a teacher, I have to learn the basics again, and the foundation becomes broader every time I teach these simple facts” (CS1-3), both examples of the positive effects teaching can have on the research. Another example relates to “the youthful contact” (Neumann, 1992) describing how students and their questions can stimulate faculty members and, as one informant states: “the interesting discussions, primarily on master level, affect us” (CS2-4) and another says: “the dynamics in meeting students is important” (CS2-7), also examples of how teaching can influence research. In case study 1, a few of the informants also address the issue of flexibility regarding the question of all faculty doing both research and teaching. They seem to agree to the idea on an overall level, but they also indicate that there might be problems involved: “that should be the guideline, but there are always exceptions” (CS1-5) and “I don’t know if quality increases when all faculty members are teaching, […] since not all of them are comfortable doing it” (CS1-4). Thus, there seem to be common view that there are a number of advantages when all faculty members do both research and teaching, even though there are exceptions.

Bachelor and master level

During the initial interviews and in the case studies, we had questions regarding whether there are any differences between including research in teaching on bachelor level and on master level. One of the top managers have concerns that introducing research too early might have a counter-productive effect and even scare students early in their studies. The informants in case 2 state that it is difficult to include research on bachelor level, for instance, one of them state: “it is mostly old stuff [on bachelor level]” (CS2-2) while the situation is the opposite on master level: “the link is stronger on master level, courses on master level are in the forefront of research” (CS2-5). However, in case study 1, one of the informants emphasise: “you can do similar activities [on bachelor and master level], it depends on what you expect [of the students]” CS1-1. Thus, there are opposite opinions on whether the possibilities are similar or different on bachelor and master level.

Links to industry

According to the informants in both the initial interviews and the case studies, there is no conflict between including links to research and to industry. On the contrary, many of the informants state that these two aspects are intertwined: “[there is] no conflict, you bring in what is relevant either from research or industry” (CS1-4) and “[there is] absolutely no conflict, we are very much applied and cooperate with industry to a large extent” (CS2-5). This show that faculty members use examples from both research and industry and sometimes the examples are from research-projects conducted in cooperation with industry. Thus, in this respect, research and aspects of engineering practice are both included in teaching and learning activities, examples of integrated learning experiences (The CDIO Standards, 2010).

Factors preventing the nexus

In the survey, there were questions regarding preventing factors, as presented in table 2. “Too little time for research” was the aspect that most respondents chose to agree with, 29% totally agree. There is an even distribution among the remaining response options related to this factor indicating that there is a variety among faculty in terms of how they regard this issue. The similar situation applies in the question of whether the link between teaching and research is not valued: 26% totally agree and 20% strongly agree to this statement. This indicates that giving the link more value might support an increase of the nexus. Furthermore, the results strongly indicate that the teaching-research link is a matter that engages faculty members since 79% disagree with the statement “It is nothing I care about”.

Table 2. Factors preventing the teaching-research nexus

Do you experience that the following aspects prevent you from obtaining a link between research and teaching?	Totally agree	Strongly agree	Partially agree	Do not agree	Cannot determine
Too little time for research	29	21	19	21	9
Too little time for teaching	15	12	26	37	10
It is not valued	26	20	18	22	13
It is not appreciated	19	15	21	31	15
It is not requested	17	17	25	29	12

It is nothing I care about	1	1	7	79	12

In the case studies, questions regarding factors preventing the research-teaching nexus also came to the fore, and informants in Case study 1 refer to difficulties in, for instance, including research on bachelor level, to the financing system, and to work overload. In Case study 2, they refer to work overload and lack of time, as for example: “Time, to be a successful researcher, you need to attend conferences and that means you are less present at your department” (CS1-6).

How the links between research and teaching are performed in practice

Type of course and teaching activity

In the survey, there was a question regarding the type of course in which faculty members include research, as presented in table 3. The most common course type in which research is included is the thesis on master level. Nearly as common is to include research in traditional courses and slightly more than 50% include research in project based courses. It is also rather common to include research into the thesis on bachelor level, a result indicating that there are possibilities to integrate research already on bachelor level.

Table 3. Type of course in which research is integrated, %

In what kind of course type do you integrate research into teaching?	
Traditional courses	70
Project based courses	54
Thesis on bachelor level	43
Thesis on master level	78
Other	9

The survey also included a question regarding in what type of teaching and learning activity faculty members integrate research. The results show that including research in lectures is the most common type, described by Neumann (1992) as the tangible type of connection, and denoted as either research-led or research-oriented by Healey (2005), and nearly 80% do so as presented in table 4. It is also common to let students read, discuss or write based on research papers, 68% of faculty members include this research-tutored type (Healey, 2005) of activity in their teaching. Research-based type of activities (Healey, 2005) as students participating in research projects or even conducting research projects are used by slightly less than half of the respondents, 48% and 45% respectively.

Table 4. Teaching activities in which research is integrated, %

In what kind of activity type do you integrate research to teaching?	
I give lectures based on my research/research field	79
I invite guest lecturers that give lectures based on their research/research field	50
Students participate in research projects at the department/unit	48
Students conduct research projects	45
Students visit research environments	26
Students read, discuss or write based on research papers	68
Other (research methodology, examples from research, master thesis)	6

The case studies reveal that the most commonly used type of teaching and learning activity is projects, in which students are active and to some extent participate in the research, thus research-based (Healey, 2005). Even when the informants refer to how they include research results in their lecturing, they do oppose to the thought that students should be considered as audience, on the contrary, they insist that students are active even in this kind of teaching and learning activity: “they can be active even during lectures, there are pedagogical methods” (CS1-5). This corresponds to the results of Elsen, Visser-Wijnveen, Van der Rijst, and Van Driel (2009) who in their study found that the students were active, rather than being the audience, in all kinds of teaching and learning activities that integrated research, no matter being e.g. research-led or research-based. This is in line with the idea of active learning, one of the core ideas of CDIO (Edström & Soderholm, 2007; The CDIO standards, 2010).

Research process

In the case studies, the question of including research results or processes was raised. The informants seem to, at least to some extent, integrate aspects of the research process and methodology into courses, rather than offering separate courses on research methodology. One of the informants state: “there is a progression, they follow lab instructions and later they work independently in projects, [there is] no course in research methods” (CS1-1), and another say: “I prefer this to be based on curiosity rather than on offering a course. The methodology is not an issue on bachelor level, but is important in the master thesis, and it should be integrated.” (CS2-4). This approach corresponds to the idea of CDIO, i.e., that the learning of skills should be integrated into courses rather than being offered in separate courses (Crawley et al., 2007). However, some informants state that the aspects of research processes and methodology are not part of their curricula: “The scientific methodology is about testing, you have a hypothesis… We do not have that kind of methodology here. We do problem solving.” (CS2-6).

Type of research

The results of the survey show that the most commonly used approach is to include research based literature in teaching and learning activities, 60% do so to a very large or a rather large extent, as shown in table 5. It is also common that faculty members use their own research; slightly more than 50% of the respondents do so to a very large or a rather large extent, while 41% include research from the department/unit. Research from other departments at the school or from other parts of KTH is far less common to include.

Table 5. Type of research included in teaching, %

To what extent are the following aspects included in your teaching?	A very large extent	A rather large extent	A rather small extent	A very small extent	Not at all
Research based literature	24	36	26	10	5
Research at KTH (other than at my school/department/unit)	3	14	29	31	24
Research at the school (other than at my department/unit)	4	14	33	30	19
Research at the department/unit (other than my own research)	11	30	32	15	11
My own research	16	37	30	9	8

Based on the results from the case studies, it seems as if the research included primarily comes from the informants departments: “my own and from the others in my research group” (CS1-3) and “both my own research and from colleagues in my corridor” (CS2-1). Nevertheless, there are also other approaches, as this informant states: “it is based on what we do, but since I have such a broad knowledge, it doesn’t have to be from our department” (CS1-2).

Bachelor and master level

Some of the informants in the case studies state that it is difficult to integrate research on bachelor level, but there are some examples of how it can be accomplished. For instance, in case study 1, they have included aspects of research already in the first and the second year: “we offer a course called ‘Perspectives on research and innovation’ in which the students during the first year meet alumni working with research in companies and in the second year do a research project at the department in which they learn about the research process” (CS1-6), an example of a research-based approach (Healey, 2005). As shown in table 4, it is rather common to include research in the bachelor thesis. Hence, there are a number of examples on how to do this integration already on bachelor level.

Inspire and attract students

In one of the case studies, one aspect of the tangible type of connection relating to the need for attracting students to continue studying at undergraduate or graduate level (Neumann, 1992) is mentioned as one informant states: “I want to inspire the students; I am passionate about my research” (CS1-1). Thus, an effect of having researchers teaching students might be that they influence and inspire students by being engaged in their research, just as mentioned in one of the policy documents in case study 1.

CONCLUSIONS AND IMPLICATIONS

Regarding our first research question on how faculty perceive the teaching-research links, the results from the interviews with top management, the case studies, together with the survey results, show on the one hand that faculty members agree with the ideal expressed in the policy documents stipulating that all faculty should do both research and teaching. There seem to be a common understanding in this matter. On the other hand, both top managers and a few of the case study informants, indicate a need for being flexible since all faculty members cannot excel in teaching, research and additional tasks at all times. This is a contradiction which raises further questions that may need to be addressed. For instance, within which limits is a division of labour among faculty an option, and on which organisational level – individual, team, unit, other – does this issue need to be addressed?

Additionally, the policy documents convey the ideal of a close link between research and teaching. However, in these documents it is presumed that research will have a positive influence on education based solely on the fact that all faculty members will do both research and teaching, which is something several informants oppose to.

Concerning our second research question on how links are performed in practice, the results show that when the informants describe how teaching and research are connected, it is obvious how the links appear in different ways and on different levels. For instance, the links do include presenting your own research in lectures, but also letting students participate in research projects at the department or in cooperation with industry, and, additionally, how researchers broaden their own knowledge when teaching students and get stimulated by

discussions with students (Healey, 2005; Neumann, 1992). Thus, the teaching-research nexus entails so much more than just including research results in lectures; the link also embraces the aspect of how teaching can influence research. Maybe this needs to be reflected in the policy documents in order to grasp all the aspects included the teaching-research nexus and to show the complexity.

Furthermore, in the policy documents, there are no details on how the links are expected to be accomplished and performed. On the one hand, this may not be desirable, but on the other hand, finding means to provide faculty with examples on how this can be done could be an option, if there is a need for encouraging stronger links between research and teaching. This could for instance be handled in faculty development activities in which courses and teaching activities are discussed (Elsen et al., 2009). Another option, as suggested by some of the informants, is to include aspects of the research-teaching nexus in evaluations, both research and educational evaluations, in order to give the nexus more value.

In the literature on academic drift, there is a focus on the risk of losing connections to engineering practice due to stronger links to research (Christensen & Erno-Kjolhede, 2011; Harwood, 2010). However, the results from this study point in another direction and show reciprocity between links to research and to industry, even though this is a research intensive university, and there are examples of how students work in projects based on cooperation between academia and units of research and development in industry. Additionally, in these projects, students get the chance to learn both disciplinary knowledge and skills in an integrated manner, one of the corner-stones of CDIO (The CDIO Standards, 2010).

REFERENCES

Annual Report 2014, available online: https://www.kth.se/en/om/fakta/policies/arsredovisning-1.3952 (2016-02-06)

CDIO Standards v 2.0, 2010, available online: http://cdio.org/search/node/cdio%20standards%20v%202.0 (2016-02-06)

Christensen, S. H., & Erno-Kjolhede, E. (2011). Academic drift in Danish professional engineering education. Myth or reality? Opportunity or threat? *European Journal of Engineering Education, 36*(3), 285-299.

Commission, B. (2008). Reinventing Undergraduate Education: A blueprint for America\'s research universities.

Crawley, E., Malmqvist, J., Ostlund, S., & Brodeur, D. (2007). *Rethinking engineering education*. New York: Springer.

Creswell, J. W. (2009). *Research Design. Qualitative, Quantitative, and Mixed Methods Approaches*. California London New Dehli Singapore: SAGE.

Edström, K., & Soderholm, D. (2007). Teaching and learning. In E. Crawley, J. Malmqvist, S. Östlund, & D. Brodeur (Eds.), *Rethinking Engineering Education* (pp. 130-151): Springer.

Elsen, M. G., Visser-Wijnveen, G. J., Van der Rijst, R. M., & Van Driel, J. H. (2009). How to strengthen the connection between research and teaching in undergraduate university education. *Higher Education Quarterly, 63*(1), 64-85.

Geschwind, L., & Broström, A. (2014). Managing the teaching–research nexus: ideals and practice in research-oriented universities. *Higher Education Research & Development*(ahead-of-print), 1-14.

Griffiths, R. (2004). Knowledge production and the research–teaching nexus: The case of the built environment disciplines. *Studies in Higher Education, 29*(6), 709-726.

Harwood, J. (2010). Understanding academic drift: On the institutional dynamics of higher technical and professional education. *Minerva, 48*(4), 413-427.

Hattie, J., & Marsh, H. W. (1996). The relationship between research and teaching: A meta-analysis. *Review of educational research, 66*(4), 507-542.

Healey, M. (2005). Linking research and teaching exploring disciplinary spaces and the role of inquiry-based learning. In R. Barnett (Ed.), *Reshaping the university: new relationships between research, scholarship and teaching* (pp. 67-78).

Jenkins, A., & Healey, M. (2005). *Institutional strategies to link teaching and research*: Higher Education Academy York.

Jenkins, A., Healey, M., & Zetter, R. (2007). *Linking teaching and research in disciplines and departments*: Higher Education Academy York.

Kasten, K. L. (1984). Tenure and merit pay as rewards for research, teaching, and service at a research university. *The Journal of Higher Education*, 500-514.

Kyvik, S. (2009). Academisation *The Dynamics of Change in Higher Education: Expansion and Contraction in an Organisational Field* (pp. 135-165).

Marsh, H. W., & Hattie, J. (2002). The relation between research productivity and teaching effectiveness: Complementary, antagonistic, or independent constructs? *Journal of Higher education*, 603-641.

Neumann, R. (1992). Perceptions of the teaching-research nexus: A framework for analysis. *Higher Education, 23*(2), 159-171.

Ramsden, P., & Moses, I. (1992). Associations between research and teaching in Australian higher education. *Higher Education, 23*(3), 273-295.

Robertson, J. (2007). Beyond the ‘research/teaching nexus’: exploring the complexity of academic experience. *Studies in Higher Education, 32*(5), 541-556.

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