Managing the Teaching – Research Nexus at the University of Twente

Author
Céline Heijnen BSc.

Organisation
Center for Higher Education Policy Studies
University of Twente

Managing the Teaching – Research Nexus at the University of Twente

Directions for Strengthening

Author
Céline Margaret Maria Heijnen, BSc.

Organisation
Center for Higher Education Policy Studies
University of Twente

Supervisors
Dr. L. Leišytė
Dipl. Soz. - Wiss. A. Kottmann
Drs. E. de Weert

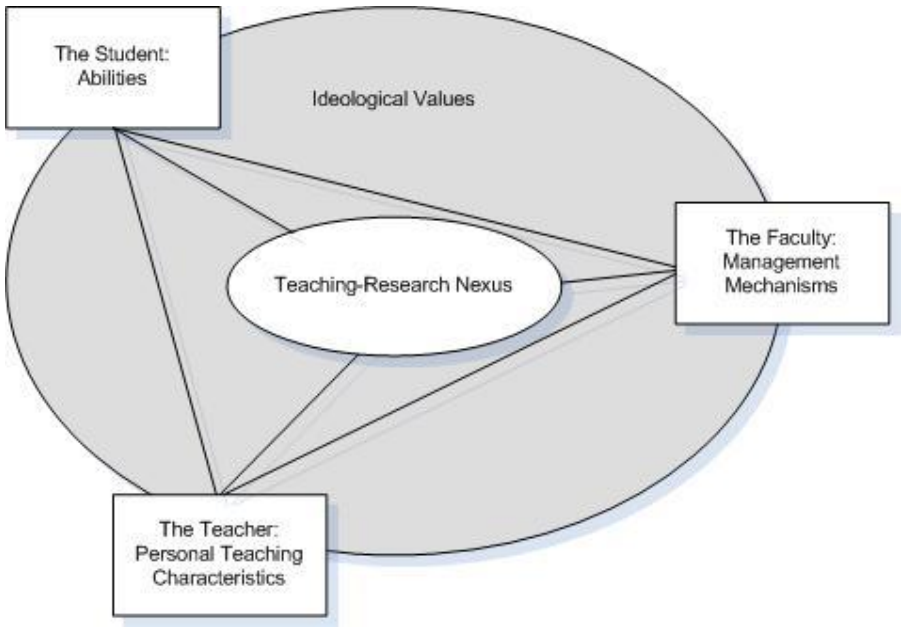
Enschede,
August 20th 2008

Summary

A strong teaching – research nexus can potentially serve universities well as they move into an uncertain future. However, there has been a tendency to separate teaching and research due to the policy of concentrating much of the research in research schools and research institutes. This is also the case for the University of Twente. This separation of research and teaching raises a concern about the strength of the existing teaching – research nexuses at this university. Therefore the research question of this thesis is:

> ***How can the faculties most effectively manage their activities in order to create an optimal synergic link between university teaching and research at the different faculties of the University of Twente?***

Within the literature review it was revealed that opinions about the existence and directions of relationships between teaching and research diverge. The common held belief about the Teaching – Research Nexus is that research and teaching are complementary activities, the Humboldtian pattern (Schimank & Winnes, Dec. 2000). However, meta analysis has shown there is a zero relationship between teaching and research (Hattie & Marsh, 1996). Some authors even suggest a negative relationship between teaching and research (Hattie & Marsh, 1996; Coate, Barnett & Williams, 2001; Schimank & Winnes, Dec. 2000). The question is thus if a Teaching – Research Nexus is naturally present or has to be actively managed. From the literature on the Teaching – Research Nexus it becomes clear there are three types of actors that have a direct and indirect influence through each other on the Teaching – Research Nexus: the students, the teachers and the faculty from a management point of view. The actions these three actors undertake are based upon values they hold about the existence of a Teaching - Research Nexus. A Teaching – Research Nexus is here defined as "the integration of research in teaching which is shaped by students, teachers and departments who are driven by ideological values".



To come to directions for improving the management of the Teaching – Research Nexus, existing Teaching – Research Nexuses were studied according to the variables the above definition contains. The Faculty of Electrical Engineering, Mathematics and Computer Sciences, and the Faculty of Behavioural Sciences were selected for the two case studies. Within the case studies a document analysis was made and interviews with 16 people consisting out of academics and policy co-workers, and a student survey among respectively 165 and 267 students of both faculties were conducted. The results from the interviews were manually analysed, whereas the results from the student survey were statistically analysed.

Four main pressures on the Teaching – Research Nexus were revealed within the analysis: 1) the two-cycle Bachelor Master structure; 2) differing necessary abilities for teaching and research; 3) diminishing student abilities; and 4) increasing separation of financial support for teaching and research. First of all, the results of the study tell that the Teaching – Research Nexuses present are generally stronger for the undergraduate phase than for the graduate phase. Within the undergraduate phase research is used more as a means of illustration, whereas in the graduate phase research becomes the topic itself. The Teaching – Research Nexuses of both faculties do not differ very much as they only differ in the extent to which research methodology is taught explicitly in the undergraduate phase.

Second, teachers derive some personal teaching characteristics from their research activities, but the effect is diminished by the restricted time available for teaching. Little evidence can be found for the assumption that one is a good teacher if one is a good researcher. However, teaching is suffering under increasing teaching loads and pressures to attract external research funding, weakening the Teaching – Research Nexuses.

Third, students influence the Teaching – Research Nexus negatively as they lack basic skills. Furthermore, students do not see a Teaching – Research Nexus present and feel excluded from research.

Fourth, the faculties are responsible for these increasing pressures as funding models applied make research more profitable than teaching. Funding consequently has a negative influence on teaching - research management mechanisms such as time allocation and curriculum development. Contravening pressures from strategic and operational planning are rather weak as both faculties and teachers believe a Teaching – Research Nexus is established automatically uniting research and teaching in one and the same persons. Staff development for establishing a Teaching – Research Nexus is even absent. However, on a meta-level quality assurance safeguards a sufficiently strong Teaching – Research Nexus.

Some recommendations can put forward to contravene the pressures that teachers are experiencing. The following directions were given for the departments and faculties:

- ***Develop departmental and disciplinary understanding***: For establishing a strong Teaching – Research Nexus a mutual understanding is indispensable.
- ***Develop staffing policies***: skills, knowledge and roles of staff play a key role in supporting or obstructing a Teaching – Research Nexus.
- Conceive teaching - research links as primarily occurring in the student experience of their course as not all staff centrally involved in research can teach all courses.
- Provide support for integrating research in teaching is practically lacking at the University of Twente.

Furthermore, directions were given to teachers:

- ***Make students learn and assess students in ways that mirror research processes***: selected upper level undergraduate students and graduate students can be organised to support student inquiry in introductory courses.
- ***Develop student awareness of learning from staff involvement in research***: students are shown they are already learning from research taking place in and outside their faculty.
- ***Develop understanding of how research is organised, commissioned and funded in the discipline and institution***: Although students see to a high extent that research is taking place at their faculty, they do not seem to know how research is organised. By developing this understanding in students, they might appreciate research more.
- ***Develop student involvement in research***: students indicated they want to be more involved in research.
- ***Limit the negative consequences for students of staff involvement in research***: for example, manage the student experience of the days when staff is 'away' doing research. Students feel teachers are not always as contactable and their ability to supervise suffers from it.
- ***Research and evaluate the student experience of research and feed that back in the curriculum***: students do not always experience the Teaching – Research Nexus as teachers expect them to do so. Therefore it is important to research and evaluate this and adjust the curriculum to make the value of research in teaching more clear to students.
- ***Support students in making clear to them the employability elements of research***: this is important for the large part of students who seek employment outside research and therefore may not appreciate the value of a Teaching – Research Nexus.

Preface

During my student assistantship at the ***Center for Higher Education Policy Studies*** my interest for research was triggered. Seen my background in education I was curious about how research and teaching interact at a university. Especially because I experienced research as something distant that also takes place at a university. Nor did I have a clue about how research is actually organised. The questions that arose in my mind triggered a search for literature about the interaction of research and teaching. Soon I stumbled upon loads of research on the teaching – research nexus, explaining concepts about how teaching and research (should) interact. However, little is known about how research and teaching are actually managed to establish such a teaching – research nexus. Concerning rumours about a possible separation of research and teaching by the establishment of research institutes led to the thesis that lies in front of you.

The goal I want to achieve with this thesis is raising awareness about the need for active steering for a strong teaching – research nexus. As a result of increasing pressures on teachers and departments the teaching – research nexus cannot be considered an automatism any more. Active steering is necessary to contravene these pressures in order to maintain a healthy teaching – research nexus.

This thesis would not have been possible without the help of the students that patiently filled in my extensive survey and the teachers, programme directors, policy co-workers, deans and scientific directors answering my long list of questions. Thank you for this. Further I would like to thank my family, friends and colleagues in supporting me during the completion of this thesis. Finally but not least I would like to express my gratitude towards my thesis supervisors Dipl. Soz. – Wiss. A. Kottmann, Dr. L. Leišytė, and Drs. E. de Weert for their keen insight and valuable advice.

Enschede, July 15th 2008
Céline Heijnen

Contents

List of Tables

List of Figures

List of Abbreviations

BS	Behavioural Sciences
EEMCS	Electrical Engineering, Mathematics and Computer Sciences
HBO	Dutch: Hoger Beroeps Onderwijs English: College
KNAW	Dutch: Koninklijke Academie van Wetenschappen English: Royal Netherlands Academy of Arts and Sciences
NVAO	Dutch: Nederlands - Vlaamse Accreditatieorganisatie English: Accreditation Organisation of the Netherlands and Flanders
NWO	Dutch: Nederlandse Organisatie voor Wetenschappelijk Onderzoek English: Netherlands Organisation for Scientific Research
QANU	Quality Assurance Netherlands Universities
R1	Respondent 1
TRN	Teaching – Research Nexus
UFO	Dutch: Universitair Functieordenen
VSNU	Dutch: Vereniging van Universiteiten English: Association of Universities in the Netherlands
WHOO	Dutch: Wet op het Hoger Onderwijs en Onderzoek
WHW	Dutch: Wet op het Hoger Onderwijs en Wetenschappelijk Onderzoek English: The Netherlands Higher Education and Research Act

1 Introduction

Throughout the recent years a major change has occurred at the University of Twente: research institutes have been erected in which all research activities have been placed. This separation of research and teaching can be perceived to have an impact on the academic work: the academics' double role becomes more evident making it harder to combine their two roles. This may be of effect on the Teaching – Research Nexus (TRN) at the University of Twente, raising questions about how this TRN is managed, and how this management can be improved to strengthen present TRNes.

Two topics that are of importance for strengthening the TRN at the University of Twente are the relations between teaching and research, and the way a TRN has to be managed. First of all, arguments are given for positive, negative, as well as no relations between research and teaching. One of the arguments ***of a positive relation*** between research and teaching is that "teachers who are involved in research are more likely to be at the forefront of their discipline" (Hattie & Marsh, 1996, p.604). A prominent argument for an ***antagonistic relation*** between research and teaching is that "classroom performance might result from academics neglecting their teaching responsibilities in order to pursue research and publications" (Marsh, 1987 in Marsh & Hattie, 2002, p.605; Ramsden & Moses, 1992, p.274). Some authors claim there is ***no relationship*** between research and teaching. They just happen to occur in the same place: "Doing research does not make someone's teaching better".

The second topic that is less discussed is the management of the TRN. There is a lack of research about how the TRN actually can be managed or how research and teaching can be integrated by managers in universities. First of all, the literature seems to focus mainly on the individual level. Research on the management of the nexus hardly seems to have taken place. According to Coate ***et al.*** (2001, p.165), the possible relationship between teaching and research were rarely managed.

The aim of this study is to research, from a managerial/sociological perspective, what management measures are taken in order to improve or implement the necessary conditions for the TRN at the University of Twente. The research question of this study is therefore:

> ***How can the faculties most effectively manage their activities in order to create an optimal synergic link between university teaching and research?***

To come to an answer to this research question staff co-workers of the faculties Electrical Engineering, Mathematics and Computer Sciences (EEMCS) and Behavioural Sciences (BS) were interviewed about how they perceived the TRN and a survey was held among students of both faculties about their experiences of research in their courses and faculty.

In chapter 2 the relevance of this study and the theoretical framework will be discussed. Chapter 3 discusses the research design for this study. In chapter 4 the theoretical framework will be used to analyse the TRN at the Faculty of EEMCS and how this TRN is managed. In chapter 5 the same will be done for the Faculty of BS. The two faculties will then be compared, answering the research question and giving recommendations for strengthening the teaching research nexus in chapter 6.

2 Theoretical Framework

In this chapter the problem statement of this thesis will be discussed. In section 2.1 the relevance of this study will be elaborated on. In section 2.2 the theoretical framework is presented, resulting in a model for researching the Teaching – Research Nexus (TRN). In section 2.3 the research questions and hypothesis of this study will be presented.

2.1 The Need for a Teaching – Research Nexus

A strong TRN is perceived to potentially serve universities well as they move into an uncertain future, and as they try to enhance the quality of university teaching and research, to relate more closely to new and important clienteles, and to deliver potential benefits to students and staff (Zubrick, Reid & Rossiter, 2001, pp.84-6). However, there has been a tendency to separate teaching and research by concentrating much of the research in research schools and research institutes within universities (De Weert, 2001, p.196). This is also the case for the University of Twente. According to Carugati and Sangiorgi (2006, p.60) "the organisational and governance structures of the University of Twente were modified in order to better meet institutional objectives by separating education and research and to increase organisational transparency".

For now, the Netherlands Higher Education and Scientific Research Act, ***Wet op het Hoger Onderwijs en Wetenschappelijk Onderzoek*** (WHW), defines universities as bodies that take care of scientific education and to conduct scientific research (Art 1.3. lid 1 WHW);

> ***Universiteiten zijn gericht op het verzorgen van wetenschappelijk onderwijs en het verrichten van wetenschappelijk onderzoek. In elk geval verzorgen zij initiële opleidingen in het wetenschappelijk onderwijs, verrichten zij wetenschappelijk onderzoek, voorzien zij in de opleiding tot wetenschappelijk onderzoeker of technologisch ontwerper en dragen zij kennis over ten behoeve van de maatschappij.***

However, in the new, upcoming higher education and research act, ***Wet op het Hoger Onderwijs en Onderzoek*** (WHOO), which will come in effect in the near future, the demanded intertwines of education and research at a university will be made more explicit in its task description. The act embodies the wish to give universities more space to govern themselves (Ministerie van Onderwijs Cultuur & Wetenschap, Jun. 2006, p.313).

It could make one wonder how this separation of teaching and research affects a TRN and what strategies are implemented to maintain or strengthen this nexus. Certainly now a new higher education and research act is at hands that embodies the wish to give universities more space to govern by deregulation.

2.2 Literature Review

The goal of this literature review is to come to a theoretical framework to research the TRNes present at the University of Twente. Furthermore, management mechanisms are discussed that possibly can improve the TRN at the University of Twente's faculties. The questions to be answered are:

- What are the possible relationships between teaching and research involvement?
- What variables influence the relationships?
- What differences can be possible between the different disciplines/faculties?
- What management measures can be used to improve the integration of teaching and research at the different faculties?

In this theoretical framework, the type of relationships between teaching and research will be further elaborated in section 2.2.1. Section 2.2.2 takes a closer look at ways to integrate research into teaching. In section 2.2.3, literature about managing the TRN will be reviewed to inventory possible solutions. In section 2.2.4, the deduced theoretical framework of the TRN will be discussed.

2.2.1 Relationships Between Teaching and Research

As already has been discussed in the introduction, three possible relations between teaching and research can be distinguished: positive, negative and no relations. In this section, a selection of previous studies on types of relations assumed to exist between teaching and research will be discussed. The following aspects will be discussed per study: theoretical perspectives of the study, questions raised, disciplines which were included in the study, types of relationships researched, indicators used, and finally general results of the studies.

Schimank & Winnes

Schimank and Winnes (Dec. 2000, p.398) distinguish three types of patterns of the relationship between teaching and research: the Humboldtian pattern, the post-Humboldtian pattern and the pre-Humboldtian pattern. The Humboldtian pattern, implemented by Wilhelm von Humboldt in the beginning of the 19th century, describes a situational differentiation of the research and teaching tasks. The post-Humboldtian pattern establishes a differentiation of roles, organisations or resources for teaching and research. In the pre-Humboldtian pattern universities are primarily devoted to teaching and research takes place in academies and institutes outside universities.

According to Schimank and Winnes (p.406) the findings of their study of the unity of research and teaching of European universities suggest most universities, including the Dutch universities, gravitate towards the post-Humboldtian pattern. However, this post-Humboldtian pattern has not stabilised at these universities.

In understanding these findings Schimank and Winnes (pp.406-407) distinguish functional requirements from interests of professors. The Humboldtian pattern fits better with professors' interest as, first of all, research has a strong intrinsic attraction as people are socialised accordingly and having both research and teaching tasks makes work more variegated. Second, more reputation can be gained with research as with teaching. Third, researchers are quite autonomous in doing research. Finally, dual tasks can be used to pay attention to one of both tasks. The pre- and post-Humboldtian patterns restrict professors to teaching. According to Schimank and Winnes people believe that only an active researcher could be a good university teacher and students at universities learn a certain style of

learning. However, empirical research demonstrates no or only a very weak and inconclusive relationship between teaching and research. The link between professors' interests and functional requirements is spurious as professors use the functional arguments to legitimate their curiosity-oriented basic research, wasting resources.

> ***This type of research is suspected to be a waste of resources for 'ivory tower' pleasures of spoiled scholars.***

Hattie & Marsh

Hattie and Marsh (1996) conducted a meta-analysis of 58 studies to provide evidence for several models explaining the relationship between teaching and research. The applied variables and classes are;

1) Type of university; liberal/college, research, unspecified.
2) Domain of study; natural sciences, social sciences, humanities.
3) Source of teaching; student evaluations, self-rating, peer-rating
4) Research indicator; number of publications, productivity, citations, quality, grants;
5) Domain of learning; which can be:
    a) Presenter dimensions; instructor enthusiasm, breadth of coverage, organisation, knowledge of topic, commitment to teaching, learning;
    b) Facilitator dimensions; individual rapport, group interactions;
    c) Manager dimensions; fairness of grading, assignment/reading, difficulty (Hattie & Marsh, 1996, p.524).

According to Hattie and Marsh (1996), the common belief that teaching and research are entwined is "an enduring myth". Furthermore, research and teaching are viewed as influencing each other in a negative way. Hattie and Marsh (pp.508-10) identified three major models explaining why the relationship should be negative; the scarcity model, the differentiated personality model, and the divergent rewards model. According to the scarcity model, time, energy, and commitment can be differentially distributed or even in conflict. The differential personality model proposes that there is a negative relationship between teaching and research, as the two activities require contrary personal orientations that are contrasting. Lastly, the divergent reward system model contends that research and teaching are conflicting roles with different expectations and obligations that are motivated by differing reward systems.

Hattie and Marsh (pp.511-12) give two arguments for a positive relationship between teaching and research; the conventional wisdom model, and the "g" model. The first model presupposes that there is an "obvious" relationship between research and teaching; the common belief among academics. The "g" model is based on the premise that the abilities underlying successful teaching and research are similar. The values associated with both are claimed to be high commitment (perseverance, dedication, and hard work), creativity (imagination, originality, and inventiveness), "investigativeness", and critical analysis.

Three arguments why the relationship is expected to be zero are; the different enterprises model, the unrelated personality model, and the bureaucratic funding model. The different enterprises model contends that research (knowledge in the context of discovery) is an entirely different enterprise from teaching (knowledge in the context of transmission). The unrelated personality model is based on the notion that teachers and researchers are different types of people and there may be few personality attributes in common. The bureaucratic funding model contends that research and teaching must be unrelated, as this fits with its beliefs or desires about how universities should or could be funded (pp.513-4).

In a later study Marsh and Hattie (2002, pp.608-13; Hattie & Marsh, 2004, p.3) revised a set of possible mediating and moderating variables that are, then, grouped in background variables and resources. In this second study possible background variables are: research and teaching ability, teaching and research satisfaction, personal goals, extrinsic rewards for teaching and research, constraints to teaching and research, beliefs about nexus between teaching and research, and departmental ethos for teaching and research. Possible resources are time spent on teaching and research, and activity in teaching and research. According to Marsh and Hattie (p.621) teaching and research outcomes are a function of ability, motivation, and time. Within this study Marsh and Hattie (p.623) found strong support for research and teaching being "independent constructs" again. Meta-analysis shows a zero relation across possible mediators and moderators.

Coate, Barnett and Williams

Coate ***et al.*** (2001, pp.160-5), tried to determine factors that impact on the TRN. Research subjects included within their study were history, chemistry, engineering and business faculties. To research the relationship, they made a distinction between the volumes of teaching and research. These are indicated by the staff time and applied resources for each activity, and the values that academics, students and institutional managers accord to each activity.

They found six possible relationships between teaching and research, see Table 1. According to Coate ***et al.*** (2001, p.166), the positive influence of research on teaching has three causes. First, the research-active academics are the "cutting-edge" people in their fields, having more authority towards the students. Second, the researchers have more relevant, up-to-date material. Lastly, there is the claim that enthusiasm gained from actively researching by teachers "rubs of" on their students.

Table 1
Types of relationships TRN.

Integrated Research and teaching are not distinct, considerable overlap (if not identical)	
Positive Research has a positive influence on teaching	Positive Teaching has a positive influence on research
Independent Research and teaching independent of each other (neutral relationship)	
Negative Research has a negative impact on teaching	Negative Teaching has a negative impact on research

Teaching is also seen as having a positive influence on the research activity; it broadens the academics' horizon and stimulates the contact with a continually changing, younger intellectual public of students. Research benefits from teaching in two ways: by forcing lecturers to articulate their research ideas and open them to challenge from students, and by teaching in less familiar areas or undergraduate students is viewed as possible leading to new ideas for research (pp.166-8). Scarcity of resources is seen as a key factor in negative relations between teaching and research. The academic work has increased over the past few decades, having negative consequences like stress, burn-out, depression, and diminishing morale of academic staff. New demands of accountability are seen as "deprofessionalizing", "inefficient", and "a reflection of a lack of trust" (p.171). However, Coate ***et al.*** (2001, p.167) point to the fact that the extent of influences on the TRN depends on the subject area and the level of teaching. Whereas for chemistry, engineering and history the extent of the influence

increased in the higher levels of teaching, the extent of influence increased for business studies only moderately.

Brew & Boud

Brew and Boud (1995, p.261) believe "a concern for learning" is a common element shared by teaching and research. From existing empirical, mainly correlation, studies they try to identify some of the underlying values of this "concern for learning" and associated political agendas. Their study is a review of previous literature and does not focus on particular disciplines. However, in their conclusion, they recognise that differences in research processes exist between disciplines (p.272).

According to Brew and Boud (pp.264-5), the research is "compounded by a number of intervening value-issues". Their argument is that the link between research and teaching needs to be sustained until there is recognition and resources for good teaching. Unfortunately they were not able to statistically demonstrate whether there is a link or there "ought to be" a link. Brew and Boud (pp.268-269) feel learning is a vital link between teaching and research. Research is about producing socially accepted knowledge; the process of discovery emanates in an individual's or group's attempt to make sense of a phenomenon or a problem in a subject domain. Teaching is like this in that it has to take account of knowledge as an individual creation. This means that by being researchers they are being better teachers since they engage in the same activities as learners.

> ***Both research and learning are informed by the tradition and forms of inquiry characteristics of the discipline and the literature of and what constitutes evidence in discipline (Brew & Boud, 1995, p.267).***

Gottlieb & Keith

The purpose of the study conducted by Gottlieb and Keith (1997) is to examine the international complexities of research-teaching nexus in higher education institutions. The study compares seven industrialised western countries, but does not make a distinction between disciplines.

The study analyses multiple indicators of research and teaching interests, time commitments, course level, students' requirements, and publication productivity, as related to institutional variables such as rank and size (pp.400-1). Their findings show that those interested in teaching spend more mean weekly hours on teaching activities than faculties interested in research, while research oriented faculties spend nine hours more on research than teaching oriented faculties. This leads them to the conclusion that teaching and research activities are not mutually exclusive even though a statistically significant difference between the two groups exists with respect to working hours, level of courses, student requirements, and number of publications (p.416). According to Gottlieb and Keith (p.417), the results show a very strong support for the coexistence of research and teaching, differentially emphasised by categories of professors and within the work environment of individuals, to varying degrees.

Colbeck

Colbeck (1998, p.653) researched the integration of teaching and research from the viewpoint of social role theory seeking answers to questions about proportion of work time, faculty activities, and contexts influencing the integration of teaching and research.

According to Colbeck (1998), contextual influences on teaching - research integration are the purpose of teaching, disciplinary paradigm consensus and knowledge structures, disciplinary

norms for research training, university research evaluation policies, and faculty involvement in department decision making. The results of his study show the way faculty integrate teaching and research is influenced less by the level of students taught than by whether the purpose of their teaching efforts was classroom instruction or training students to conduct research (pp.654-5). Faculties in low paradigm consensus fields integrate classroom-oriented teaching with research more than faculty with high paradigm consensus fields (p.658). Second, faculties that use a graduate-apprentice model to teach students how to conduct research will integrate research and research training more than faculties that use a counsellor model to teach students how to conduct research (p.660). Third, the broader the university definition of what counts for research is, the more faculties are able to integrate research and classroom-oriented teaching (p.661). Fourth, the more teachers are involved in departmental decisions about teaching assignments, the more able they are to integrate teaching and research by teaching courses about their current research in existing required courses (p.663). Colbeck (pp.664-5) concludes that individuals are not continually faced with decisions about fulfilling the expectations of one role at the expense of others. Opportunities to integrate teaching and research are shaped by the definitions of the expectations of the two roles by their disciplinary, university, and departmental context. Departmental differences indicate that role expectations are socially negotiated. However, Colbeck (p.665) comments that limited expectations for faculty members' teaching role may restrict some perceptions of teaching - research integration.

Neumann

Neumann (1992, p.162) conducted interviews with academics, from the humanities, sciences, social sciences and professional areas, on the relationship between research and teaching. From her findings, she distinguished three broad and positive types of connections; the tangible, the intangible and the global connection.

The ***tangible connection*** relates to the transmission of advanced knowledge and the most recent facts, particularly at the senior undergraduate and postgraduate levels. According to Neumann (p.162), academics who are not involved in research are not at the forefront of their discipline. This might lead to less informed and up-to-date research. Neumann does not describe any differences in results between disciplines, but points to some significant factors one has to keep in mind while discussing the TRN: the type and purpose of the course, the ability and motivation of the student, the nature of the discipline, and the level of development of the discipline. The ***intangible connection*** relates to the development in students of an approach and attitude towards science (pp.162-3). Only academics who are actively involved in research are held able to effectively instil a questioning and a critical way of thinking, because only by doing research it can be appreciated how complex the knowledge is. Moreover, there is a felt need for academics to develop in students a positive attitude towards knowledge and confidence in learning, which is perceived to only be achieved by academics who already possess these attributes. The ***global connection*** describes the interaction between teaching and research at departmental level (Neumann, 1992, p.162). Neumann (pp.164-5) believes research and teaching can be seen as complementary activities within academic work. By organising and clarifying knowledge for teaching, academics can discover gaps in their knowledge of which they were not aware. Furthermore, constant contact with young, intelligent people stimulates academics by keeping them alert (pp.164-165).

To examine the degree to which students are aware of an academics' research role and whether the conduct of research, in their view, had any impact on their teaching and learning experiences, a study was carried out on the perspectives of undergraduate and postgraduate students on their teaching and learning experiences in academia and their contact with

university research. Students representing the broad disciplinary groupings of the humanities, sciences, social sciences and professional areas were selected. The general findings were that the majority of the students had experienced a relationship between the teaching and research roles of academics, and each of the three levels of connection could be identified. At the tangible level, students thought the lecturer was at the forefront of knowledge, relevant examples of teacher's research were used during teaching, and students were taught useful techniques which the lecturer used in his or her own research. Factors influencing evidently the nexus were: ability and motivation of the student, nature of the discipline, type of course, opportunity for teacher-student interaction (Neumann, 1994, pp.323-5).

Jenkins et al.

Jenkins ***et al.*** (1998, p.127) focus on students' perspectives on staff research, which is a main point not considered by previous studies. This research is conducted using focus groups. The key disciplines studied are: adult nursing, anthropology, English studies, educational studies, catering management, planning studies, business administration, and biology.

Perceived benefits of staff research besides teaching to be up to date are, enthusiasm for their discipline; giving credibility in the eyes of students, also to an extent to their degree and to the department/university in which they are studying; credibility through staff research validated their decision to attend the institution; for third year students, staff expertise could be an advantage in choosing a dissertation topic and gaining effective supervision; and one unexpected benefit was the sense it gave them of staff as people and as learners (p.132).

Lindsay, Breen and Jenkins (2002, p.316), extend the study to postgraduate studies. The postgraduate studies involved are: environmental management, advanced health care practice, urban planning, international hospitality and tourism management, modular arts, anthropology of Japan, international management, and education. According to Lindsay ***et al.*** (pp.321-2), the following generalisations can be drawn from both studies;

- ***Both undergraduate and postgraduate students associate more benefits than disadvantages with lecturer research.***
- ***Both samples agree that knowledge currency, credibility, competence in supervision and enthusiasm/motivation are enhanced by lecturer research activity.***
- ***Postgraduates commend salience when lecturer research directly benefits their own learning.***
- ***Both samples or studies associate some disadvantages with lecturer research, including reduced availability, competition with teaching, and curriculum distortion.***
- ***Undergraduates feel excluded from direct involvement in research as stakeholders.***
- ***Postgraduates think research impacts negatively when it lacks salience (the key terms used in discussion were interest, relevance or utility).***
- ***Both samples make a considerably greater number of positive than negative statements about lecturer research activity.***
- ***Both samples make a greater number of positive statements about research as the amount of research activity in their department increases.***
- ***Undergraduates make a greater number of negative statements about teaching as the amount of research activity in their department increases.***
- ***Postgraduates make a greater number of positive statements, and a smaller number of negative statements about the effect of research upon teaching as the amount of research activity in their department increases.***

Relations: Out of the three types of relationships possible between research and teaching, e.g. positive, negative and zero relationships, positive relationships are more likely than negative or zero relationships. However, if one wants the relationship to be positive one has to actively manage the relationship and take in account influences on the relationship from the subject area and level of teaching.

Three types of relationships between research and teaching can be found: positive, negative and zero relationships. Evidence can be found for all three types of relationship; however there are more adherents of a positive relationship (Neumann, 1992; Coate ***et al***., 2001; Brew & Boud, 1995; Jenkins ***et al***., 1998) than of a negative or zero relationship (Hattie & Marsh, 1996). The evidence pointed to by the different adherents differs: the adherents of a negative/no relationship only seem to point to some contextual factors influencing the relationship, whereas adherents of a positive relationship point less strongly to contextual factors but more to rather elusive relationships that seem hard to measure, for example "being at the forefront of their discipline" (Neumann, 1992, p.162).

Factors that are perceived to be of influence on the TRN are the subject area/discipline, for example engineering sciences or social sciences, and the level of teaching, e.g. undergraduate or graduate level.

With the tangible and intangible connection Neumann does not really describe possible relations between teaching and research, but possible goals of a teaching research nexus: the transferral of recent developments and knowledge, and the development of an academic attitude.

To come to a conclusion, it seems that there is a relationship between research involvement and the extent of integration of research in teaching if one wants that relationship to be there. If one wants the relationship to exist one has to actively manage the relationship.

2.2.2 Ways of Integrating Research in Teaching

Teaching is a wide concept. The focus of this study lies on the integration of research at the level of the study programme. Each study programme has its own curriculum.

Griffiths

Griffiths (2004) considers the research-teaching nexus from the standpoint of the built environment disciplines. The goal of his study is to review the ideas about the nature and the meaning of research, and draw attention to key differences in the modes of knowledge production employed in practice-oriented fields, such as built environment disciplines, and other fields.

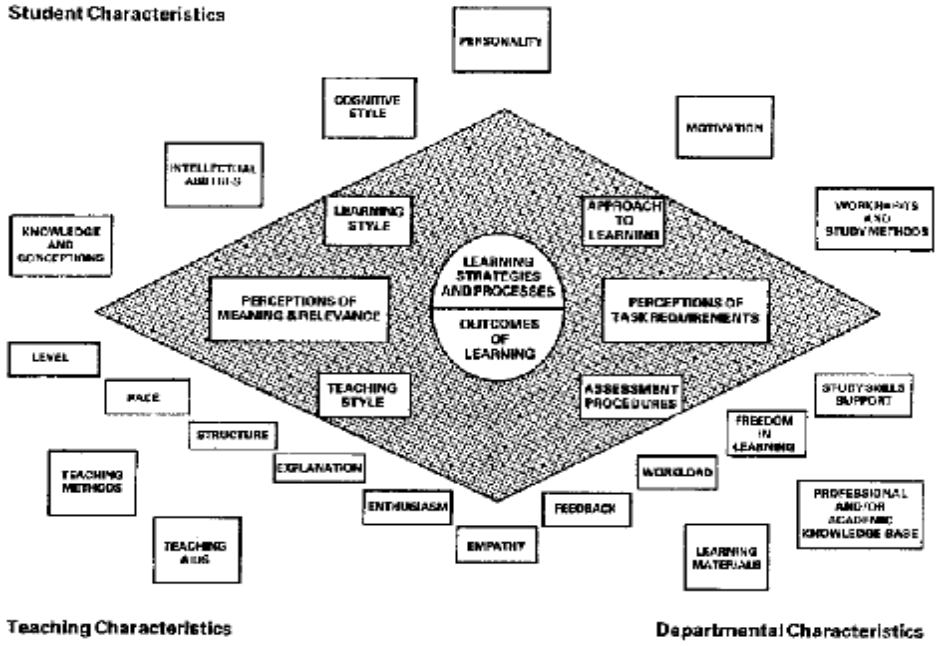
Griffiths (p.721) identifies three dimensions of the teaching – research relationship. First, the relationships can be specific in form or more diffuse or indirect in character; when particular research projects that academic staff worked on are incorporated in some way in their teaching activities. Second, research can be weakly embedded in teaching activities, or it can be more strongly integrated; staff research is referred to in lectures, or research output is included in reading lists. Third, the direction of the relationships can be predominantly unidirectional or having a more strong reciprocal, two-way, character. Bearing in mind these dimensions, he defined four models of the research-teaching nexus. Teaching can be;

i. ***Research led; the curriculum is structured around subject content, and the content is directly based the specialist research interest of the teaching staff;***
ii. ***Research oriented; the curriculum places the emphasis as much on understanding the process by which knowledge is produced in the field as on learning the codified knowledge that has been achieved;***
iii. ***Research based; the curriculum is largely designed around inquiry-based activities, rather than on acquisition of subject content;***
iv. ***Research informed; draws consciously on systematic inquiry in the teaching and learning process itself.***

Entwistle & Tait

According to Entwistle and Tait (1990), it has been proven that academic environments have a direct effect on students' approaches to studying, but these effects are also indicated to be mediated by students' own perceptions of those learning environments. The 1987 model made by Entwistle, see Figure 1, draws attention to the ways in which aspects of the academic environment might be expected to interact with the individual characteristics of the learners in affecting both approaches to learning and the quality of the learning outcomes.

Figure 1. A heuristic model of the teaching-learning process in higher education.



Jenkins et al.

Jenkins and Zetter (2003), and Jenkins, Healey and Zetter (Apr. 2007) also recommended measures for strengthening the TRN. See Appendix I for a summary of these recommendations.

Ways of integrations: The TRN is established at the course level by means of content and teaching methods. Actors influencing the TRN are students by their abilities and motivation; teachers by their personal teaching characteristics authority, difficulty, enthusiasm, supervision, empathy, authority and difficulty; and the department by resource allocation and knowledge base.

The place where the TRN is actually established is mainly at the course level in terms of content and teaching methods. The curriculum can be designed around subject content or inquiry-based activities. The inquiry-based activities can be seen as a type of teaching method.

Looking at the bigger context of teaching and learning processes at the higher education, teaching and learning are determined by three types of characteristics: student, teaching and departmental characteristics. For the student characteristics the abilities and motivation of students are influencing the TRN. Teaching characteristics also seem to have a prominent influence on the TRN, especially personal teaching characteristics, as has been pointed out by Jenkins ***et al.*** (1998) in the previous section. Types of personal teaching characteristics that have been pointed out to be enhance by research activities undertaken by teachers are credibility/authority, competence in supervision, enthusiasm/motivation, ability to balance workload, difficulty, ability to show empathy, and organisation of teaching. The departmental characteristics include the learning materials and knowledge base.

2.2.3 Managing the Teaching – Research Nexus

Studies about how to manage the TRN are scarce. No grounded theory has been developed yet, however some case studies have been executed, suggestions have been given and one preliminary model has been sketched.

De Weert

According to De Weert (March 2004, p.1) the widely shared view is that teaching and research are "mutually reinforcing", meaning good teaching can only be done by good researchers. However, there are also postmodernist views that critique the TRN as "do research and teaching not represent aspects of a single dimension" but to be competitive and contradictory.

De Weert (pp.3-4) identified four pressures affecting the relationship between teaching and research:

- Financial support for research is being increasingly separated from that intended for teaching as money for research is taken away from universities and transferred to research councils which distribute grants more selectively;
- National research priorities changed the research infrastructure such as the establishment of separate research organisations, making research more competitive on an international scale;
- The implementation of new university governance structures is transforming the traditional task-oriented organisation into a market-type of organisation. As a result managerial aspects of teaching and research work processes are emphasised and academics traditional freedom as a professional is put under pressure; and
- The two-cycle structure of the bachelor and master system tends to create a divide between undergraduate and graduate level as research training is concentrated in the latter.

Furthermore, in his paper De Weert (pp.5-7) distinguishes four institutional models;

- The integrated system, the classical Humboldtian model
- The concentration of research in a separate set of research institutes
- Institutional differentiation, also the Dutch binary structure, and
- Separation of teaching and research within universities.

According to De Weert there is no ideal organisational form. One would think the integrated model guarantees an optimal relationship between research and teaching. However, this model entails the danger that teaching displaces research. De Weert (pp.7-10) mentions several initiatives in the sphere of staff policies that can "bridge the teaching and research connection". Two of them are about strengthening the connection between research and teaching within a university;

- ***Cross-fertilisation***, meaning research institutions and universities become "associated". According to De Weert (p.8) the faculty – research institutes model does not need to weaken the connection, but could even strengthen it;

In the model each individual staff member who is working in the research institute is in principle also charged with teaching tasks. All staff members belong to the faculty which is a build-in mechanism to assure that individual staff members cannot solely base their workload on their research obligations. Especially in the master phase characterised by specialisation and in-depth study the relationship between teaching and research is expected to be strengthened.

- ***New systems of job rankings.*** To prevent research performance to become the all-determining factor in a career path a new staffing model can be implemented which allows for more freedom "in the relative proportion of these task components for each individual academic".

Gibbs

Gibbs (2001, pp.12-3) identified four types of learning and teaching strategies: "devolved", "integrated", "policy driven" and "strategic". From the analysis of institutional documentation, a set of 12 components for learning and teaching strategies were identified: context, creation, goals, targets, culture, curriculum, teaching, quality assurance, change mechanisms, implementation, and monitoring. Change mechanisms employed are: staff development, promotion and rewards for excellent teachers, funding for projects and innovation, training for teachers, student feedback systems, organisational change, appraisal of teachers and use of teaching portfolios, new types of posts (e.g. readership in teaching), educational development support services, training for part-time teachers and graduate teaching assistants, and learning material production facilities.

Zubrick, Reid & Rossiter

Zubrick, Reid and Rossiter (2001, p.xi) tried to determine whether, and if so how, the relationship between teaching and research was enhanced by policy and practice under different institutional circumstances. The authors' view the undergraduate teaching as the core activity of most schools and departments; thus, the primary focus of this study lies on the undergraduate experience. Zubrick ***et al.*** sought to identify examples across disciplines and institutions of good practice linking teaching and research, faced problems in linking the two activities, and key reasons for doing so. See Appendix I for examples of measurements undertaken to strengthen the nexus within institutions.

Taylor

Taylor (2007, p.868-9) examined factors influencing management of the TRN, deriving a new conceptual model, see Figure 3, enhancing understanding of "how the relationship between teaching and research may be organised and influenced in practice". Two English and two Swedish universities were selected "on the basis of their publicly expressed commitment to the interaction of teaching and research and their breadth of academic disciplines". A list of

interviewees was devised from voluntary academic staff from different levels of seniority and different fields of study.

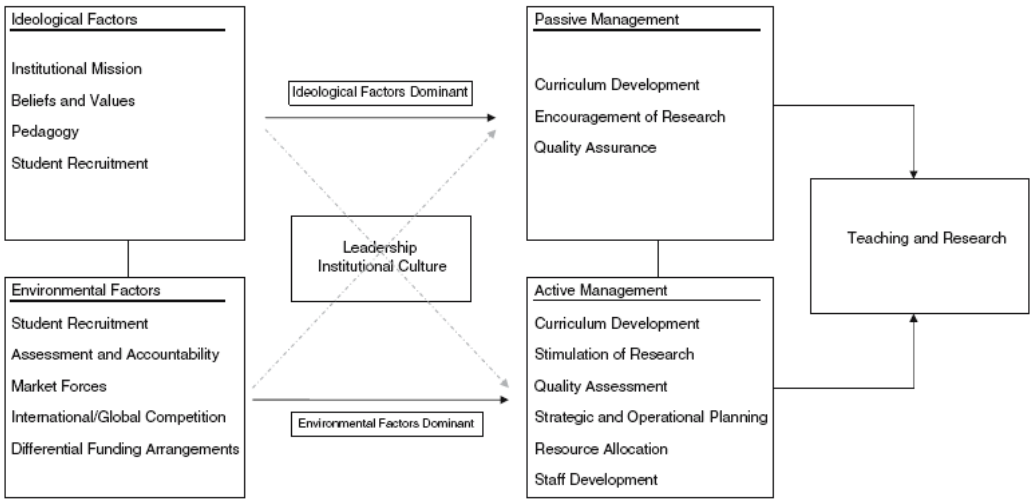
Taylor (p.870-6) found a range of "key drivers" shaping the commitment to and nature of the TRN, characterised by ideological and environmental factors. The ideological factors were: institutional mission, beliefs and values, pedagogy, and student recruitment. Environmental factors were: assessment and accountability, market forces, international and global competition, and differential funding arrangements.

For the response of institutional management Taylor makes a distinction between passive and active management. Characteristics of passive management are curriculum development, and quality and relevance. Characteristics of active management are strategic and operational management, resource allocation, and staff development (pp.876-82).

His findings were that when ideological factors were more dominant, more passive management was in place. In contrast, dominance of environmental factors led to more active management (p.876).

The majority of the studies on how to manage the TRN, nor are clear cases of "good" and "miss management" evident. The studies differ in their level of abstraction, which makes comparison difficult.

Figure 2. Model Taylor.



Coate et al.

Coate ***et al.*** (2001, pp.161-3) distinguish weakly and tightly managed systems. Weakly managed systems are often based on collegial ideas about university management. Tightly managed systems are usually based on an allocation of teaching or contact hours with students. However, "an assumption that fair allocations will result largely from goodwill of staff seems unlikely to actively promote synergies between teaching and research". Research activities are more difficult to quantify than teaching activities, which can be timetabled and counted in hours. According to Coate et al. (p.162), a managerial strategy "that promotes the intellectual perception of teaching and research as integrated" is missing. Suggestions for explicit management strategies are:

- Improving the links between teaching and research committees;

- Considering the scholarships as an activity distinct from research: since scholarships are considered to blur the boundaries between teaching and research.

Leišytė

Leišytė (2007) has researched organisational responses to institutional change in Dutch and English research units. According to Leišytė (p.329), Dutch research units apply compliance strategies to cope with changes like increasing student numbers and teaching loads, in their institutional environment. Responses to these changes are working overtime and diversification of tasks in work portfolio. Units that to a large extent depend on income from teaching hire temporary staff to teach and involve junior researchers in teaching. Declining internal university funding pushes research units to earn money internally via teaching or via external research funding, e.g. diversification of work portfolio.

Management mechanisms: Additional to the in section 2.2.2 mentioned disciplinary and level of teaching influences on the TRN and the management of it, additional influencing factors are ideological beliefs and values, institutional mission, pedagogy and student recruitment, and external factors like market forces, international competition and differential funding arrangements.

Management mechanisms that can be applied to steer the TRN are: curriculum development, encouragement of research, quality assurance, stimulation of research, quality assessment, strategic and operational planning, resource allocation, and staff development.

Zubrick ***et al.*** offer some hints to impediments to the TRN and mechanisms to encourage linkages, but do not make a clear connection between them.

2.2.4 Discussion

The goal of this discussion is to come to a set of variables that indicate the possible relationships and relating them to each other in a ***preliminary*** model. First, the encountered variables and relationships between research involvement and the pattern of teaching presented in section 2.3.1 will be discussed. Second, in section 2.3.2 the disciplinary differences will be discussed. Third, a model of teaching - research variables influencing the teaching pattern will be developed, section 2.3.3. The resulting model can be used to research the TRN at different faculties of the University of Twente. Finally, in section 2.3.4 the possible management mechanisms will be discussed and connected to the nexus variables in a second model.

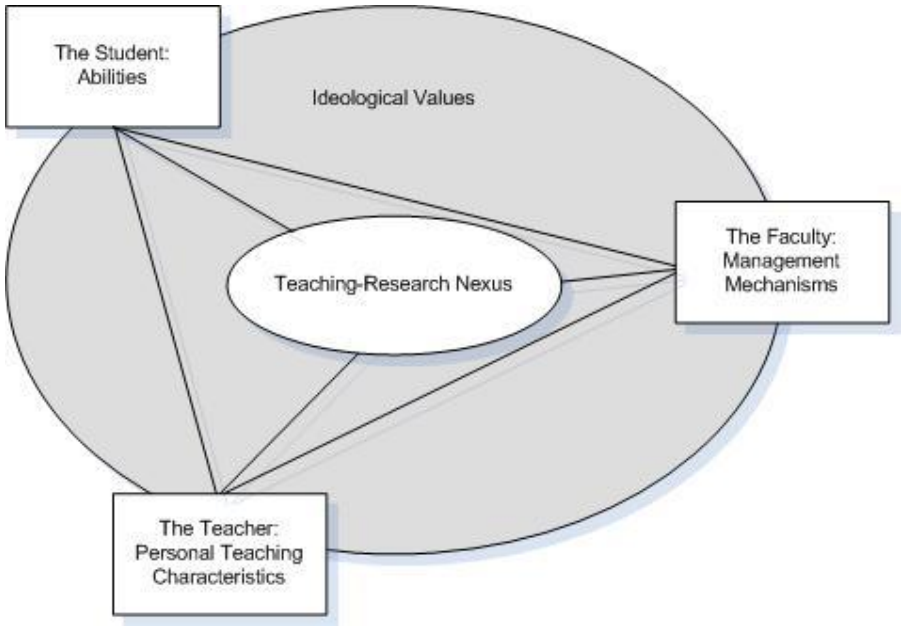
The TRN is established at the course level by means of content and teaching methods. Actors influencing the TRN are students by their abilities and motivation; teachers by their personal teaching characteristics authority, difficulty, enthusiasm, supervision, empathy, authority and difficulty; and the department by resource allocation and knowledge base. In the model in Figure 3 these three actors are depicted as three elements influencing the TRN

Another element in the model is the ideological values influencing the TRN. In the model in Figure 3 the ideological values are depicted as underlying not only the teaching - research as such, but also the three actors. In my opinion ideological values provide the context in which actors respond to a TRN.

The model distinguishes the following categories of management mechanisms: curriculum development, appraisal, quality assurance, strategic and operational planning, resource allocation, and staff development. Appraisal includes Taylor's encouragement and

stimulation of research, and the environmental factor assessment and accountability. Quality assessment is viewed as being part of quality assurance. Differential funding arrangements are viewed part of resource allocation.

Figure 3. The Teaching – Research Nexus Model.



On the basis of this model a TRN is defined as:

> ***The integration of research in teaching which is shaped by students, teachers and departments whom are driven by ideological values.***

In Table 2 the possible relationships between research and teaching are connected to the variables of the TRN model to visualise what influences on the TRN can be expected from the variables. The relationships between research and teaching can take on three different directions, e.g. positive, negative and zero relationships, positive relationships are more likely than negative or zero relationships, see Table 2. However, if one wants the relationship to be positive one has to actively manage the relationship and take in account influences on the relationship from the subject area and level of teaching. The connections between the variables are visualised in Figure 3.

2.3 Research Questions and Hypothesis

In this section the research questions will be presented, starting with the main question followed by the deducted sub-questions;

How can the faculties most effectively manage their activities in order to create an optimal synergic link between university teaching and research?

1. How is research integrated in teaching at the different faculties and different study phases (e.g. BSc. and MSc.)?
2. How does research involvement influence the different personal teaching characteristics at the different faculties?
3. How do abilities of students influence the integration of research in teaching at the different study phases and faculties?
4. How are ideological values and beliefs influencing the TRN at the different faculties?
5. What management mechanisms are applied to strengthen the TRN for the different study phases and faculties?
6. How can differences in personal teaching characteristics, ideological values and beliefs, and management mechanisms of the different faculties explain differences in their TRNes?
7. How can the management of the TRN be optimised for the different study phases and faculties?

On the basis of the theoretical framework, the following hypothesis can be drawn for each (group of) variable(s);

1. If the teacher is involved in research, the personal teaching characteristics “enthusiasm”, “supervision” and “authority” may receive less attention in staff development.
2. If the student characteristics are changing, management has to respond by adjusting entry requirements and the study programmes by curriculum development.
3. If faculties differ profoundly in the nature of research, variations will occur in the TRN present, requiring a different management approach.
4. The TRN being less present naturally in the undergraduate phase than in the graduate phase requires more proactive management mechanisms for the undergraduate phase.
5. If the nature of the TRN differs for faculties (ideological vs. environmental factors), different management mechanisms (passive vs. active) are in place to optimise the TRN at those faculties.

Table 2

Possible relationships between research and teaching.

Author	Model	Description	Variable
Positive relationships between teaching and research			
Hattie & Marsh + Neumann + Schimank & Winnes	Conventional wisdom/ Global connection	An "obvious" relation exists between teaching and research: research and teaching are complementary activities	
Hattie & Marsh	"g" model	Abilities underlying teaching and research are similar	Abilities academics
Brew & Boud + Colbeck	Social role theory: Concern for learning	Learning is a common element for both teaching and research	Role teacher
Negative relationships between teaching and research			
Hattie & Marsh + Coate et al.	Scarcity model	Time, energy and commitments are distributed differently	Resource allocation
Hattie & Marsh + Schimank & Winnes	Differential personality model	Teaching and research suppose contrary personal orientations	Beliefs and Values
Hattie & Marsh	Divergent rewards	Different rewarding systems	Appraisal
Zero relationship between teaching and research			
Hattie & Marsh + Coate et al.	Social role theory: Different enterprises model.	Research is about knowledge discovery, whereas teaching is about knowledge transferral	Role teacher
Hattie & Marsh	Unrelated personality model	Teaching and research assume different types of personality	Beliefs and Values
Hattie & Marsh	Bureaucratic funding model	Teaching and research ought to be funded and managed separately	Resource allocation

3 Research Design

Before we start with the description of the research design, a comment should be made. The goal of this study is to come to a description of the Teaching – Research Nexuses (TRNes) present at the University of Twente, factors that are of influence of these TRNes, and recommendations for strengthening the TRNes present.

To analyse the TRN at the University of Twente, the faculties of BS and EEMCS will be researched as two case studies. These two faculties were selected because the nature of the study programmes taught and research conducted at these faculties differ from each other: beta engineering sciences versus alpha social sciences. To gather the necessary data, the following activities were conducted:

1. Analysis of relevant key policy documents and other discussion papers;
2. Interviews with academic staff and administrators of the DUB and the faculties GW and EWI; and
3. Survey among students of both faculties.

3.1 Document Analysis

The first activity was an analysis of key policy documents and other discussion papers that should reflect the operation within the institution. Key documents included are, for example, mission and vision statements, teaching and learning plans, research and development plans, promotion policies and appointment policies.

3.2 Interviews

The interviews were performed with 16 academics consisting out of policy co-workers of the university, the deans of the faculties, the scientific directors of the research institutions that are closely related to the two faculties, directors of education, teachers and professors from the faculties of BS and EEMCS, and a professor at the School of Management and Governance (MG). The teachers were partly selected on the basis of self-evaluation documents of both departments, and partly by asking the teachers to name other stakeholders of the TRN. For the interviews, each teacher was emailed the outline of the purpose of the study, together with some framing issues to be discussed in advance. The interviews were digitally recorded after permission of the teacher and transcribed afterwards. The transcriptions were returned to the teachers for comment and amendment.

The interview questions are based on questions from the ***International Survey of the Academic Profession*** (Altbach & Boyer, 1996) and the by LTSN Generic Centre (Jenkins & Zetter, 2003, pp.18-19; Jenkins, Healey & Zetter, Apr. 2007) proposed questions to consider.

The interviews with the policy co-workers and professor at the School of MG were used as additional background information for the interviews with the staff members of the faculties of EEMCS and BS. After the first two interviews with faculty staff members, the interview schedule has been reviewed. The final interview schedule, see Appendix II, consists of four parts: general questions, curriculum and research based learning, teaching skills, and management, organisational structure and staffing at department level. The general part consists out of mainly open-ended questions covering some background variables like age

and function and ***time allocation***. The curriculum and research based learning part consists of open-ended, evaluative questions covering the variables research content, teaching methods, materials and resources, and management mechanism***s***. One Likert-type question with a bipolar 5-point scale evaluating the quality of the students is taken in to compare the teachers' statements. For the teaching skills part, the teachers evaluated their teaching skills (e.g. the variables ***organisation***, ***enthusiasm, empathy***, ***authority***, ***supervision***, and ***difficulty***) according to the before described scale. Also, the part contains (Likert-type) evaluative and fact questions covering the variables ***type courses***, ***resources***, ***time allocation*** and ***policies***. The final part, management, organisational structure and staffing at department, consists also of (Likert-type) evaluative and fact questions covering the variable ***policies***.

3.3 Student Survey

Under the students of the faculties of BS and EEMCS a survey was performed. In total 434 students, 267 from BS and 165 from EEMCS, filled in the student survey. The students were selected by approaching teachers giving large courses in the first quartile of the study year. When given permission, the surveys were handed out in hard-copy to the students at the beginning, the brake or the end of a class of a course.

The student survey , see Appendix III, is based on two existing instruments: the CEQ developed by the Centre for the Study of Higher Education (CSHE) and Assessment Research Centre (ARC) (McInnes, Griffin, James & Coates, 2001) which has been used extensively among Australian universities. Furthermore, a part of the student survey was based on a questionnaire that measures students' perceptions on the research activities of their teachers and their appreciation of the link between research and teaching within the KU Leuven, Belgium. This instrument was inspired by an instrument of Healey, Jordan, Pell and Short (2003, in Verburgh, Elen & Clays, 2007).

The student survey consists of four parts. The first part contains open-ended questions about demographic data. The second part consists of 5-point bipolar Likert-type scale questions from the CEQ. Students can choose from the scales;

++	fully agree
+	agree
0	neutral
-	disagree
--	totally disagree
NA	not applicable

The 5-point bipolar scale is perceived most suitable for the student survey as a 3-point bipolar scale does not. The remaining parts originate from the Verburgh ***et al.*** questionnaire. Part three consists of research activities students checked. The final part contains again 5-point bipolar Likert-type scale opinion questions about the integration of research in teaching and how students feel being involved in research influences the teaching. Since the questionnaire is based on two questionnaires that have been tested extensively, a pre-test is not assumed to be necessary. The variables cannot be clearly appointed to these parts: each part conveys some information about all variables.

3.4 Data Analysis

As has been discussed in the introduction this study is more descriptive in nature. Therefore and because of the limited number of respondents participating in the interviews and surveys, it was decided to describe a general TRN for both faculties as a whole. Because the nature of the fields of study at the Faculty of EEMCS can be argued to differ from the nature of the fields of study at the Faculty of BS it is expected to find a more inclusive picture when comparing the faculties as a whole than when comparing single study programmes.

The interviews were performed with 16 respondents. Because of the limited number of respondents and their differing positions within the faculties , reliable statistical analysis is not possible. From the responses on the bipolar 5 point scale the percentages of highest scores, scores 1 and 2 in the scale, were calculated for the undergraduate and graduate students and manually compared.

Because the survey was taken during the first quartile of the academic year not junior undergraduate students will be compared to senior undergraduate and graduate students were compared, but undergraduate to graduate students. To compare the groups of students for both faculties and between faculties, bar charts were made. The bar charts are based on cross tabulations that were made in SPSS. To correct for students that did not fill out the survey seriously, the cross tabulations were made on basis of student surveys that were filled out 30 or more items out of 47, exclusive the items on demographic data.

In case of yes or no questions, the bar charts show the percentage of students that filled out “yes”. To analyse the extent to which the evaluations of undergraduate students differ from graduate students for both faculties and EEMCS students from BS students, chi square tests were conducted for the different items. In case of the bipolar Likert-type questions, the bar charts in the chapters 4 and 5 show the percentage of students that fill out “agree” or “strongly agree”. To analyse the extent to which the evaluations of undergraduate students differ from graduate students Mann-Whitney ***U*** tests were conducted for the different items.

4 Faculty of Electrical Engineering, Mathematics and Computer Sciences

The Faculty of Electrical Engineering, Mathematics and Computer Sciences (EEMCS) consists of three departments: Electrical Engineering, Applied Mathematics, and Computer Sciences. In 2006 about 1,500 students were studying at the Faculty of EEMCS: 774 undergraduate (bachelor) students, 298 graduate (master) students, and 53 "pre-master" students[1] (University of Twente, 2007a).

As previously described, the Teaching – Research Nexus (TRN) at the Faculty of EEMCS will be discussed according to the theoretical framework mentioned in chapter 2. In section 4.1 the TRNes at the Faculty of EEMCS will be depicted and how students notice and value the research integrated within their study programmes. In section 4.2 the personal teaching characteristics of teachers will be discussed. Section 4.3 will address abilities of students. In section 4.4 the ideological values of the faculty and teachers will be discussed. Finally section 4.5 examines the management mechanisms to steer the TRNes at the Faculty of EEMCS.

4.1 The Teaching – Research Nexuses of the Faculty of EEMCS

A clear definition of what a TRN ***is*** or ***should be*** does not exist. Rather, the TRN can take on many shapes within scientific institutions providing education. This section attempts to provide a picture of the TRN at the Faculty of EEMCS. This picture will be drawn from information from qualitative interviews with teachers and from a survey among students from the Faculty of EEMCS.

Within the qualitative interviews teachers were asked to describe how they integrate research in their teaching and how they think students perceive the integration of research in teaching. Furthermore, the interest lay on the differences between graduate and undergraduate study programmes in respect of visibility of research conducted at the departments within teaching.

In the student survey, both undergraduate and graduate students from the Faculty of EEMCS were asked to indicate which type of research situations they experienced already. Also, the students were asked to evaluate different statements about certain type of work forms.

The TRN at the Faculty of EEMCS will be analysed according to the following items:

- practices of integrating research in teaching,
- organisational characteristics, and
- student perceptions about the integration of research in teaching.

4.1.1 The Integration of Research in Teaching

The way research is integrated in a curriculum can be shaped by theories which students learn by heart and type of skills they acquire. Research content and skills be transferred to students both by using different types of teaching methods.

[1] Pre-master students are students whom take a small selection of courses, usually ranging from four to six courses, in order to be accepted to the graduate programme.

The Integration of Research in Teaching within the Undergraduate Programmes

The global goal of the undergraduate study programmes of the Faculty of EEMCS is to prepare students for specialised graduate education or professional work. Within the document analysis, one statement about what qualifications are developed within the study programmes was found. The qualifications that students develop show that the faculty wants students to develop an academic attitude and research skills. Qualifications students possess at graduation are (EEMCS, Feb. 2006a, pp.5-6; EEMCS, Feb. 2006b, pp.5-6):

- elementary knowledge and insights, and the ability to critically assess and apply these knowledge and insights;
- the ability to put research conveyed and developments in the research areas in a social context;
- communicative, project and team skills; and
- possessing an explorative attitude.

Within the evaluations of the Quality Assurance Netherlands Universities (QANU) the integration of research in teaching takes place mainly via a "test" consisting of a design project and a "bachelorreferaat", or an undergraduate project at the end of the undergraduate phase. In the test students engage actively in research. The bachelorreferaat develops an academic attitude as students individually formulate a research question, perform research, and write a paper. These steps are accompanied by lectures on research methodology, e.g. how to perform research, how to search for the right literature, how to argument, and how to write a scientific paper. The QANU perceives the undergraduate project as the first time students come in contact with research (QANU, Dec. 2004a; QANU, Sept. 2007; EEMCS, Feb. 2006a; Feb. 2006b).

Within the interviews teachers were asked how research content is taught in the undergraduate study programmes. First of all, opposite of what the evaluations of the QANU suggest for the bachelorreferaat, teachers feel a methodological discussion is generally missing in the undergraduate phase (R1; R3; R4). One respondent is of the opinion that teaching methodology should be addressed more explicitly: not specifically as a separate course but as a general part of existing courses. Students should become more aware of methodological issues as they apply their knowledge in different contexts. One respondent points to more practical research skills: undergraduate students should learn "how to set up an experiment" (R1). Other respondents do not feel such a need, as they think, although methodology is not explicitly taught, methodological skills and competences are acquired throughout the different project courses in both undergraduate and graduate study programmes (R2; R3; R5).

> ***Er is niet echt sprake van aparte methodiek vakken. Het zit als het ware als een rode draad door alle programma's heen. … Al dat soort methodiekzaken komen in- of expliciet aan de orde in alle projecten door de bachelorprogramma's heen (R3).***

Second, some respondents perceive the undergraduate phase as a preparation phase for the graduate phase (R2; R4): within undergraduate courses mainly the general, established techniques of research are taught while in graduate courses research is actually performed (R2; R3). Nonetheless, within this preparation phase a broad range of courses in different research areas is offered to the students as courses are divided among chairs. This division of work gives each of the chairs the chance to present themselves and their research to the students (R2): the research done at the departments is perceived as a means to accentuate the content of the undergraduate study programmes (R3). According to one respondent teachers try to illustrate theory with examples from their research to show the relevance, to enliven the

mater. Theory is illustrated by teachers' research to explain why the theory taught is important.

> ***..je illustreert de theorie die je wenst over te brengen in je eigen vakken met je eigen onderzoek. Je geeft aan waarom bepaalde theorie belangrijk is, want soms is die gortdroog. … Maar door dan meteen aan te sluiten bij een voorbeeld waar je die theorie hebt nodig gehad in een lopend onderzoek, kan dat gaan leven (R5).***

The teaching methods, see Appendix IV for types of teaching methods, by which research skills are taught within the undergraduate study programmes are relatively traditional. Within the interviews the teachers were asked what teaching methods are applied to integrate research in teaching. Respondent 1 says teaching methods are relatively traditional within the undergraduate study programmes: students mainly visit lectures and tutorials, and take part in student laboratories,

> ***In de bachelor zitten meer practica, een enkel project, ook wel hoorcolleges, veel werkcolleges ook, bijna allemaal afgesloten met een klassiek tentamen (R1).***

The teachers believe that students "learn by doing" (R1; R2; R3; R4): the steps they undertake while working on their project are considered analogue to undertaking a research project, e.g. starting with a problem formulation, methodological discussion, etc. (R1; R4; R5). According to the teachers, methodological skills and knowledge are not taught separately (R1; R2; R3; R4).

> ***... dan is er leren door te doen. Waarom is er voor deze onderzoeksaanpak gekozen .. dat wordt in zekere zin overgeslagen .. Dat merk je vanzelf wel als je erin duikt, dan zal je zien dat dit de goede manier is om dat aan te pakken of dan loop je zelf tegen de discussie over de aanpak aan.***

The Integration of Research in Teaching within the Graduate Programmes

A similar picture can be drawn for the graduate programmes taught at the Faculty of EEMCS. Within the document analysis, goals and evaluations of the integration of research in teaching were revealed as well. The goals of the graduate study programmes build on the goals of the undergraduate study programmes as students are not only aware of research developments, acquire research skills and develop an academic attitude, but practice research as well. The goals and attainment targets of the graduate courses are (EEMCS, Feb. 2006c; EEMCS, Feb.2006d):

- acquire extensive knowledge and insight;
- develop an inquisitive and reflective attitude;
- understand and gain practical experience with methods and technologies;
- developing a constructively critical attitude;
- learn to work as part of a team;
- gain practical experience from working in complex, dynamic settings; and
- become encouraged to follow the trends in the field and incorporate them in the students' own personal development.

According to QANU (Dec. 2004a; Sept. 2007) a large number of parts of the study programmes teach about recent research developments. Especially within the graduate thesis a clear connection is established between teaching and research conducted at the faculty as students get integrated in departmental research projects as junior researchers.

Also from the statements of the teachers a similar picture can be depicted. Within the interviews the teachers were asked how research is integrated in teaching within the graduate study programmes. One respondent says that the role of research in teaching changes throughout a study programme: growing along the programme goals from transferring knowledge during the undergraduate phase to in depth understanding of research during the graduate phase (R5).

> ***… Dat de rol van het onderzoek in het onderwijs meegroeit met de doelstellingen die vakken hebben in het onderwijs. Die doelstellingen zijn in de lagere jaren nog meer het overbrengen van kennis en vaardigheden en in hogere jaren komen die langzaam op het gebied van begrip uit.***

The integration of research in teaching is strongest during the graduate phase. The respondents explain most academic staff feels that the content of the graduate study programmes is tightly connected to the research done by the chairs their field of research (R2; R3) as students get the opportunity to participate in departmental research via elective research projects (R1; R2; R4) and their graduate thesis. In the elective research projects graduate students get the opportunity to participate in current research projects at the departments in a so called research project course. In this research project course students can acquire methodological knowledge and skills as an active researcher (R2; R4). At the end of their thesis, students are stimulated to write scientific papers about the research they undertook, resulting in one or even more scientific publications under their authorship after graduating (R4).

How deep research is integrated in teaching depends on the students' preferences as students are not forced to take the elective research project courses and have the possibility to write their graduate thesis at an external company (R1).

> ***… ik denk dat het in de masteropleiding van student tot student verschillend is. … Alle studenten komen daar in ieder geval in het laatste half jaar van die twee jaar keihard in aanraking met onderzoek en realiseren zich dan dat daar een hele wereld is die ze hadden kunnen kennen (R1).***

Regarding explicit methodological training most teachers say that this was also missing in the graduate study programmes (R1; R2; R3; R4; R5).

The teaching methods applied in the graduate phase are not as traditional as in the undergraduate phase. Teaching methods applied are: assignments; lectures; books and literature; research project; writing research papers.

> ***Het master onderwijs is niet zo traditioneel: het wordt zelden afgesloten met een tentamen en er is zeker niet één docent die voor de klas staat. Iedereen krijgt een opdracht, werkt die uit, vertelt daar een verhaal over. Het vak wordt bijna altijd afgesloten met een individueel paper waar je een beoordeling voor krijgt (R1).***

Courses have relatively fixed teaching methods as teachers are not known to switch from one to another type of teaching method from one to the next academic year (R2).

Integration of research in teaching: Teaching research does not systematically integrate the teaching of methodology. The global goals of the undergraduate and graduate study programmes are confirmed by the statements of the teachers as they point out that the ability to apply and assess knowledge, to gain practical experiences and to work as a part of a team

are the main goals of their teaching. However, most of the academic staff indicates that the content of the programmes mainly aims at acquiring knowledge about theories and hardly at how to apply this knowledge in a methodological sense.

An interesting difference in goals between the undergraduate and graduate study programmes is that whereas undergraduate study programmes aim at understanding, gaining basic knowledge, and acquiring basic skills, graduate study programmes aim at gaining practical experience, working in complex and dynamic settings, and developing a critical attitude. This difference is reflected in the respondent's statements: the undergraduate courses teach the general established techniques, while within graduate courses the research actually conducted at the chairs of the departments is integrated.

Another difference between the undergraduate and the graduate phase is that undergraduate students are taking part in more traditional, school-like types of activities and less research types of activities than graduate students. From the teachers' description of the applied teaching methods one can conclude the more "practical" teaching activities are, the more close activities undertaken by students are to doing research. As students step forward in the curriculum by moving to the laboratories of research groups, they start performing more advanced forms of performing research.

4.1.2 Experiences, Visibility & Evaluation of the Teaching – Research Nexuses by Students

How is the presentation of research within teaching experienced and evaluated by the students? How do they appreciate the implicitness of research methodology? One may argue that this could negatively affect the retention of acquired research skills: students forget or are less capable of performing certain research tasks because the necessary research skills have not been taught as such.

In the following sections an analysis about how visible research is to students and how students experience research during their undergraduate and graduate phase will be made. The analysis is based on statements of respondents and the student survey.

Undergraduate Students Experiences of Research

Within the survey the students were asked to indicate in what ways they experience research to be integrated in the teaching they receive. Students had to check research situations they have already experienced during their training, see Appendix III. As one can see from Figure 4, the results show less than 10 per cent of the undergraduate students have experienced situations in which they;

- contributed to scientific advice,
- contributed to a scientific paper or other output,
- contributed to a paper or a poster for a conference,
- engaged in the preparation of a research project,
- had been a student assistant, or
- presented a research project in a seminar.

10 to 40 per cent of the undergraduate students experienced situations in which they;

- attended a research seminar outside classes,
- developed research competences,
- discussed scientific work of their professor or his assistant,
- discussed scientific work of a guest speaker,

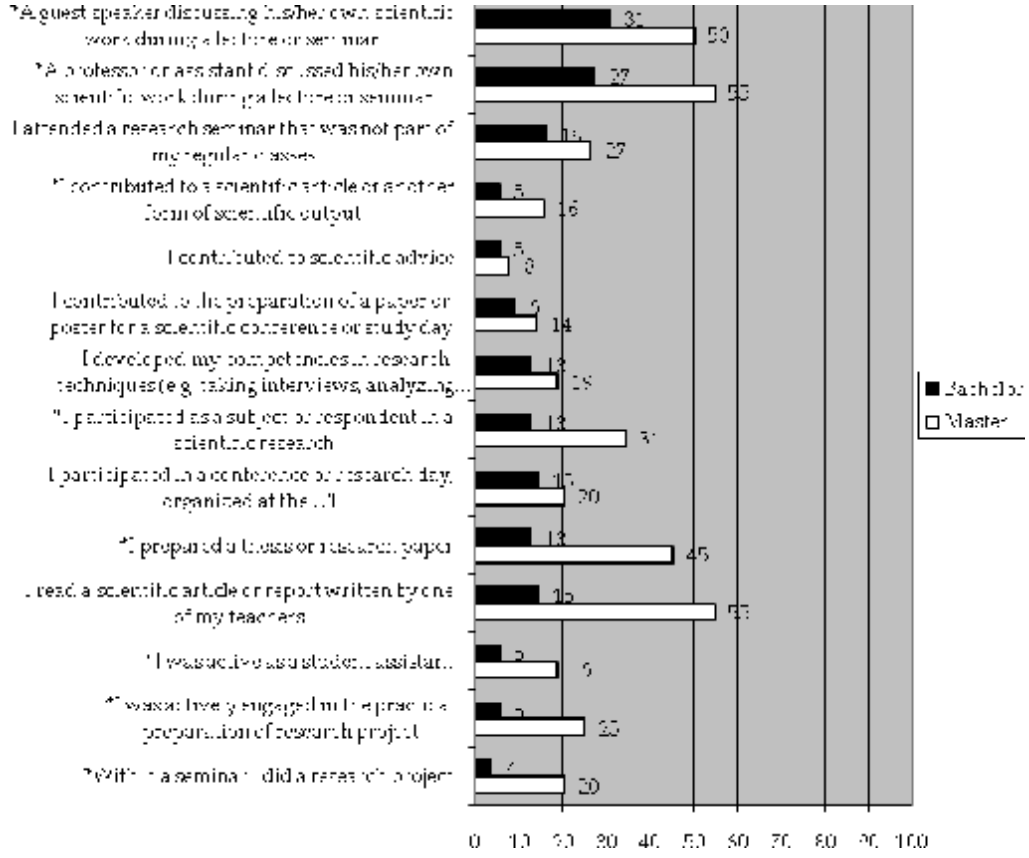
- prepared a thesis or a research paper,
- participated in an experiment as a subject or teacher,
- participated in a conference or a research day at the University of Twente, or
- read a scientific article or a report of their teacher.

The fact that undergraduate students experience only few research situations mirrors the fact that classic teaching methods prevail during the undergraduate phase. There is not a single research situation that more than 40 per cent of the undergraduate students experienced.

Graduate Students' Experiences of Research

The picture is very different for the graduate students. As the foregoing section already showed research plays a much bigger role in the graduate study programmes than in the undergraduate study programmes. Only one item where less than 10 per cent of the graduate students indicated that they experienced this situation was found: a contribution to scientific advice.

Figure 4. Experienced Research Situations by Students Faculty EEMCS, in %, answer categories "yes".



Question: Which of the following situations have you experienced already?
*$p < 0.10$

10 to 40 per cent of the undergraduate students experienced situations in which they;

- attended a research seminar outside classes,
- contributed to a scientific paper or other output,
- contributed to a paper or a poster for a conference,
- developed research competences,

- engaged in the preparation of a research project,
- have been a student assistant,
- presented a research project in a seminar,
- participated as a subject in an experiment, or
- participated in a conference or a research day at the University of Twente.

40 to 60 per cent of the undergraduate students experienced research situations in which they;

- discussed scientific work of a guest speaker,
- discussed scientific work of their professor or his assistant,
- prepared a thesis or research paper, or
- read a scientific article or report of their teacher.

The conclusion that graduate students actually conduct research during their graduate phase is reflected in the fact that graduate students, compared to the undergraduate students, more often indicated to have participated in a research situation. For the following research situations there is a substantial difference;

- discussing scientific work of guest speaker,
- discussing scientific work of professor or his assistant,
- contributing to scientific articles,
- participating in research as a subject or respondent,
- engage in preparation research project,
- preparing a thesis or research paper,
- being active in research as a student assistant, or
- presenting research project in seminar.

These experienced research situations fit to the teaching methods mentioned by the teachers: discussing scientific work can take place during lectures, and participating in research projects.

For the Faculty of EEMCS graduate students are more integrated in research than undergraduate students as they on average experience more research situations during their study programme. Students of the Faculty of EEMCS experienced on average 2.89 out of the 14 given research situations (21%). Undergraduate students experienced on average 1.71 (12%) research situations, whereas graduate students experienced 3.91 (28%). There are no research situations that are generally present in teaching in both the undergraduate as the graduate study programmes.

Teacher's Evaluations of Visibility of Research within Teaching

Teachers feel research is more visible to graduate students than to undergraduate students. Within the interviews the teachers were asked to what extent research which is presented and skills which are developed during courses are visible to the students. Two respondents doubt that it is visible for the students that research is integrated in teaching (R1; R4). Respondent 4 says teachers have discussions about what approach to take to a certain problem, but students are not aware of the fact they are handling methodological issues:

> ***Kijk, als je aan een onderzoeksproject begint heb je een probleemstelling, een vraagstelling. En in het begin moet dan altijd worden vastgesteld hoe je te werk kunt gaan om die vragen op te lossen. Nou, daar komen dan natuurlijk ook methodologisch discussies aan te pas. …of de studenten zich daar altijd zo scherp van bewust zijn, dat ze in wezen bezig zijn met een methodologische verkenning….dat weet ik niet.***

Nonetheless, some respondents think that research is more visible for graduate students than for undergraduate students (R1; R4). The first time undergraduate students come in contact with research is during their undergraduate project. Before the undergraduate project students are told teachers are performing research, but students do not feel or see it (R1).

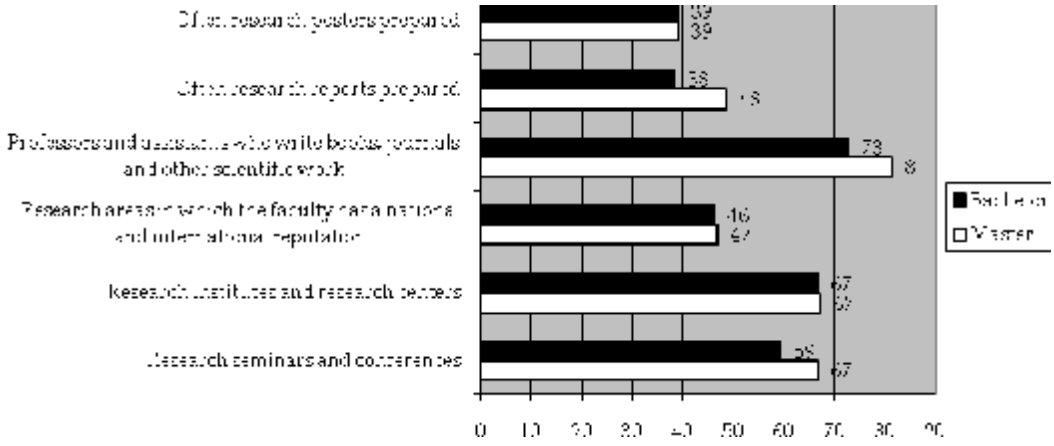
> ***..ik denk dat bachelorstudenten tot ze aan hun bacheloropdracht toekomen het onderzoek nauwelijks ervaren. … het wordt wel tegen ze gezegd, maar ze voelen het niet. Ze zien ook niet waar die onderzoekers mee bezig zijn (R1).***

Although teachers indicate they do not know to what extent (their) research is visible for students, they feel students that appreciate the integration of research in teaching (R1; R2; R3; R4; R5). According to one teacher students appreciate the chance they are given to write scientific papers and the teachers' contribution to scientific conferences organised by student associations especially (R4).

Student's Evaluations of Visibility of Research within Teaching

Within the student survey students were asked to indicate to what extent they are aware of the ongoing research activities at their faculty, and more specifically of their teachers. Figures 5 and 6 show that both undergraduate and graduate students are highly aware of both ongoing research activities at their faculty and research activities undertaken by their teachers. Graduate students generally seem slightly more aware than undergraduate students of ongoing research activities, but the differences are not significant.

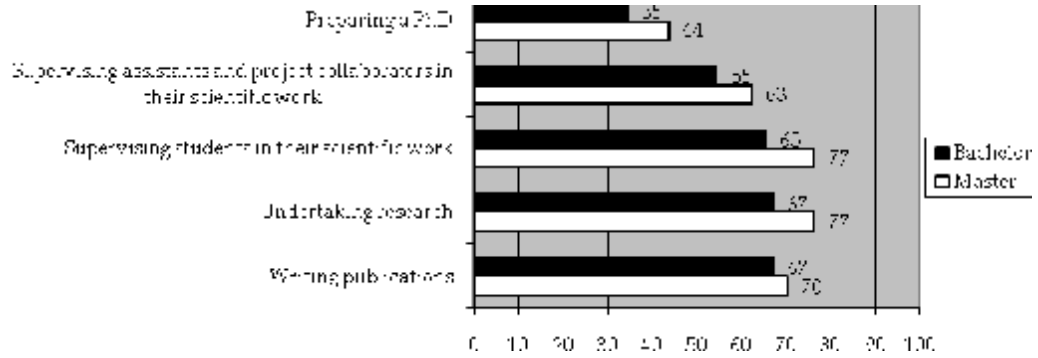
Figure 5. Student's Awareness of Research Activities at the Faculty of EEMCS, in %, answer category "yes".



Statement: I know that within the faculty of my study programme there are…..

The TRN is working well at the Faculty of EEMCS as research undertaken by their teachers and research undertaken at the Faculty of EEMCS in general is as visible to undergraduate as to graduate students. Students are on average aware of 3.41 out of the 6 (57%) indicated research activities that are undertaken at their faculty. Undergraduate students are on average aware of 3.27 (55%) of the indicated research activities undertaken at their faculty, whereas graduate students are on average aware of 5.53 (59%) of the indicated research activities undertaken at their faculty. Most visible to students is the fact professors and their assistants are writing books, journals and other scientific work. Least visible is the fact that research posters are prepared.

Figure 6. Awareness of Research Activities of Teachers, in %, answer category "yes".

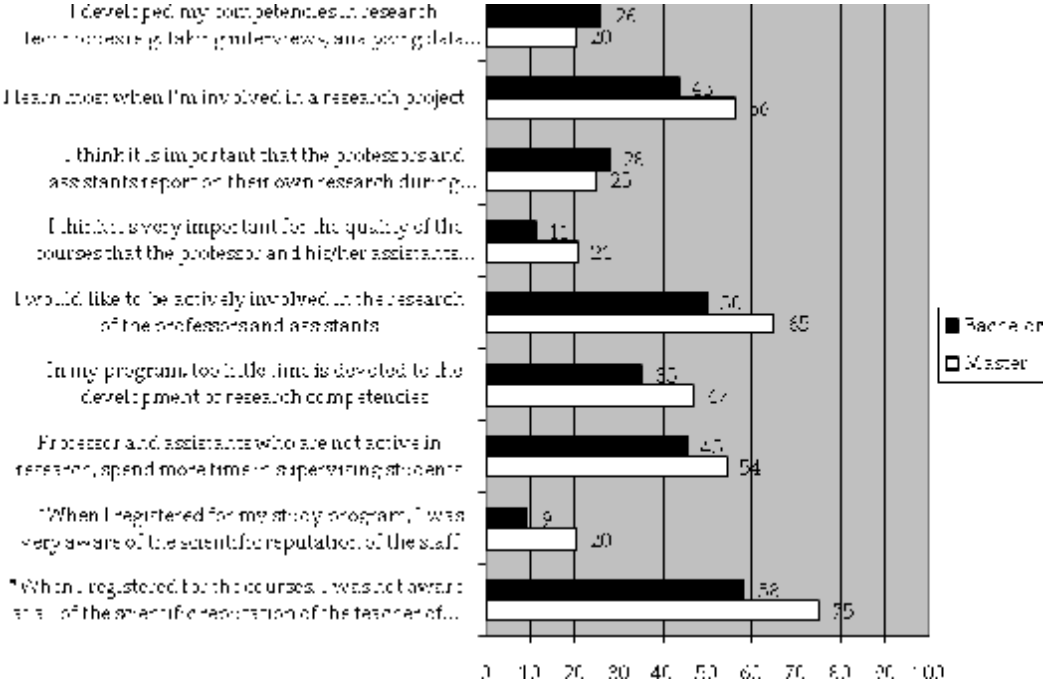


Statement: I know the teachers of my programme are…..

Student Evaluations of the Teaching Research Nexus at the Faculty of EEMCS

The student survey also contained statements about the integration of research in teaching (see Figure 7).

Figure 7. Student's Evaluations of the TRN, in %, answer categories ++ and +**.



*$p < 0.10$

** on a 5 point scale from ++ "fully agree" to -- "totally disagree".

From the results of the student survey it becomes clear the research performed at the different departments of the faculty EEMCS is visible to both undergraduate and graduate students. It appears these same students do not see a TRN in their study programme as they see research and teaching as two separate worlds.

However, they would appreciate it if they could see the TRN. Students appreciate the integration of research in teaching in that they not only want to be involved in research but also feel they can learn from it. Both undergraduate and graduate students do not see the TRN in that they were hardly aware of the research reputation of their department and their teachers. Furthermore, both undergraduate and graduate students feel their research competences are hardly being developed and more time should be devoted to this development.

Undergraduate and graduate students perceive research and teaching as being two worlds in that they indicate that being involved in research distracts from teaching. First of all, students indicate professors who are not involved in research spend more time in supervising students. Furthermore, they do not think it is very important that professors report on their own research during classes. Most surprisingly they do not think at all that research involvement of professors improves the quality of courses.

Generally, the part of the graduate students that evaluate the statements positively is larger than the part of the undergraduate students.. But the difference is only minor as undergraduate and graduate students only significantly differ in their awareness of the research reputation of their department and teachers when subscribing for their study programme or courses.

4.1.3 The Teaching – Research Nexuses at the Faculty of EEMCS

Within this section, an answer to the first research question "How is research integrated in teaching?" will be given. The TRN will be described according to the components of the theoretical model developed in section 2.2.4: materials and resources, teaching methods, roles of teacher, types of grouping, locations, and contents.

From these finding two separate TRNes can be distilled: one for the undergraduate phase and one for the graduate. During the undergraduate phase students take part in more school-like types of activities. Materials and resources like beamers, overhead projectors, chalk boards and whiteboards can be applied to present research, for example how formulas evolve. Further computer and student laboratories can be applied to practice certain research skills. The undergraduate study programmes aim at understanding, gaining basic knowledge, and acquiring basic skills. Research is used more as a means of illustration of general theories that are taught. Undergraduate students do not experience many research situations during their study programme. The general established techniques of doing research are taught, but underlying methodology is not made explicit.

During the graduate phase the applied teaching methods are more practical teaching activities that approach doing real research. Graduate students move to the laboratories of research groups and become integrated in the departments' research. Similar to the undergraduate phase materials and resources like beamers, overhead projectors, chalk boards and whiteboards can be applied to present research, for example how formulas evolve, and computer and student laboratories can be applied to practice certain research skills. By being integrated in departmental research graduate students gain practical experience, learn to work in complex and dynamic settings, and develop a critical attitude. During the graduate phase the research conducted in the field of study, and the departments of the faculty, becomes the topic itself. However, also in the graduate phase the underlying methodology of research is not made explicit.

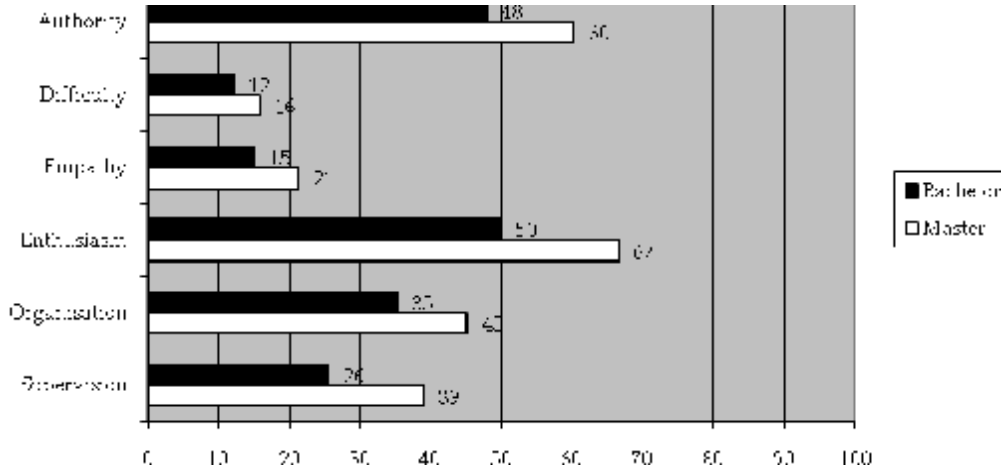
Generally one can conclude research is integrated more deeply in teaching for the graduate phase as certain types of teaching methods that are more often applied during the graduate phase establish a deeper integration of research in teaching.

From the evaluation of the integration of research in teaching it becomes clear the TRN is not very visible to undergraduate and graduate students and therefore they do not evaluate it very positively. Students would better appreciate the TRN if they could see it.

4.2 Personal Teaching Characteristics

Teachers can be perceived to be the central actors in conveying the TRN to the students. In this respect the performance of teachers and its effects on the TRN are of great importance. This section will take a closer look at how the teachers of the Faculty of EEMCS actually teach in different respects. A set of indicators measuring different aspects of their teaching competences will be used to evaluate their performance.

Figure 8. Student Evaluation Personal Teaching Characteristics, in %, answer categories ++ and +*.



* on a 5 point scale from ++ "fully agree" to -- "totally disagree".

Table 3
Statements Given about Personal Teaching Characteristics in the Student Survey.

Mode of Teaching	***Statements***
	Due to the involvement of my teachers in research…..
Organisation	I understand the subject better.
Enthusiasm	I am more interested in the domain of my study.
	I am more motivated to do my best.
	I am more enthusiastic about the course.
Supervision	I am better supervised (e.g. during writing thesis, project work).
Empathy	I am shown more empathy towards me as a student.
Authority	I give more credibility/authority towards them.
Difficulty	The workload and difficulty of the course is more balanced.

The interviewed respondents were asked to indicate how they feel being involved in research influences their personal teaching characteristics, and how they feel that their teaching competences were influenced by being involved in research. Within the student survey the

students were asked to evaluate the same set of performance indicators via statements, again on a bipolar 5-point scale. Figure 8 shows the results of the student survey.

The personal teaching characteristics at the Faculty of BS that will be analysed are shown in the first column in the table below. The second column shows the statements from the student survey that were given to the students.

4.2.1 Organisation

The variable organisation shows how well structured the teaching is: if the message send by the teacher is received and understood. Within the interviews teachers were asked to explain how their research activities influence the organisation of their teaching.

Research involvement of teachers has both positive and negative influences on the organisation of their teaching: positive in that the most important theories are presented in a clear way, and negative in that it takes away time for teaching. One respondent is of the opinion that research involvement positively influences the organisation of teaching in that teachers are better able to decide which theories are of importance, and to present theories more clearly (R3). According to another respondent the involvement in research can have negative influences on the organisation of teaching as it diminishes the time available for. Sometimes deadlines are pressing; also teachers may be more attracted by a certain research problem. In the end teachers tend to invest more time in and neglect teaching;

> ***Als een onderzoeker werkelijk gegrepen is door het probleem waarmee hij bezig is….is dat niet bevorderlijk voor de organisatie van je vak, want dat stel je allemaal uit …. Maar iets goed organiseren, daar heb je dan geen tijd voor. In die zin kan onderzoek nog wel eens slecht uitwerken op onderwijs (R1).***

Personal characteristics of a teacher can be of influence on the organisation of teaching as well. For example, if a teacher is able to present theories in a well structured way. Nonetheless one respondent claimed that teachers who are not that structured still can be good teachers:

> ***Je praat natuurlijk over universitaire docenten die in het algeheel op het hoogste niveau zijn opgeleid. Dus dat zijn de mensen die goed zijn in één of andere variant van analytische scherpte. En daar zullen ook chaoten tussenlopen, maar die kunnen tegelijkertijd nog steeds het vak goed doen…… Mensen zijn niet per definitie ongeschikt, omdat ze een soort bevlogenheid hebben (R4).***

Within the student survey students were asked to rate their agreement with the statement "Due to the involvement of my teacher in research I understand the subject better". The line of thought of this statement was that due to the research involvement teaching is better organised, resulting in better transfer of knowledge to students. Respectively 35% of the undergraduate and 45% of the graduate students agree that research involvement has a positive influence on organisation, see Figure 8.

Organisation: Research involvement does not influences the organisation of teaching in a clear direction. Research involvement has a direct, positive influence on the organisation of teaching in that teachers are able to teach theories more clearly. On the other hand, research involvement has a negative side effect as research involvement burns time resources for teaching and therefore affect the organisation of teaching negatively.

4.2.2 Enthusiasm

Another mode of teaching is the teacher's ability to enthuse students. During the interviews a common comment from teachers was that doing research gives the possibility to enliven the topic taught (R2; R3; R4; R5). The enthusiasm created by doing research and the things a teacher encounters and undertakes are rubbed off on the students during lectures (R3).

> ***Het enthousiasme dat je opdoet in het onderzoek en de dingen die je daar tegenkomt, gedaan hebt en kan laten zien, die neem je mee in de collegezaal.***

Especially the insight in the practical relevance of research gives the chance to enthuse students about the topic. One respondent indicated that presentations (for example of former students) can show this relevance very clearly to the students and motivate them to a very high extent.

Students' opinions about this outflow of being involved in research confirm this finding. Of the undergraduate students 50 per cent responded positively to the statements given in the student survey and of the graduate students 67 per cent, see Table 3 and Figure 8. Thus students think being involved in research is of influence on teachers' ability to enthuse students.

Enthusiasm: One can conclude that research involvement has a positive influence on teachers' ability to enthuse students in that they are able to show the relevance of research to students and enliven the topic they are teaching with their research experience. Both teachers and students indicated a positive influence of research involvement for teaching. More graduate students than undergraduate students are positive about this aspect.

4.2.3 Empathy

The ability of the teacher to show empathy or be responsive towards students is another important mode of teaching. During the interview the teachers were asked their opinion about the influence of research involvement on teachers' ability to show empathy and responsiveness towards students.

One respondent mentioned that the ability of teachers to make a realistic estimation about the ability of students is very important in this respect. While most teachers tap from their own experience of having been a student once, some teachers have distanced themselves from that time so far that it has become difficult for them to make this realistic estimation of the students' abilities. Therefore respondent 1 thinks that it is important to make sure first year courses are taught by teachers who still can and want to relate to the needs of the students:

> ***Ik denk dat de meeste hun eigen ontdekkingstocht van "ik ben hier begonnen en ik ben daar geëindigd en het was fantastisch" dat ze die in hun hoofd hebben. Of ze 'm nog hebben goed inschatten dat is weer wat anders. Ze waren waarschijnlijk gemiddeld wat meer getalenteerd dan diegenen aan wie ze het moeten uitleggen (R1).***

From the undergraduate students only 15% and from the graduate students only 20% responded positively to the statement given about empathy, see Table 3 and Figure 8. This low agreement can possibly be explained by the fact students indicated before that they feel research involvement eats away time from teaching in terms of supervising, see section 4.1.4. It can be argued students feel teachers do not have the time to show empathy towards them due to being involved in research as well.

Empathy: Research involvement does not influence the ability of teachers to show empathy towards students. Teachers tap their experience of having been a student themselves. However, the longer ago they were a student, the more difficult it gets to relate to students. Furthermore, most teachers pointed out that the empathy and responsiveness is depends on other determinants than research involvement.

4.2.4 Authority

As a mode of teaching authority is the extent to which a student gives credibility to a teacher. According to one respondent authority is the dot on the ”i” which makes good teaching competences mostly effective:

> ***Er moet bij de studenten een basisgevoel zijn dat er iemand voor de klas staat die betrouwbaar is, die gezag heft, die weet waarover hij het heeft. … als je de autoriteit niet hebt, kun je nog zoveel vaardigheden ontwikkelen maar kom je niet heel ver (R1).***

Another teacher points out that students notice immediately if a teacher has a rich experience of doing research (R3). Some respondents said that they gain credibility if they show that the matter taught is already applied research or originates from their own research (R4; R5).

The view of the teachers is reflected in the student survey as a bigger part of the undergraduate and graduate students feel that research involvement has a positive influence on teachers' authority towards students, graduate students being strikingly more often positive than undergraduate students. From the undergraduate students 48% responded positively to the statement given and of the graduate students 60 per cent, see Figure 8 and Table 3.

Authority: From these findings one can conclude research involvement gives teachers more authority. Teachers who are involved in research gain in credibility because they show the matter taught is already applied research or originates from their own research.

4.2.5 Supervision

Another mode of teaching characteristic is supervision. Supervision can range from supervising groups of students during assignments to supervising and mentoring students during their graduate thesis. One respondent said he feels his ability to supervise in general is not significantly influenced by being involved in research (R2). On the other hand, another respondent says that for many teachers the supervision of undergraduate or graduate thesis very much benefits from their research experiences (R5).

Also, few undergraduate students indicate they are better supervised due to them being involved in research. From the undergraduate students 26 per cent responded positively to the statement given and from the graduate students 39 per cent, see Figure 8 and Table 3.

Supervision: One can conclude there is no direct influence from being involved in research on the ability of teachers to supervise. However, teachers tap their experience of doing research themselves in supervising students during their graduate thesis.

The fact supervision is a mode of teaching that integrates teaching in research is reflected in the teaching methods to which supervision can be connected. Supervision can be connected

to teaching methods like research projects and graduate thesis. In section 4.1 these teaching methods have been pointed out to integrate research in teaching to a large extent.

The relatively low agreement of students with the statement research involvement improves teachers' ability to supervise can be explained by the finding students feel supervisors have less time to supervise when involved in research as shown in section 4.1.

4.2.6 Difficulty

The final mode of teaching to discuss is the difficulty of content taught. Teachers should be able to tune the difficulty of the content they teach to the presumed ability of students. During the interviews one respondent indicated that some teachers are facing problems in balancing what they want students to learn and what students are able to learn (R4). According to respondent 1 the longer ago a teacher was a student and the more a teacher has advanced in doing research, the more difficult it becomes for teachers to relate to students in terms of difficulty. However, on respondent shows that with a gain in experience throughout the years, teachers become more able to tune their demands and expectations to the abilities of students:

> ***In het eerste jaar gaf ik veel te moeilijk les. Dan stapte ik over heel veel stappen heen die de student nog moet maken, die jij dan als onderzoeker al een keer gemaakt hebt. Na 4 jaar heb ik het idee dat ik het wel op het niveau kan uitleggen dat aansluit bij het niveau van de studenten (R2).***

Students are also critical about this issue: Only a small part of the surveyed students stated that research involvement has a positive influence on teachers' ability to balance workload and difficulty. From the undergraduate students 12% responded positively to the statement given, from the graduate students 16%, see Figure 8.

Difficulty: Teachers' ability to balance workload and difficulty is not influenced by being involved in research by their teaching experience and the extent to which they are able to relate to their experience of having been a student themselves.

Analysing the statements one can distinguish some similarities to teachers' ability to empathise with students: for both teachers ability to tune difficulty and empathise with students they tap their experience of having been student themselves ones. Furthermore, students are critical about both abilities. Thus, one can argue the ability to tune the difficulty of content to teach to students' ability is part of teachers' ability to empathise with students.

4.2.7 Influence of Teaching on Research Performance

Aside from the influence of research involvement on personal teaching characteristics, the teachers were also asked what influence teaching has on their research. According to one respondent research and teaching are constantly influencing each other and therefore the behaviour of the researcher: Abilities one needs to teach are to some extent similar to the abilities one needs to conduct research. In a sense by developing research abilities one develops one's teaching abilities and the other way around (R4);

> ***…onderzoekers zijn in principe reflecterende en analyserende mensen. Dus die zullen met het materiaal, met het soort proces waarin ze verkeren als ze onderwijs geven hun zintuigen scherpen die ze ook scherpen bij het onderzoek. Dus daar is altijd beïnvloeding.***

Another respondent claims a positive influence from teaching on research: As the development of courses, particularly new courses, forces teachers to explore new theory; teachers also develop themselves (R5). Another respondent sees positive effects of teaching on the writing competences of researchers: as they formulate theory in a clear way to students they also learn how to write clear research papers (R2). Teaching helps researchers to understand their work much better. According to one respondent presenting theory in a clear way also helps teachers to clarify to themselves what they are actually researching (R3).

Finally, one respondent perceives that discussions with students influence their research as discussions trigger new ideas for research. According to one respondent in some rare cases discussions with "good" students could determine research, but do not necessarily lead to (ideas for) research papers (R2). Another respondent has the experience that ideas of students lead to small research projects, but did not change research itself (R4).

Influence: Thus teaching influences research as well. Especially the need to present scientific information in a very clear way clarifies and enriches their research. Also, discussions with students determine the course of research slightly, because new ideas or small scale research projects develop from these discussions. However these influences on research are perceived very small.

4.2.8 Evaluation of the Personal Teaching Characteristics

Within the interviews the respondents were asked to evaluate the extent to which they possess the in the previous paragraphs discussed personal teaching characteristics: organisation, enthusiasm, empathy, authority, supervision, and difficulty. In general, the respondents were quite satisfied about their competences. All respondents were most satisfied with their ability to enthuse students. All respondents were less satisfied with their ability to balance difficulty and workload.

Furthermore, respondents were asked to indicate which teaching modes were affected by being involved in research. The teachers pointed to two personal teaching characteristics: the enthusiasm (R2; R3; R4; R5) and authority (R3; R4; R5).

Evaluation: Teachers possess all the personal teaching characteristics pointed out by the theory, but only teachers' ability to enthuse and authority are positively influenced by being involved in research.

4.2.9 Influence of the Personal Teaching Characteristics on the Teaching – Research Nexus of the Faculty of EEMCS

One can argue research involvement has a positive influence on the integration of research in teaching as teachers who are involved in research are better at enthusing students and have more authority. The TRN is strengthened by teachers' ability to enthuse in that students taught by teachers whom are involved in research have a higher interest in research. Moreover, one can argue students internalise the matter taught to a larger extent when students give more credibility to teachers who are involved in research as to teachers who are not. Organisation can be argued to improve the integration of research in teaching in that teachers who are involved in research present research content more clearly. However, time consuming research minimises this effect in that little time is left to come to a clear organisation of teaching. Supervision can be argued to integrate research in teaching as it enhances the effectiveness of teaching methods like the undergraduate project and the graduate thesis.

Research involvement does not have a positive influence on teachers' ability to organise their teaching, to supervise students, and to balance workload and difficulty. The two personal teaching characteristics difficulty and empathy overlap as the ability to tune in the abilities of students can be considered as a form of showing empathy. Finally, a small, positive, reversed influence from teaching on teachers' research as discussions with and research output from students can alter the direction of the teacher's research.

4.3 Abilities of Students

As presented in the theoretical model, other factors influencing the TRN are the characteristics of students. The manner the TRN is conveyed has to be tailored to the characteristics of students in order for the message to be understood by students. In the TRN literature, abilities of students have been pointed out to be of influence.

The Faculty of EEMCS acknowledges the abilities of students are changing and action has to be taken to encounter the changing abilities. Within the document analysis one explicit statement concerning the abilities of students was revealed: the faculty perceives it as a structural problem that, nowadays, students possess mathematical skills and conceptual thinking on a low level, and students put too little effort in their study. As a result undergraduate study programmes are revised (EEMCS, Jul. 2006, p.17).

Within the interviews the teachers were asked to evaluate the abilities of students: how they changed over the last ten years, and if or how they change their way of teaching, particular the integration of their research in their teaching. The teachers distinguished both negative and positive changes in the abilities of students, but differed on the extent to which these changes are of influence on the TRN.

On the one hand, teachers shared the concerns of the faculty as they too perceive that the abilities of students are changing in a negative direction. Respondent 3 feels the conceptual level of thinking is underdeveloped. According to respondent 4, students are less able to analyse problems in theoretical sense than ten years ago.

> ***…ik heb in 10 jaar tijd gezien dat de vaardigheid van de studenten om met zo'n analytische vraag, want het is een analytische vraag, om te gaan. Dat enorm veranderd is…. Dus er zijn analytische vaardigheden verloren gegaan ….(R4)***

Also, two respondents say the possession of a "tool box", such as simple mathematics skills, is not valued any more by the secondary education (R2; R3). Another respondent thinks this missing tool box can be perceived as hindering, resulting in a more superficial discourse of scientific research:

> ***Als je wil ontdekken wat een hamer en een spijker is voordat je überhaupt iets kan gaan timmeren, dan kom je aan dat timmeren niet meer toe (R1).***

Teachers respond to this lack of skills in two ways: they either fix the lacking skills leaving less time for higher level skills, or they just omit the higher level skills from their teaching. Respondents 2 and 5 feel that teachers are forced to focus more on the basics, leaving less space and time for teaching higher level theories and skills: additional courses are taught to "fix" this lack of skills (R2; R4; R5). According to respondent 1 certain parts of the material are skipped because they are considered too difficult for these students.

However, according to respondent 3, one has to look not only for answers to lacking basic skills at the university, as the Faculty of EEMCS suggested, but also at the level of secondary education. Finding an answer will be difficult seen the fact abilities of students can change of short periods of time.

On the other hand, the abilities of students have changed in a positive way as well (R1; R3; R4; R5). Students have become more practical, communicative and better able to see the connection between the matter taught in the different courses. Respondent 4 perceives that they are very capable in practical sense (R4). More specifically, verbal communication (R1; R5) and reporting skills (R5) are perceived to have improved over the last 5 to 15 years. Furthermore, respondent 3 perceives students more able in seeing connections in the matter taught between the different courses. Another respondent explains these improved abilities of students make it easier to find a student assistant for a research project: for example students are better equipped to analyse a research proposal;

> ***Het is wel zo dat ik met meer gemak bijvoorbeeld een student-assistent kan vinden voor een onderzoeksklus. Ze zijn er handiger in en bedrevener om een projectvoorstel te doorgronden en een plan te maken om het onderzoeksvoorstel aan te pakken (R5).***

Abilities: One can conclude that the abilities of students are changing, both in a positive and a negative direction. Analytical abilities and conceptual level abilities have deteriorated as a result of lacking basic skills, which is "fixed" either by new courses or changes in content of existing courses. On the other hand practical, communicative abilities and the ability to see connections in the matter taught have improved.

To give a preliminary answer to the research question "How do student characteristics influence the TRN?" is that depth of integration of research in teaching might be affected by the students' analytical and conceptual level abilities. Due to lacking basic skills teachers are forced to allocate more time and energy to teaching these basic skills. As a result teachers have less time to teach higher level abilities, which one can argue to be necessary for students to understand and acquire research abilities. However, students have shown to be better able to see connections in the matter taught and to be more communicative. Thus the time consumed by teaching basic skills may be limited.

4.4 Ideological Values Steering the Teaching Research Nexuses

Within the theoretical framework, in line with Taylor (2007), ideological factors were presented as factors that influence the management of the TRN within the theoretical framework. According to Taylor (2007) ideological factors are "those forces that impact upon the relationship between teaching and research drawn from an underpinning body of ideas, beliefs and philosophy". The ideological factors include the mission statement of the faculty, and the beliefs and values the faculty and its staff hold.

Within the Faculty of EEMCS teaching and research are related to each other as teaching produces high quality researchers that secure the research quality in the long term, putting teaching in service of research. Therefore the goals of teaching are adjusted to the goals of the research programme. Within the document analysis two explicit statements concerning the mission statement, and beliefs and values were revealed: First, the Faculty of EEMCS aims at scientific education and pioneering, multidisciplinary research in the disciplines Electrical Engineering, Applied Mathematics and Computer Sciences. In the view of the faculty,

scientific education is necessary to be able to guarantee pioneering research in the long term. Second, the Faculty of EEMCS strives both for excellence in teaching and research. According to the Faculty of EEMCS, pioneering research can only be guaranteed if academic education is of the highest level in its area. Therefore "agendas for future research are translated in agendas for education" (EEMCS, Jul. 2006, p.5).

Within the interviews the teachers were asked what they know about existing (explicit) statements of the faculty on the importance of a TRN and the beliefs and values the teachers hold. The teachers did not know of the existence of any explicit statements on the TRN of the Faculty of EEMCS. With respect to the beliefs and values teachers hold about the TRN, the respondents declared their heart lies either in education (R1; R3; R5) or the combination of research and teaching (R2; R4).

First, teachers hold the ideology that teaching is, next to research, one of the primary tasks of a university. According to two respondents, universities are institutions that teach individuals to become scientific researchers (R4; R5): this means students should be able to analyse problems in a sound methodologically way on an academic level (R4).

> ***….de gedachtegang is denk ik altijd geweest: als je mensen leert om zo'n analytisch traject te doorlopen, dat ze daarna de vaardigheden hebben van iemand die je een academisch niveau toeschrijft. Iemand die een probleem methodologisch verantwoord kan analyseren.***

A second ideology teachers hold follows from the first ideology and underlines the ideology of the Faculty of EEMCS: teachers feel teaching has to produce qualified researchers that are able to secure the future research of the faculty. Respondent 1 says teaching secures the future research of the faculty as it delivers new researchers that are able to continue the research conducted at the departments.

However, these ideologies are not established by aligning the goals of research and teaching, as the Faculty of EEMCS indicated. The establishment of ideologies is hardly steered and partly left over to the students. According to one respondent the establishment of these ideologies is considered an automatism as teachers who are involved in research are put to teach (R1). Some respondents say they feel it should be like this (R2; R4). Respondent 2 feels a deeper integration of research in teachings puts too high demands on students, forcing them to go too deep into the theory. It should be up to the student: if students want to dig into the theory, they still have possibilities to get involved with departmental research projects.

Mission Statement, Beliefs & Values: The ideology at the Faculty of EEMCS is that one of the primary tasks of a university is to teach students to become scientific researchers that are able to secure the future research of the faculty. However, the integration of and the extent to which students are integrated in research is only steered by the fact teachers are involved in research.

In terms of Taylor (2007) one can argue the ideology is rather passive and mostly in the minds of the people: they are not shared and acted upon very much. The ideologies impact the TRN in that the positive views provide support for a TRN.

4.5 Management Mechanisms Steering the Teaching – Research Nexus

The TRN can be managed actively or passively by different management mechanisms. Within the theoretical framework the following passive management mechanisms were presented;

- curriculum development,
- appraisal, and
- quality assurance.

The presented active passive management were;

- curriculum development,
- strategic and operational planning,
- resource allocation, and
- staff development.

University and faculty documents have been analysed to find out what management mechanisms are applied. Moreover, within interviews teachers were asked what management mechanisms they are aware of.

4.5.1 Curriculum Development

The first tool at hands for managing the TRN is curriculum development. A curriculum can be defined as "an interrelated set of plans and experiences that a student undertakes under the guidance of a school" (Marsh & Willis, 2003, p.13). According to Marsh and Willis (p.68) the word development "suggests an unhurried, comprehensive, cyclical, and ongoing process in which careful thought and worthwhile actions constantly refine each other". The TRN can be managed by curriculum development in that it makes sure that research is integrated in teaching via the practices discussed in section 4.1: materials and resources, contents of the study programme, and teaching methods.

Within the Faculty of EEMCS curriculum development is not applied in the sense that a TRN is actively established. Within the document analysis one statement was found only concerning curriculum development: the Faculty of EEMCS (Jul.2006, p.12) issues the wish all chairs cover a field of study that is integrated in the undergraduate study programmes.

Within the interviews teachers were asked how curriculum development is applied to establish a TRN. According to respondent 11 the Faculty of EEMCS is exploiting research strengths in the development of teaching programmes. The scientific director of the research institute and dean of the faculty look at possible graduate study programmes that fit to the research areas in which the Faculty of EEMCS performs high quality research. For example a graduate track has been developed in the area of Human Media Interaction, a strategic research orientation (SRO) of the research institute.

In case a research area is not covered by a course within a study programme, courses can be erected via two ways: chairs are either addressed by the programme director to erect a course or chairs ask approval for a course they want to erect themselves. In case a research area is lacking in the offer of courses, chairs are addressed by the programme director (R1; R5). The other way around chairs can ask approval of the dean for erecting a new course (R3; R4). Existing courses are assessed on the amount of research conducted at the department they contain by the educational committee of the Faculty of EEMCS (R1). Guidelines about how research should be integrated in teaching are lacking. According to respondent 1, no specific

rules or guidelines exist about how to integrate the research content of a research group in teaching (R1).

Curriculum development: One can conclude that steering of the TRN through curriculum development takes place passively only in terms of overlap between research areas and content of courses. This overlap is attained in that the programme director addresses chairs to erect new courses in research areas that are not covered yet or chairs ask approval for new courses they want to erect themselves. Rules about how research actually is integrated in the courses are lacking.

4.5.2 Appraisal

Another tool for managing the TRN is appraisal. It is assumed that if teachers are appraised less for their teaching than for their research activities, teachers are inclined to invest more time and energy in their research activities thereby harming their teaching. As a result the TRN could be weakened.

Within the Faculty of EEMCS appraisal does not seem to be applied as a management mechanism in the sense that a TRN is actively established. No strategies strengthening the TRN by appraisal have been found in the faculty documents.

Within the interviews the teachers were asked how they are appraised for their teaching responsibilities. Teachers are mainly praised for their research activities and hardly for their teaching. According to the respondents no differentiation is made formally in the way teaching and the way research are rewarded (R1). However, promotion takes place mainly on the basis of research performances (R2).

Opinions differ about if teaching should be appraised more. On the one hand teachers feel their teaching activities should be recognised more. Respondent 1 feels teaching is not appreciated very strongly: priorities set by their professors are dominant over the faculty policy. According to respondent 1, teaching is not given the priority it should have, but thinks this is hard to change. On the other hand existing awards for teaching are not evaluated as effective. For teaching a teacher award exists: students can elect the best teacher (R1; R4). Moreover, according to respondent 1, incidentally, a financial gratuity is given to teachers who innovates education. However, respondent 2 says teachers do not teach better when rewarded with money.

Appraisal: One can conclude appraisal is not applied as a management mechanism to strengthen the TRN either. Teachers are praised mainly for their research activities and hardly for their teaching activities. However, rewarding good teaching with money will not improve the TRN. Thus one cannot conclude that appraising teaching more will strengthen the TRN.

4.5.3 Quality Assurance

Quality assurance may strengthen the TRN as it pays attention to the way teaching and research is integrated.

Within the Faculty of EEMCS the quality assurance system consists of a variety of evaluations that are applied in a cyclical manner but are not aimed at strengthening the TRN. Within the document analysis, no specific quality assurance strategies concerning the integration of research in teaching were revealed, only statements that depict the general

quality assurance at the Faculty of EEMCS were revealed: the goal of the quality assurance of the Faculty of EEMCS is to identify objects of quality control and following through the phases of the plan-do-check-act-circle (EEMCS, Jul. 2006, p.23); to evaluate the courses the faculty carries out (pp.24-27);

- course evaluations,
- thesis assignments evaluations,
- minor evaluations and accreditation,
- curriculum evaluations,
- student satisfaction research,
- evaluations of complaints,
- evaluates study progress data,
- alumni polls, co-workers polls, and
- more incidental evaluations.

In addition to the internal quality assurance system, all the study programmes of the University of Twente and other Dutch universities and colleges (HBOs) are accredited by the Accreditation Organisation of the Netherlands and Flanders (NVAO) once every six years. Without accreditation the study programmes do not receive funding and students participating do not receive a monthly scholarship from the government (NVAO, Feb.2003, p.13). The accreditation framework is composed of the topics "goals study programme", "programme", "staff allocation", "resources", "internal quality assurance", and "results". For the topic programme the following criteria apply to the TRN (p.8);

- Students develop their knowledge in interaction between teaching and research;
- Recent developments and theories from the scientific area are integrated in teaching;
- The study programme guarantees the development of academic skills.

Generally, the integration of research in teaching is evaluated as sufficient to very good for the study programmes at the Faculty of EEMCS (QANU, Dec. 2004b; QANU, Sept. 2007; QANU, Oct. 2007).

A separate quality assurance system for research is applied at the different research institutes of the University of Twente. Within the document analysis of the University of Twente it was revealed the University of Twente (n.d.) has set up protocols for evaluating research: one for every discipline and one for the research institutions as a whole. The disciplines conduct a self evaluation every three years and are externally accredited every 6 years by an external committee. For these evaluations the ***Standard Evaluation Protocol 2003-2009 For Public Research Organisations*** of the Associate for the Universities in the Netherlands (VSNU) the Netherlands Organisation for Scientific Research (NWO), and the Royal Netherlands Academy for Arts and Sciences (KNAW) (Jan. 2003) is applied. This protocol assesses research according to the following criteria;

- Quality (international recognition and innovative potential)
- Productivity (scientific output)
- Relevance (scientific and socio-economic impact)
- Vitality and feasibility (flexibility, management and leadership).

Although the TRN is not a criterion for evaluation the executive board will ask to pay special attention to researchers their education (3TU, May 2008, p.8).

Generally the research conducted at the disciplines teaching at the Faculty of EEMCS are evaluated as good to excellent (QANU, Aug. 2004; QANU, Dec. 2004a; QANU, Nov. 2006)

Within the interviews the teachers were questioned about how courses, study programmes and teaching performance are evaluated. No specific quality assurance strategies concerning the integration of research in teaching were revealed either within these interviews. From their answers the following procedures can be depicted. Table 4 gives a summary of the general evaluation procedures.

Table 4
Evaluation Procedure Faculty of EEMCS (R1; R2; R3; R4; R5).

Type evaluation	***Who***	***Activities***
Term/Semester Evaluations	Study Associations	Student Panel
Annual Simple Course Evaluation	Educational Evaluation Committee/ Student Assistant	• Student Surveys • Student Panel/Feedback • Teacher Form
Three Year In Depth Course Evaluation	Educational Evaluation Committee	• Student Surveys • Student Panel • Observer
Every five years Accreditation/Visitation	External Committee	

Within the interviews the evaluations were criticised in that the current manner of evaluation is too student centred. Respondent 1 feels the current manner of evaluation is too much student centred: more attention should be paid to other aspects of teaching performance.

Quality Assurance: One can conclude the quality assurance systems treat teaching and research as two separate activities and the integration of research in teaching is only evaluated on a higher level. However, the positive results of the external evaluation committee implicate the quality assurance is effectively applied as a management mechanism to strengthen the TRN.

On the one hand, the current quality assurance system does not strengthen the TRN as the integration of research in teaching is not part of the "day-to-day", student centred quality assurance system for teaching. The TRN is only touched upon on during external accreditation once every 6 years, and separate quality assurance systems exist for research and teaching. On the other hand, the study programmes need to be evaluated positively by this external accreditation committee as they depend on funding and are disciplines stimulated to pay attention to their teaching while evaluating their research. Furthermore, the positive external evaluations of both teaching and research proof the quality assurance systems are working.

4.5.4 Strategic and Operational Planning

Within the theoretical model presented in section 2.2.4, strategic and operational planning is another mechanism which can be applied to actively manage the TRN. Within strategic operational planning it can be made explicit how teaching should contribute to the achievement of the strategic goals of the faculty. Operational planning on the other hand can make explicit how teaching should be organised or operated to achieve these goals. Especially the task definitions of academic staff are used to plan how teaching should be operated within a faculty.

Within the University of Twente teaching and research are treated as two distinct tasks as research and teaching are organisationally separated by putting the research task in research institutes. According to Carugati and Sangiorgi (2006, p.60), "the organisational and

governance structures of the University of Twente were modified in order to better meet institutional objectives by separating education and research and to increase organisational transparency".

Within the Faculty of EEMCS the strategic and operational planning concerning the TRN mainly uses the division of labour between the chairs and the task definition for academic staff as their main policy to achieve their goals within teaching. Within the document analysis two explicit statements concerning the integration of research in teaching were revealed: First, every chair should participate in teaching as they cover at least one field of study that is part of the undergraduate study programmes (EEMCS, Jul.2006, p. 12). Second, the Faculty of EEMCS has the policy to define the tasks of academic staff in the Humboldtian tradition: every member of the academic staff should be integrated in teaching and research. Therefore EEMCS stated the rule that all researchers with a fixed contract are involved in teaching, and also all teachers on non-permanent positions are included in research (p. 14).

Within the interviews teachers were asked which policies stimulating the integration of research and teaching they would know. Furthermore, teachers were asked what their opinion about these policies is. Most respondents state they would not know if there were explicit policies stimulating the teaching research nexus (R2; R3; R4). But all respondents were informed about the policy of the faculty to integrate temporary academic staff in teaching and research (R1; R2; R3; R4; R5; R11). Also, one respondent mentions that the policy that EEMCS forces as many associate professors, and also professors, as possible to participate in the undergraduate study programmes.

However, the respondents are also critical about these policies: on the one hand they fear that the balance in research and teaching responsibilities varies strongly between individual academic staff members. On the other hand they also fear that the policy to establish research institutes would lead to an implicit classification of good and bad teachers. On respondent mentions that the establishment of research institutes has set a trend to evaluate research higher than teaching. While research is attracting high quality researchers, education could turn out to be a waist bin for low quality researchers. However, according to one respondent this separation of research and teaching can be prevented as long as academics support both of their roles: to be researcher and simultaneously to be a teacher:

> ***…de mensen die zijn ondergebracht in het onderzoeksinstituut, dat zijn dezelfde mensen die ook het onderwijs verzorgen. Dus in de hoofden van die mensen zijn die twee dimensies nog steeds aanwezig. Zolang het gedragen wordt door mensen, geloof ik niet in dat gevaar (R4).***

Furthermore, this respondent points out that the strategy of the university's to put teaching obligations on the shoulders of researchers and to incorporate teaching obligations in the UFO-profiles[2] would inhibit the risk that teaching would become a waist bin for "low quality" researchers.

Strategic and Operational Planning: One may conclude that the management of the TRN through strategic and operational planning is present at the Faculty of EEMCS but it is rather passive than active. It mainly functions through the operational planning of the task definitions of academic staff: permanent academic staff is obliged to participate in teaching as well as in research. Also, two extra strategies for the undergraduate study programmes could

[2] UFO stands for Universitair Functieordenen, it is a system that contains position descriptions. The system describes academic and supporting positions on the basis of output and results, and role to be performed (University of Twente, 2007b)

be revealed: chairs cover at least on field of study that is included in the different programmes, and professors are force to participate in the undergraduate study programmes actively. Thus for the undergraduate phase the TRN is managed more actively through strategic and operational planning as for the graduate phase.

Strategic and operational planning poses a threat to the TRN in that the establishment of research institutes leads to a higher evaluation of research, making teaching a "waist bin" for "bad teachers". However, as the UFO-profiles incorporate both teaching and research tasks and as long as academic staff support their teaching and research roles, this threat is inhibited.

4.5.5 Resource Allocation

Two main types of resource allocation can be distinguished: funding and time allocation. One can argue funding and time allocation strengthen the TRN in that they stimulate integrative activities for example by allocating money and time to initiatives that are meant to improve the integration of research in teaching.

Funding

Within the document analysis a funding strategy strengthening the TRN is the sub component "research and teaching". According to the funding model of the University of Twente (Sept.2007) the funding the faculties receive consist out of two compartments: research and teaching. The research compartment contains a sub component called "research and teaching". This component has been introduced to safeguard the necessary amount of research conducted at the departments for the alpha and gamma study programmes, as these study programmes have more students and less income from research compared to the beta study programmes. The amount of research conducted in the departments teaching courses especially plays an important part in the accreditation of graduate study programmes. 30% of the money of this sub component is allocated to the undergraduate study programmes and 70% to the graduate study programmes.

According to EEMCS (2006e, p.10), increasing pressures to attract external funding for research projects and participate in these research projects results in diminishing involvement with the primary teaching in the undergraduate phase. The distance between teaching and research is perceived as large sometimes.

Within the interviews teachers were asked how teaching and research are being funded by the Faculty of EEMCS. Teachers feel the current funding model weakens the TRN. According to respondent 4 teaching is perceived to be far less profitable than research. From this financial viewpoint, education is loss-making activity since the University of Twente pushes chairs to make as much research capacity chargeable as possible.

> ***..er zijn rekenmodellen in zwang geraakt waardoor het in sommige groepen, sommige contexten, sommige jaren zo is dat onderwijs als het ware een cluster in de weg zit omdat het ze verhindert om uren te besteden die ze zouden kunnen declareren. Dus in die zin is onderwijs dan een verliespost als het gaat om de financiële benadering…(R4)***

However, strengthening research activities over teaching may have a positive influence on the TRN as the more integrated teachers are in teaching, the better they are able to integrate their research in teaching (R3).

…dan heb je dus heel veel mensen die dus tijd besteden aan onderzoek. Dat hoeft niet ten koste te gaan van de hoeveelheid onderzoek die zijn weg vindt in het onderwijs. Want dan zijn er mensen die meer in onderzoek zitten en zouden ze dat zonder moeite een plek moeten kunnen geven in het onderwijs (R3).

Funding: The separate funding of teaching and research activities has a weakening effect on the TRN for the undergraduate phase. For the graduate phase the influence is not very clear. At first, the funding model seems to strengthen research over teaching. However, in the end teaching might be strengthened as well as teachers are better able to integrate their research in teaching.

Time Allocation

Within the document analysis no time allocation to activities that integrate research in teaching were revealed. According to the Faculty of EEMCS (Jul.2006, p.12) the proportions of time allocated to research and teaching are equal to the proportions of funding for research and teaching: a 3:7 ratio.

Within the interviews the teachers were asked about how much time is allocated by the faculty to teaching and research. Within these interviews no statements were given on time allocated to activities integrating research in teaching either. In general teachers feel an increasing amount of time is allocated to research and less time is available for teaching. One respondent feels fewer teachers are available per student, resulting in less contact time (R4). Two explanations were given for the reduced time for teaching. First, the profitability of research causes a tendency to invest more time in research. According to respondents 4 and 5 this reduced time to teach can partially be explained by the research obligations teachers face: the reduced time for teaching pushes teachers to invest more time in research and less time in teaching. A second explanation is a lack of teaching staff. According to respondent 4, this lack of teaching staff is the result of a combination of less money available to hire staff, less students applying for study programmes at EEMCS, and more study programmes available in comparison to 25 years ago.

However, in some cases more time is allocated to teaching than to research as the development new courses can also demand a lot of time during (R1; R4; R5).

Time allocation: The extent to which the TRN as a whole is impacted by time allocation is not clear, as statements on the effects of time allocations to the TRN are absent. Thus no conclusions can be drawn either about the impact of time allocation on the TRN.

However, the time allocated to teaching and research is clearly influenced by the funding model. As a result of the funding model applied by the Faculty of EEMCS, less time is allocated to teaching and an increasing amount of time to research. In this sense the funding model strengthens research activities over teaching activities.

4.5.6 Staff Development

Staff development can be applied in the establishment of a TRN in that teachers are taught and coached in how to integrate research in their teaching.

From the document analysis it becomes clear that the University of Twente has a broad spectrum of courses to develop research and teaching skills, in which the academic staff can take part. Offered teaching courses are in the area of preparation for teaching, designing a course, the organisation of teaching, supervising, assessment, and educational policy. None of

these areas contain courses in establishing a TRN within ones teaching (ITBE, 2007). Within the documents of the Faculty of EEMCS neither specific statements about how staff development in terms of establishing a TRN, nor how staff development takes place in general were revealed.

Within the interviews teachers were asked about possibilities to develop their teaching and research skills. The teachers mainly pointed to the possibility to take part in courses to develop either their teaching or research skills. The teachers did not know of the existence of courses on how to integrate research in teaching. The respondents perceive the available courses to be of good quality (R2). However, according to respondent 2 hardly any teacher ever takes part in a course on a voluntary basis. According to one respondent the professor can be viewed as a kind of personal support. However, not many research staff aspires a teaching career, making the topic of marginal importance. In this sense the available support is perceived to be sufficient (R4). Respondent 3 says the coaching that teachers receive from their professor is mainly aimed at research skills. However, respondent 3 felt this coaching can also have positive effects for their teaching, but implicitly and indirect.

Staff Development: No staff development activities are specifically aimed at the integration of teaching and research. Or at least the teachers do not know of their existence. In this sense ***staff development*** does not contribute to the development of a strong TRN.

Through special measures of staff development teachers have the opportunity to develop both their teaching and research skills. Teachers develop themselves mainly through courses and coaching. However, teachers hardly take part in the courses offered and coaching is aimed at research mainly.

4.5.7 Management of the TRN at the Faculty of EEMCS

Answering the fifth research question, "How is the TRN managed at the different faculties?" one can conclude that the TRN at the faculty of Electrical Engineering, Mathematics and Computer Science is rather weakened by management than strengthened. In general the management of the TRN is not absent but some measures only strengthen one side of the TRN, which is mostly the research side. Only a few management mechanisms strengthen the TRN.

Management mechanisms strengthening the TRN are: quality assurance, curriculum development, strategic and operational planning, and funding. First, although the quality assurance system treats teaching and research as two separate activities and the integration of research in teaching is only evaluated on a higher level, the evaluations of the Associate for the Universities in the Netherlands (VSNU) prove the quality assurance system is strengthening for the TRN as well. Second, curriculum development strengthens the TRN in terms of overlap between research areas and content of courses. This overlap is attained in that the programme director addresses chairs to erect new courses in research areas that are not covered yet or chairs ask approval for new courses they want to erect themselves. Guidelines for how to integrate research in teaching are lacking. Third, strategic and operational planning strengthen the Teaching - Research Nexus the management of the Faculty of EEMCS as permanent academic staff is obliged to participate in teaching as well as in research. Additionally for the undergraduate study programmes, chairs cover at least one field of study that is included in the different programmes, and professors are force to participate in the undergraduate study programmes actively. Finally, funding strengthens the teaching - research indirectly. On the face of it, the funding model seems to strengthen

research over teaching. Actually, teaching might be strengthened as well as teachers are better able to integrate their research in teaching.

Management mechanisms that weaken the TRN are: appraisal, time allocation through funding, and staff development. Appraisal strengthens research activities over teaching as teachers feel they are more appraised for their research results as for their teaching. Time allocation strengthens research activities over teaching as funding pushes teachers to invest more time in their research activities than their teaching. Finally, staff development strengthens research in that their main tool of development, e.g. coaching, mainly aims at research.

The management of the TRN of the undergraduate study programmes hardly differs from the management of the TRN of the graduate study programmes. Only in terms of strategic and operational planning the TRN of the undergraduate programme is managed more actively.

4.6 Conclusion

The shape of the Teaching – Research Nexus (TRN) is determined by practices integrating research and teaching, organisational characteristics, contents of study programmes, and visibility of performed research for students. Possible influences on the management of the TRN might come from the personal teaching characteristics, student characteristics and ideological values.

The Teaching – Research Nexuses

As one has read in section 4.1.5, the following TRNes for the undergraduate and graduate study programmes of the Faculty of EEMCS can be described; within the undergraduate phase students take part in more school-like types of activities. Teaching methods that are applied are assignments, labs, lectures, project work, tutorials and papers. Furthermore, computer and student laboratories can be applied to practice certain research skills. The undergraduate study programmes aim at understanding, gaining basic knowledge, and acquiring basic skills. Research is used more as a means of illustration of general theories that are taught. Undergraduate students do not experience many research situations during their study programme. The general established techniques of doing research are taught, but underlying methodology is not made explicit.

Within the graduate phase the applied teaching methods are more practical teaching activities that approach doing real research. Graduate students move to the laboratories of research groups and become integrated in the departments' research. By being integrated in departmental research graduate students gain practical experience, learn to work in complex and dynamic settings, and develop a critical attitude. During the graduate phase the research conducted in the field of study, and the departments of the faculty, becomes the topic itself. However, also in the graduate phase the underlying methodology of research is not made explicit.

The main difference between the integration of research in teaching in the undergraduate phase and graduate phase is that undergraduate students are taking part in more traditional, school-like types and less research types of activities than graduate students. The more practical teaching activities are the more close activities undertaken by students at the Faculty of EEMCS come to doing research.

The TRN is working well, both for undergraduate and for graduate students. On the one hand students perceive teaching and research as two separate worlds. On the other hand students appreciate a Teaching - Research Nexus. The teaching research is not very visible to students as students are not very integrated in research. Both undergraduate and graduate students do not experience many research situations, undergraduate students experience even less research situations than graduate students. Interestingly, students view research and teaching as two separate worlds, while students feel they learn from the research conducted by their teachers. Although graduate students are slightly more integrated in research than undergraduate students, the TRN is as visible and evaluated as positively by graduate students as by undergraduate students.

Personal Teaching Characteristics

In case of the Faculty of EEMCS, being involved in research has a positive influence on teachers' ability to enthuse, their authority, and their ability to supervise. From these three personal teaching characteristics, only teachers' ability to enthuse and teachers' authority actually have a positive influence on the TRN. Research involvement does not have a positive influence on teachers' ability to organise their teaching, to supervise students, to enthuse their students, and to balance workload and difficulty. The last two personal teaching characteristics overlap as the ability to tune in the abilities of students can be considered as a form of showing empathy. Undergraduate and graduate students generally agreed with each other and the respondents about the statements. Finally, teaching influences research as well as the need to present scientific information in a very clear way clarifies and enriches their research.

Abilities of students

At the Faculty of EEMCS abilities of students entering the study programmes are changing, both in a positive and a negative direction. Lacking analytical and conceptual abilities are fixed before higher level abilities can be taught, if enough time is left to teach them. As a result the integration of research in teaching is affected. On the other hand students' practical, communicative abilities and the ability to see connections in the matter taught have improved. Thus the time consumed by teaching basic skills may be limited.

Ideological Values

In terms of Taylor (2007) one can argue the ideology is rather passive and mostly in the minds of the people. The ideology at the Faculty of EEMCS is that one of the primary tasks of a university is to teach students to become scientific researchers that are able to secure the future research of the faculty. However, the integration of research in teaching can be considered an automatism as the integration of and the extent to which students are integrated in research is only steered by the fact teachers are involved in research.

Also for the Faculty of BS in terms of Taylor (2007) one can argue the ideology is rather passive and mostly in the minds of the people as they are not shared and acted upon very much. Within the Faculty of BS the TRN is established automatically as teaching and research are united in the staff and students are integrated in the departmental research.

Management Mechanisms

The TRN at the Faculty of Electrical Engineering, Mathematics and Computer Science is rather more weakened by management than strengthened. In general management is not absent but some measures only strengthen one side of the TRN, which is mostly the research side. Management mechanisms strengthening the TRN are quality assurance as the positive QANU evaluations prove the quality system is working; curriculum development as

programme directors addresses chairs to teach courses in research areas that are not yet covered; and strategic and operational planning as permanent staff is obliged to participate in teaching as well in research, and professors participate in undergraduate courses. Management mechanisms weakening the TRN are appraisal as teachers are more appraised for their research performance than teaching; time-allocation as research funding pushes teaching to invest more time in research; and staff development as coaching mainly aims at personal development in research.

5 Faculty of Behavioural Sciences

The Faculty of Behavioural Sciences (BS) consists of twelve departments "Cognitive Psychology & Ergonomics", "Curriculum Design & Educational Innovation", "Instruction Technology", "Marketing Communication & Consumer Psychology", "Educational Organisation & Management", "Research Methodology, Measure Methods & Data Analysis", "Organisational Psychology & Human Resource Development", "Media, Communication & Organisation", "Psychology & Communication of Health & Risk", "Technical & Professional Communication", and "Philosophy". The faculty offers three undergraduate and six graduate study programmes (BS, 2008). In 2006 about 1,500 students were studying at the Faculty of BS: 911 undergraduate students, 328 graduate students, and 142 "pre-master" students[3] (University of Twente, 2007b).

The Teaching – Research Nexus (TRN) at the Faculty of BS will be discussed according to the theoretical framework mentioned in chapter 2. In section 5.1 the TRNes at the Faculty of BS will be depicted and how students see and value these. In section 5.2 the personal teaching characteristics of teachers will be discussed. Section 5.3 will address abilities of students. In section 5.4 the ideological values of the faculty and teachers will be discussed. Finally section 5.5 examines the management mechanisms to steer the TRNes at the Faculty of BS.

5.1 The Teaching – Research Nexuses of the Faculty of BS

A clear definition of what a TRN ***is*** or ***should be*** does not exist. Rather, the TRN can take on many shapes within scientific institutions providing education. This section attempts to provide a picture of the TRN at the Faculty of BS.

This picture will be drawn from information from qualitative interviews with teachers and from a survey held among students from the Faculty of BS. Within qualitative interviews teachers were asked to describe how they integrate research in their teaching, also about their opinion about how students perceive the integration of research in teaching. Furthermore, teachers were asked for a self-evaluation of their abilities and their courses, and how much time they allocate to either research or teaching. Finally we were interested in the differences between graduate and undergraduate study programmes in respect of visibility of research conducted at the departments within teaching.

In the student survey, both undergraduate and graduate students from the Faculty of BS were asked to indicate which type of (research) situations they experienced during their study programme already. Also, they were asked to evaluate different opinions about certain type of work forms. The TRN at the Faculty of BS will be analysed according to the following items:

- organisational characteristics
- contents of the study programmes,
- practices of integrating research in teaching, and
- student perceptions about the integration of research in teaching.

[3] Pre-graduate students are students whom take a small selection of courses, usually ranging from four to six courses, in order to be accepted to the graduate programme.

5.1.1 The Integration of Research in Teaching

The contents of a curriculum can be shaped by theories students learn by heart, and by the form of skills students acquire. Contents can also be transferred to students by using different teaching methods. Assessment will be viewed as a teaching method as well: for example, writing a paper can be seen as a method to study a certain topic but also as a form of assessment of how well the topic has been studied. Therefore assessments will be regarded as a teaching method in the remaining sections.

The Integration of Research in Teaching within the Undergraduate Programmes

Like for the Faculty of EEMCS, see section 4.1.3, the global goal of the undergraduate study programmes of the Faculty of BS is to prepare students for specialised graduate education or professional work. Within the document analysis, two statements about what qualifications are developed within the study programmes were found. First, the Faculty of BS educates students to be competent academics and academically educated professionals who continue to develop themselves in both fields. Graduates graduate the relevant techniques and tools which they apply, in combination with their scientific knowledge, while conducting research and while working in professional situations (BS, May 2005a, p.13; BS, Feb. 2006, p.10). Other qualifications to be developed are (BS, Mar. 2005a, pp.8-9);

- domain specific knowledge,
- design, research and consultancy competences; and
- academic reflective abilities

According to the self-evaluation of the undergraduate study programmes students develop their research competences within the following programme components (BS, Feb. 2006, pp.86-87; BS, Mar. 2005a, p.15);

- Methodological (research) courses: introduction to research methodology, data-analysis and empirical cycle;
- Design courses: first acquaintance with the regulative cycle of research;
- Specific skills courses;
- Theme courses: philosophical and ethical view upon research (data);
- Fundamental courses; and
- Theses; performing individual (and independent) research.

Within the document analysis it was revealed that students develop their research skills incrementally throughout the programme. Students will come into contact with departmental research via design courses, the undergraduate project, and the test subject system in which students participate as test subjects in departmental and student research. Students will acquire research skills via methodological courses and practice the acquired research skills in the design courses. Together these courses form a “learning line” by which students incrementally develop their research skills (QANU, Oct. 2006; Dec. 2006; May 2007).

Within the interviews teachers were asked how research content is taught within the undergraduate study programmes. respondent 8 speaks of a link with research is established already at the beginning of a study programme. In the first year, students make an assignment under the strict supervision of a teacher during specially developed design courses. The assignments students accomplish during these design courses are connected to research taking place inside one of the departments. During these design courses students solve a problem, search for information, test if the information works, and substantiate and finally test the solution they have designed (R13). The design course during the first year is followed up by another design course in the second year of the undergraduate programme. During the entire year students take part in a departmental research project for which they

can sign up. During this project the supervision by teachers is less strict than in the first project (R8).

Within the theoretical courses in the first and second year of the undergraduate programme, teachers talk about their own research and give examples from their research in general terms (R8; R9; R10). In some courses experiments for the teachers' research are being conducted. For example, within the course Testing Theory and Psycho Diagnostics students undertake an IQ and personality test during a lab (R8).

> ***Binnen sommige vakken worden ook experimenten uitgevoerd die gebruikt worden weer voor het onderzoek van docenten. Ik weet bijvoorbeeld dat binnen testtheorie en psychodiagnostiek wordt daar…daar zit een practicum bij waarin studenten leren ook wat een…volgens mij dit jaar een IQ-test en een persoonlijkheidstest…en dan leren ze dus die test heel goed kennen, maar dragen daarbij ook bij aan dat onderzoek. En leren daar zelf weer heel veel van. Want docenten koppelen dat gelijk weer terug van nou wat komt daar nou precies uit (R8).***

Two respondents explain that students take part in methodological courses like methodology, statistics and data-analysis in addition to the design and theoretical courses (R8; R9). These methodological courses teach students basic research skills and different types of research one can undertake. Methodology is about how to design scientific research. Statistics and data-analysis are about how to interpret results. During the second year the acquired methodological and data-analysis skills are extended (R9) and applied (R8), for example to see how psychological tests work. Also, communication skills are trained, for example how to interview respondents (R8). According to respondent 10, students experience a discrepancy between what they learn during these courses and what they actually use during their research for their graduate thesis. Respondents 8 and 9 feel a more clear connection could be made between the methodological courses and theoretical courses: the relevance of all the research techniques they study should be shown to the students much earlier. Currently, students only start seeing the relevance of all the techniques they had to study during their undergraduate project.

> ***… wat er in de vakken wordt geleerd, dat zijn gewoon hele droge methoden en technieken. En natuurlijk daar moet een inhoud bij, want je moet iets analyseren. Maar je hoort heel vaak als studenten bezig gaan met hun onderzoeksopdracht ze écht geen benul hebben met waar ze mee bezig zijn, dat ervaar ik elke keer weer. Dan moeten ze opeens een onderzoeksplan schrijven, wat ze nog nooit gedaan hebben. Ze snappen vaak niet waar ze het over hebben. … Maar als ze dan eenmaal bij hun eigen proces op gang zijn gekomen en bezig zijn om een onderzoeksvraag te beantwoorden en analyseren, dan krijgen die statistiekdingen opeens betekenis. Dus dan betekend dat eigenlijk dat die vakken, dat concludeer ik daar maar uit, gewoon te leeg zijn. Het is te weinig zeggend. Je doet een kunstje, maar je weet niet waarom je het kunstje doet en er blijft weinig hangen (R9).***

During the final year of the undergraduate programme students participate in so-called theme courses and write an undergraduate thesis. Within these theme courses teachers talk in general terms about their own research. For the undergraduate thesis the students perform research on a topic in the area of their specialisation. This research is performed relatively independently, under the supervision of a teacher (R8). For undergraduate study programmes research participation is perceived limited to the undergraduate project. Respondent 7 says that within the undergraduate project students are pushed to perform research (R7; R10): within the undergraduate project students are taught how to set up a

research project, how to design research instruments, how to make research instruments work as optimal as possible, how to analyse data and how to report the results (R7).

Finally, some respondents mentioned some undergraduate study programmes have a test subject system (R8; R10): in the first year students participate in research as a test subject for 10 credits, during their second year for 5 credits. One credit is one hour. Via this system students get first-hand experience in what doing research is about. They can use this experience during the research they undertake themselves (R8).

Within the courses research can be integrated in various ways; e.g. assignments, literature, lectures and tutorials. One respondent explains that students make assignments within undergraduate courses. The aim of these assignments is to involve students more actively in the substance taught. Generally, courses are closed off with an exam. Another teaching method is the use of literature. A comment made about the literature was that some research areas do not have a "standard book one can pull from ones bookshelf". In this case teachers write the teaching materials themselves or bundle scientific articles that are available while including their own research (R7). Teaching methods like lectures and tutorials are considered not the most interesting teaching methods for students. According to this respondent teaching should be organised via new media and new technologies: both students and researchers should be able to communicate about their field of study with peers abroad (R13).

Choices made about teaching methods, see Appendix IV for types of teaching methods, are influenced by factors such as group size and the amount of money available for teaching. Innovative teaching methods can be applied to deal with these limiting factors. According to one respondent the types of teaching methods that are applied depend on the number of students participating in a course (R8). Respondent 7 says that due to large groups of students in the undergraduate phase, teachers deal with a limited capacity of teaching staff, making certain forms of research participation hardly possible. According to respondent 7, teachers find a middle path. An example of such a middle path is a short midterm paper next to the final exam. Applying such combinations of teaching methods force students to actively study the matter taught. According to respondent 9, money should not be a problem in designing high quality courses. However, respondent 9 says it is generally known there are teachers who let the available time in terms of money be an issue in choosing teaching methods: for example, 6 lectures can be more efficient than 10 tutorials. Respondent 13 feels teachers should apply innovative teaching methods in which students study intensively about 30 to 40 hours a week. Students are attracted by the manner of acquiring knowledge at a university: they rather study in groups and international communities than spend their time behind a desk.

Teachers consider themselves relatively free in integrating research in their teaching (R7; R8; R10). Respondent 10 feels informally stimulated by the organisational culture and discussions during semester meetings to integrate research in teaching. However, respondent 7 is of the opinion that the level of integration of research in teaching is determined by the amount of overlap between the content of the course taught and the research conducted at the department of the teacher. In comparison to the graduate phase, respondent 7 perceives the research to be more introductory of nature for the undergraduate phase.

The Integration of Research in Teaching within the Graduate Programmes

Within the document analysis, goals and evaluations of the integration of research in teaching were revealed as well. Also for the Faculty of BS the goals of the graduate study programmes

build on the goals of the undergraduate study programmes. The Faculty of BS teaches students to be academics who are able to combine their thorough theoretical knowledge with their ability to apply this knowledge in scientific research or solve problems in an organisational context (BS, Feb. 2006, p.10; BS, May 2005b, p.12). Specific competences to be developed are (BS, Mar. 2005b, p.5);

- domain specific knowledge;
- design, research, and consultancy competences; and
- academic reflective abilities.

For the graduate phase research competences are developed less explicitly than in the undergraduate phase. According to the self-evaluation of the undergraduate study programmes students develop their research competences by the following programme components (BS, Feb. 2006, pp.86-87);

- Theme courses: philosophical and ethical view upon research (data);
- Theses; performing individual and independent research.

For some graduate study programmes, the development of research competences is integrated in the theme courses (BS, Mar. 2005b, pp.5-13).

The evaluations of the QANU (Oct. 2006; May 2007) revealed a similar set of connections between research and teaching. First of all a connection between research and teaching is established as teachers participate in national and international research projects. Recent knowledge from these research projects is transferred to students via recent literature and publications students study. Not only do students study, they also need to gather, process, revise and present literature. Second, development of research skills is continued within the graduate phase as students participate in and get acquainted with departmental research via design and research project courses. Third, students get in contact with departmental research via assignments that are inspired by recent developments. Fourth, within certain graduate study programmes, students take a methodology course that establishes links between often used theoretical models within the subject field and often used methods and techniques within that field. Finally, the graduate thesis further deepens the research skills students acquired throughout their undergraduate and graduate study programme. With their graduate thesis students contribute to the scientific knowledge. Under supervision of teachers, students perform research within the field of study of their study programme.

From the statements of the teachers a similar picture can be depicted. Within the interviews the teachers were asked how research is integrated in teaching within the graduate study programmes. Generally, students read a set of core theories as an introduction in the first half of the course. In the second half of the course they get acquainted with the research itself: how their teachers develop a research line according to the discussion in these core theories (R6). Furthermore, PhD students talk in lectures about what kind of research they are performing. They try to show how abstract thoughts can be translated to a concrete research project. In this way students can see how much fun it is to do research and get enthusiastic about the topic (R7). In one of the graduate study programmes, a separate course exists in which students search for a topic for their thesis and a thesis supervisor. During this course the student gets acquainted with the selected topic under supervision of his thesis supervisor. The course is closed off with a paper and a research proposal (R6).

According to respondent 6, within the graduate phase students orient themselves based on the teachers' research preferences, joining research projects and work towards the selection of a topic connected to this research project for the student his graduate thesis. For example an

Ethiopian student wanting to research the influence of new technologies in the context of Ethiopia.

> ***Bijvoorbeeld vorig jaar heb ik een student uit Ethiopië begeleid die onderzoek wilde doen naar de invloed van nieuwe technologieën in de context van Ethiopië. Dus hoe in het westen ontwikkelde technologieën impact kunnen hebben in andere culturen. En voor de techniekoverdracht zijn dan ook wat theorieën bekend in de culturele antropologie, maar dat is allemaal heel beperkt. En wij hebben hier een heel kader ontwikkeld om na te denken over de invloed van apparaten op het gebruik van mensen en op interpretatiekaders van mensen. En die is hij gaan gebruiken als basis om zich vervolgens in te werken in theorieën over techniekoverdracht. Nou, daar is een heel interessant verhaal uitgekomen dat heel erg goed past bij zijn interesses, maar ook rechtstreeks aansluit bij dingen die hier ontwikkeld zijn.***

At the end of the study programme students write a graduate thesis. For the graduate thesis students perform research at one of the research departments connected to their specialisation. An additional goal of the graduate thesis is to come to a publication in cooperation with the student's supervisor (R8). The extent to which students are free to choose a topic of their own differs from department to department: some students are completely free to choose a topic; others are bound to topics related to the department's research projects. A dilemma is perceived in searching for efficiency and effectiveness of the teacher's time while not compromising the student's freedom to choose a topic (R9).

Also within the graduate courses research content is integrated via various teaching methods; methodological courses, workshops for academic writing, lectures in which research is discussed and even separate courses in which students search for a topic for their thesis and write a research proposal. Initiatives are taken to integrate teaching in research: for example developing a specific course on how to perform research, like "experimental research in advertising" for the graduate communication sciences (R10). Within one particular graduate programme the development of research skills receives a lot of attention as workshops are given at the start of the study programme to correct discrepancies in methodological skills such as academic writing (R6).

According to respondents 6 and 7 the size of the group of students influences which teaching methods can be used. Attractive teaching is easier to accomplish for small groups. In small groups teaching methods like papers, group discussions, presentations, and assignments are easier to apply. Papers can be discussed individually. When using presentations, students learn how to briefly and concisely summarise the most important elements of research done and explain them in a clear way to fellow students. With assignments students are involved more actively with the substance taught (R7). Finally some courses work with cases that are related to research done at the departments (R10).

Outside the graduate programme, not many opportunities exist for students to participate in research projects. Sometimes some money is available for a student assistant (R6; R7; R8; R9; R10; R13). However, the lower level research skills of these students make it difficult to write a good research paper.

Students who like to publish an article on the basis of a good paper they wrote can get assistance from a member of the research group (R6). Respondent 13 thinks it might be a good idea to let students apply for a position in a research centre and let them take part in the research as part of their graduate programme. This way, students learn to participate in a

research team. At the same time students get a better introduction to their field of study, making them more able to develop preferences for their specialisation.

Also, within the graduate study programmes teachers feel relatively free to integrate research. According to one respondent the ordering of teaching around themes gives teachers more freedom to shape the content to their own ideas and insights. However, it is not like one can change the topic of the course completely from year to year (R7). Also respondent 6 feels, despite the minimum requirements, teachers remain relatively free to integrate research within their teaching:

> ***Ik bedoel, niet een totale vrijheid. Althans niet binnen het eerste jaar. Niet zo maar al zijn hobby's doen, maar wel een groot deel daarvan. ... Ik bedoel wij hebben gewoon een aantal deelgebieden van het vakgebied geïdentificeerd waar onderwijs over is. Als je een cursus geeft over sociale politieke filosofie en technologie, dan moet het daar wel over gaan. Maar als de docent een ontzettende interesse heeft in democratietheorie en vervolgens dat wil uitwerken in techniekontwikkeling, nou dan kan zo'n docent daar heel makkelijk meer op focussen dan op andere aspecten van sociale filosofie (R6).***

Integration of research in teaching: Generally one can conclude research is integrated more deeply in teaching for the graduate phase than for the undergraduate phase, both in terms of content and the teaching methods that are applied.

One main difference between the undergraduate and graduate phase are that for the undergraduate phase research skills are presented explicitly, but research is taught in terms of examples. Whereas for the graduate phase research skills are less explicit and research becomes the topic itself. Thus the TRN can be considered stronger for the graduate phase.

Another important difference between the phases are the types of teaching methods applied. The types of teaching methods applied depend on the size of the group. Because of the smaller group sizes, time consuming teaching methods like papers, group discussions, presentations and assignments are easier to apply within the graduate phase. These time consuming teaching methods establish a deeper integration of research in teaching than more traditional types of teaching like lectures and tutorials. The TRN for the undergraduate could be strengthened by applying more innovative teaching methods that do not need to take extra time from teachers.

5.1.2 Experiences, Visibility & Evaluation of the Teaching – Research Nexus by Students

How is the presentation of research within teaching experienced and evaluated by the students? How do they appreciate the implicitness of research methodology? One might argue that this could negatively affect the retention of acquired research skills: students forget or are less capable of performing certain research tasks because the necessary research skills have not been taught as such.

In the following sections an analysis about how visible research is to students and how students experience research during their undergraduate and graduate phase will be made. The analysis is based on statements of respondents and the student survey.

Research Situations Experienced by Undergraduate Students by Teachers

Within the survey the students were asked to indicate in what ways research is integrated in the teaching they experience. Students had to check research situations they have already experienced during their training, see Appendix III. As one can see from Figure 9, the results show less than 10 per cent of the undergraduate students have experienced situations in which they;

- attended a research seminar outside classes,
- contributed to a paper or poster for a conference,
- contributed to a scientific paper or other output,
- contributed to scientific advice, or
- were a student assistant.

10 to 40 per cent of the undergraduate students experienced situations in which they;

- developed research competences,
- discussed scientific work of their professor or his assistant,
- engaged in preparation research project,
- participated as a subject or teacher,
- participated in a conference or research day at the University of Twente,
- prepared a thesis or research paper,
- presented a research project in a seminar, or
- read a scientific article or report of their teacher.

42 per cent of the undergraduate students experienced research situations in which they discussed scientific work of a guest speaker. The fact that undergraduate students experience only a few research situations mirrors the fact that classic teaching methods prevail during the undergraduate phase. There is not a single research situation that more than 50 per cent of the undergraduate students have experienced.

Research Situations Experienced by Graduate Students

The picture is very different for the graduate students. Research plays a much bigger role in the graduate study programmes than in the undergraduate study programmes. Only one item where less than 10 per cent of the graduate students indicated that they experienced this situation was found: a contribution to scientific advice.

10 to 40 per cent of the undergraduate students experienced situations in which they;

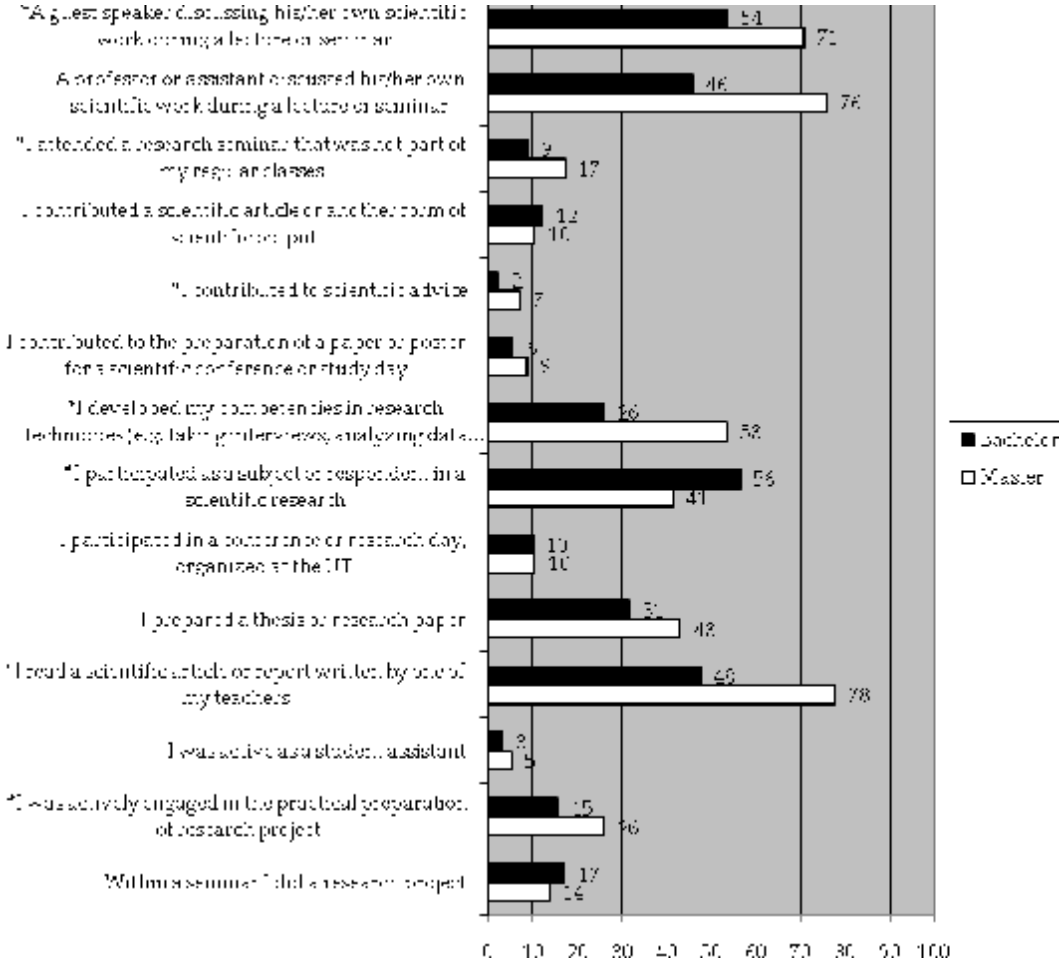
- attended a research seminar outside classes,
- contributed to a scientific paper or other output,
- contributed to a paper or poster for a conference,
- developed research competences,
- engaged in the preparation of a research project,
- have been a student assistant,
- participated as a subject or teacher,
- participated in a conference or research day at the University of Twente, or
- presented a research project in a seminar.

40 to 60 per cent of the undergraduate students experienced research situations in which they;

- discussed scientific work of a guest speaker,
- discussed scientific work of their professor or his assistant,
- prepared a thesis or research paper, or
- read a scientific article or report of their teacher.

For the Faculty of BS, graduate students are more integrated in research than undergraduate students as they experience more research situations during their study programme as well. Students of the Faculty of BS experienced on average 3.54 out of the 14 given research situations (25%). Undergraduate students experienced on average 3.23 (23%) research situations, whereas graduate students experienced 4.50 (32%).

Figure 9. Experienced Research Situations by Students Faculty of BS.



Question: Which of the following situations have you experienced already?
*$p < 0.10$

The fact that graduate students conduct "real life" research during their graduate phase is reflected in the fact that graduate students indicated more often than undergraduate students to have experienced a research situation. However, the differences between the two groups of students are still quite small. Only for the following research situations there is a substantial difference:

- attend research seminars outside classes
- developing research competences
- discussing scientific work of guest speakers
- discussing scientific work of the professor or his assistant
- engaging in the preparation of a research project

- preparing a thesis or research paper, and
- read scientific article or report of teacher.

Teacher's Evaluation of Visibility Performed Research for Students by Teachers

Within the interviews the teachers were asked to what extent research which is presented and skills which are developed during courses are visible to the students. Two respondents says that understanding and awareness of the necessity of research skills are being developed during the course of the undergraduate programme (R7; R8).

Within the study programmes students are being trained to use statistics and methods. According to two respondents, students have a certain aversion against statistic courses and the use of the statistical computer programme SPSS[4] in the beginning of the study programmes. However, when they start using these methodological techniques during their undergraduate assignment they learn to appreciate them and experience the fun of doing research (R7; R8). Respondents 7 and 8 feel students become aware of the use of the methodological techniques for conducting research too late: the methodological courses are experienced as an obligation since students do not see the necessity of having to acquire methodological skills. They only see the use once they start using them during their undergraduate project;

> ***Ik denk dat de bewustwording van het nut van de methodologievakken samenloopt binnen de ontwikkeling van die statistiekvakken. Want in het begin denk je "Nou, waar heb ik dat nou eigenlijk nodig die vakken" En in het tweede jaar komt er dan al iets meer begrip, omdat je dan zelf ook een onderzoek uitvoert. En het derde jaar, als je dan zelfstandig een opdracht moet uitvoeren, dan heb je al helemaal dat begrip. Van "Oh, daarvoor gebruik ik dus al die technieken en al die analysemethodes"(R8).***

According to respondent 8 this link can be strengthened by discussing how certain statistical or methodological techniques could be applied in introducing courses.

Within the graduate phase too an incline in the visibility of research can be noticed. Respondent 6 thinks visibility is still minimal in the beginning of the graduate as well. According to respondent 10 the students taking part in the elective research course really know what researchers are doing. But then these students are generally more motivated to do research than other students. For the not interested students the penny will fall when they are forced to do research during their graduate thesis project. Respondent 6 pointed out two factors influencing this visibility. First, the extent to which research is visible to students depends on how much liberty teachers take to present their research. Second, the amount of teaching responsibilities of teachers can be of influence on the visibility of research: teachers with large teaching responsibility have less time to conduct research, thus less research to integrate in their teaching, thus producing a less close connection to research.

However, for the graduate programme that has introduced workshops at the start of the programme, research is more visible to students (R6);

> ***…. het lijkt mij dat het kwartje wel valt dat al dat schrijfonderwijs en eindeloos blijven leren hoe je papers moet schrijven, eindeloos feedback krijgen niet alleen. Maar ook over de inhoud, ook over de vorm, ook over de structuur. Ik denk dat studenten toch wel zullen moeten snappen dat dat nodig is om een goede afstudeerscriptie te kunnen schrijven (R6).***

[4] SPSS is a statistical computer package that can be used to analyze statistical data.

Evaluation of Visibility Performed Research for Students by Students

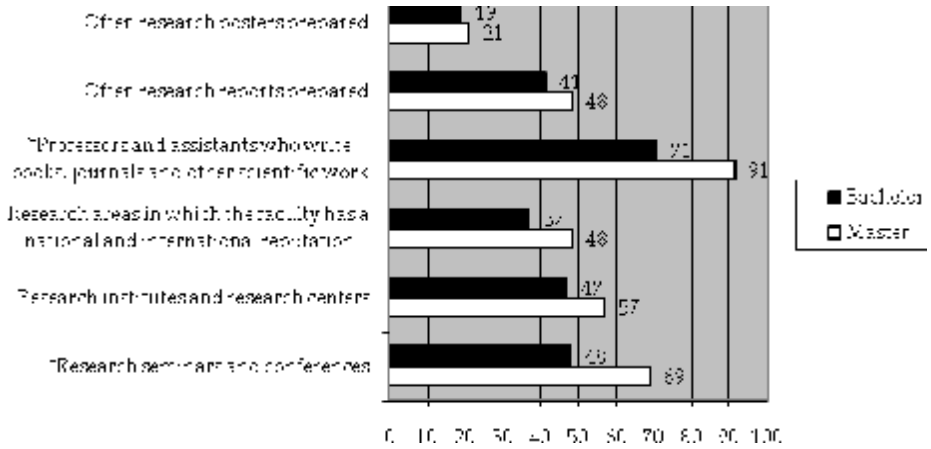
Within the student survey students were asked to indicate to what extent they are aware of the ongoing research activities at their faculty, and more specifically of their teachers. Figures 10 and 11 show both undergraduate and graduate students are highly aware of ongoing research activities at their faculty as well as research activities undertaken by their teachers. Graduate students are more aware of ongoing research activities as significantly more graduate students than undergraduate students indicated to be aware of;

- ongoing publication activities (monographs, journals and other publications), and
- research seminars and conferences that take place at their faculty.

Furthermore, graduate students are more aware than undergraduate students of the fact teachers are

- preparing PhD's,
- supervising assistants and collaborate in research projects,
- supervise students in their scientific work, and
- undertaking research.

Figure 10. Student's Awareness of Research Activities at the Faculty of BS, in %, answer categories ++ and +**.

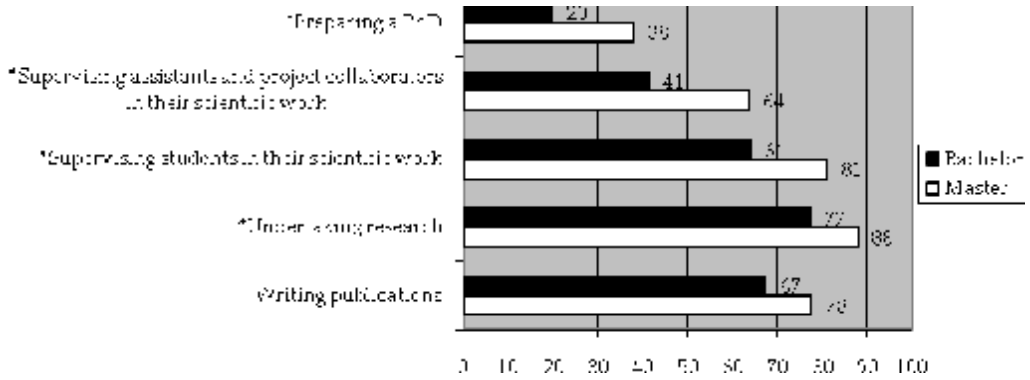


Statement: I know that within the faculty of my study programme there are…..
*$p < 0.10$
** on a 5 point scale from ++ "fully agree" to -- "totally disagree".

The TRN is working well at the Faculty of BS as research undertaken by their teachers and research undertaken at the Faculty of BS in general is as visible to undergraduate as to graduate students. Students are on average aware of 2.80 out of the 6 (47%) indicated research activities that are undertaken at their faculty. Undergraduate students are on average aware of 2.63 (44%) of the indicated research activities, whereas graduate students are on average aware of 3.34 (56%) of the indicated research activities. Most visible to students is the fact professors and their assistants are writing books, journals and other scientific work. Least visible is the fact that research posters are prepared (see Figure 10).

Furthermore, students are on average aware of 2.89 out of 5 (58%) indicated research activities that are undertaken by their teachers. Undergraduate students are on average aware of 2.70 (54%) of the indicated research activities undertaken by teachers, whereas graduate students are on average aware of 3.48 (70%) of the indicated research activities undertaken by teachers. Most visible to students is the fact teachers undertake research, least visible the fact teachers prepare PhD-students (see Figure 11).

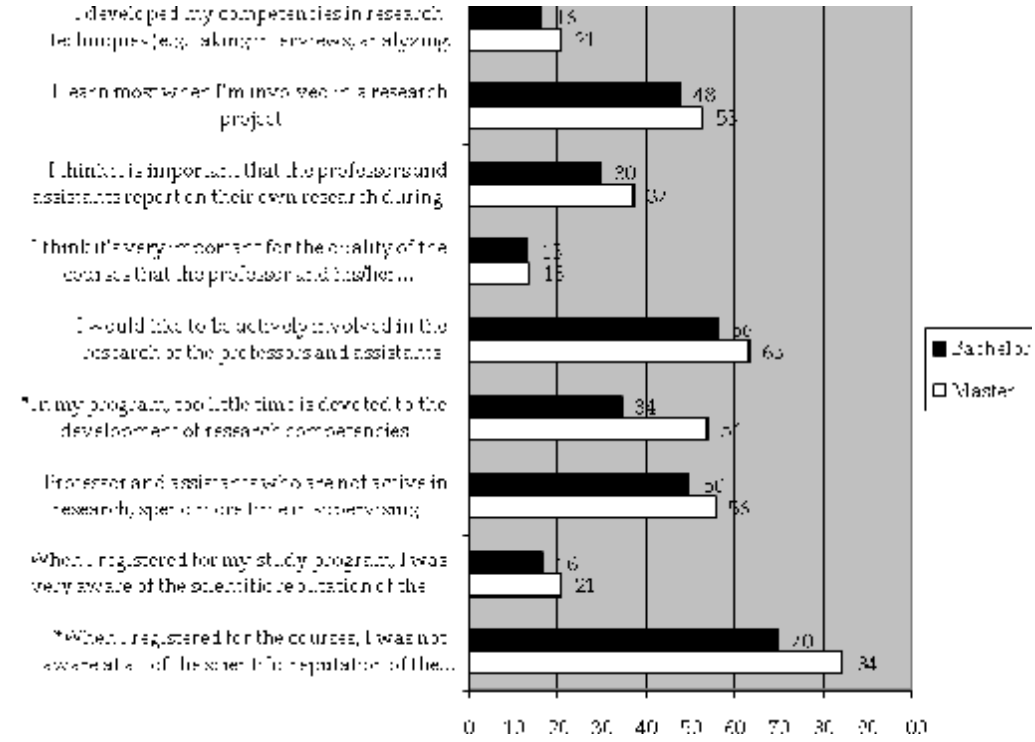
Figure 11. Awareness Research Activities Teachers by Students at the Faculty of BS, in %, answer category "yes".



Statement: I know the teachers of my programme are…..
*$p < 0.10$

Appreciation of the BS' Teaching Research Nexus by Students

Figure 12. Student's Evaluations of the TRN, in %, answer categories ++ and +**.



*$p < 0.10$
**on a 5 point scale from ++ "fully agree" to -- "totally disagree".

Within the interviews the teachers were asked as well how they think students appreciate the integration of research in teaching. Respondent 6 thinks students appreciate the integration of research and teaching. Students appreciate the fact they can think of a research question for their thesis, knowing it fits within the context of the current research being done. According to respondent 10, only some students think it is interesting and fun to do research. These

students generally choose to take a research course. Other students do not really care about doing research: these students want to get to their recommendations as quickly as possible:

> ***… die met een opdracht aan de slag komen en eigenlijk vanuit die opdrachtomschrijving zo snel mogelijk naar de aanbevelingen willen en alles wat ertussen zit dat boeit ze in feite niet. … Die mensen die zijn er absoluut en dan is onderzoek dan alleen maar iets lastigs dat je dan ook nog eens moet uitvoeren, en theorie ook iets lastigs is waarin je ook nog eens moet verdiepen. En ja, die mensen heb je er ook tussen zitten. Maar absoluut ook mensen die het heel erg leuk vinden. (R10).***

The student survey also contained statements about the integration of research in teaching (see Figure 12).

Most undergraduate and graduate students highly agreed to the statement "when I registered for the courses, I was ***not*** aware at all of the scientific reputation of the teachers of the courses" (70% vs. 84%). 56 per cent of the undergraduate student and 63% of the graduate students highly agreed to the statement they like to be actively involved in the research of professors and assistants. Furthermore, both undergraduate and graduate students generally were not aware of the scientific reputation of the staff working in the department of their study (16% vs. 21%).

5.1.3 The Teaching – Research Nexuses of the Faculty of BS

Within this section, an answer to the first research question "How is research integrated in teaching?" will be given. The TRN will be described according to the components of the theoretical model developed in section 2.2.4: materials and resources, teaching methods, roles of teacher, types of grouping, locations, and contents.

The Teaching – Research Nexuses

From these findings two separate TRNes can be distilled: one for the undergraduate phase and one for the graduate. During the undergraduate phase teaching methods that can be applied to large groups are being applied, like lectures and tutorials. Content wise, research skills are presented explicitly in that methodological courses are taught, but research content remains implicit in that research is only presented as examples to theories. Theory and methodology are taught separately, but come together in the design courses. In these design courses students tackle design problems in a scientific way. Furthermore, students are taught methodological techniques, participate in experiments, and are to a certain degree integrated in the departmental research projects during the design courses. However, although students are pushed to follow the steps of the empirical cycle and practice these methodological techniques, they do not have a clue about how to conduct research when they start their undergraduate project. Because a clear link is missing between the theoretical and methodological courses, students have problems establishing this link themselves within the design courses.

For the graduate phase the size of the groups of students attending courses is smaller, making it possible to apply more time intensive courses like papers, group discussions, presentations and assignments. Content wise, research skills are taught less explicitly and research content more explicitly. The graduate phase is about orientation on research topics for the graduate thesis and extending and applying research skills. Orientation on a topic for the graduate thesis takes place by taking courses on topics students are interested in or by taking part in research projects. Research skills can be extended by assignments, papers, workshops, or presentations of PhD-students about their research. Students learn to apply the acquired

research skills by joining research projects and writing their graduate thesis. However, explicit methodology courses are not taught any more during the graduate phase.

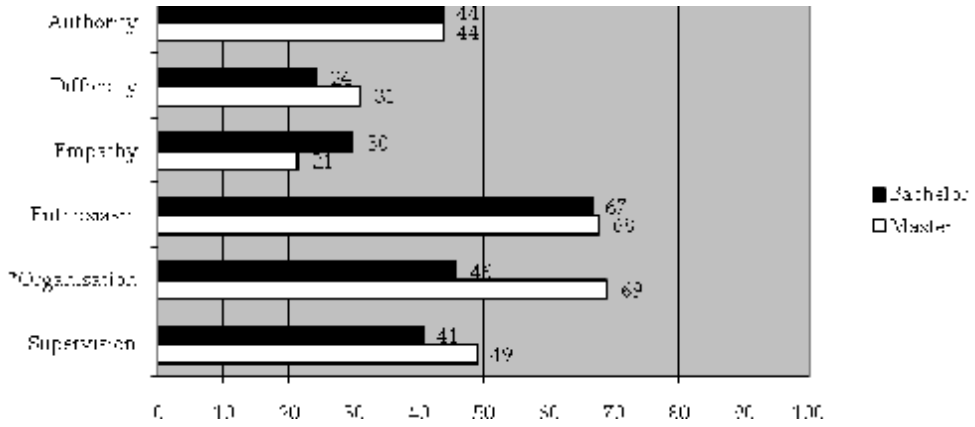
Generally one can conclude research is integrated more deeply in teaching for the graduate phase as certain types of teaching methods that are more often applied during the graduate phase establish a deeper integration of research in teaching.

From the evaluation of the integration of research in teaching it becomes clear the TRN is not very visible to undergraduate and graduate students and therefore they do not evaluate it very positively. Students would better appreciate the TRN if they could see it.

5.2 Personal Teaching Characteristics

Teachers can be perceived to be the central actors in conveying the TRN to the students. In this respect the performance of teachers and its effects on the TRN are of great importance. This section will take a closer look at how the teachers of the Faculty of BS actually teach in different respects. A set of indicators measuring different aspects of their teaching competences will be used to evaluate their performance.

Figure 13. Student Evaluation Personal Teaching Characteristics, in %, answer categories ++ and +**.



*$p < 0.10$
** on a 5 point scale from ++ "fully agree" to -- "totally disagree".

Table 5
Statements Given about Personal Teaching Characteristics in the Student Survey.

Mode of Teaching	***Statements***
	Due to the involvement of my teachers in research…..
Organisation	I understand the subject better.
Enthusiasm	I am more interested in the domain of my study.
	I am more motivated to do my best.
	I am more enthusiastic about the course.
Supervision	I am better supervised (e.g. during writing thesis, project work).
Empathy	I am shown more empathy towards me as a student.
Authority	I give more credibility/authority towards them.
Difficulty	The workload and difficulty of the course is more balanced.

The respondents were asked to indicate how they feel being involved in research influences their personal teaching characteristics, and how they feel that their teaching competencies were influenced by being involved in research. Within the student survey the students were asked to evaluate the same set of performance indicators via statements, again on the bipolar 5-point scale from section 3.3. Figure 13 shows the results of the student survey.

The personal teaching characteristics at the Faculty of BS that will be analyzed are shown in the first column in the table below. The second column shows the statements from the student survey that were given to the students.

5.2.1 Organisation

The variable organisation shows how well structured the teaching is: if the message send by the teacher is received and understood. Within the interviews teachers were asked to explain how their research activities influence the organisation of their teaching.

From the interviews no clear connection can be drawn between the influence of research involvement on teachers' ability to organise their teaching. According to respondent 8, a teacher who performs good research is not necessarily good at organising and explaining clearly the matter to be taught;

> ***Er zijn heel warrige docenten die dat heel moeilijk kunnen overbrengen, maar wel ontzettend goed in hun onderzoek zijn.***

Moreover, respondent 9 feels it is sometimes difficult to take into consideration the point of development the student is at. For example teachers sometimes forget students do not know the meaning of certain concepts which are common knowledge to the teachers themselves as they are experienced researchers.

Students do not see either a clear positive or a clear negative influence of research involvement on teachers' organisation of teaching as well. In the student survey students were asked to rate their agreement with the statement "Due to the involvement of my teacher in research I understand the subject better". The line of thought of this statement was that due to the research involvement of teachers teaching is better organised, resulting in better transfer of knowledge to students. 38 per cent of the undergraduate and 44 per cent of the graduate students agree that research involvement has a positive influence on the teacher's ability to organise his or her teaching, see Figure 13.

Organisation: From the above findings one can conclude there is not a clear connection between research involvement and the organisation of one's teaching. There is a negative influence of research involvement in that teachers forget students are not known with certain concepts. However, good researchers are not necessarily good teachers too.

5.2.2 Enthusiasm

Another mode of teaching is the teacher's ability to enthuse students. Teachers feel that being involved in research makes one better able to enthuse students. Two respondents felt it is important that teachers have a deep understanding of the matter they are teaching to be able to enthuse students (R8; R10). According to respondent 8 it is therefore important to put those teachers on courses that teach topics they are researching, especially in the graduate phase. Furthermore, respondent 9 feels teachers' ability to motivate students is not only influenced by research involvement, but also by the content to be taught and teaching method applied.

Also, the students' responses are positive. Of the undergraduate students 64 per cent responded positively to the statements given and of the graduate students 67 per cent, see Table 5 and Figure 13. Thus students think being involved in research is of influence on teachers' ability to enthuse students as well.

Enthusiasm: One can conclude research involvement has a positive influence on teachers' ability to enthuse students, but also factors like the content to be taught and teaching methods applied can be of influence on teachers' ability to enthuse students.

5.2.3 Empathy

The ability of a teacher to show empathy or be responsive towards students is another important mode of teaching. Within the interviews the teachers were asked about their opinion about the influence of research involvement on teachers' ability to show empathy and responsiveness towards students.

Teachers do not really know to what extent they should empathise with students. One respondent says it becomes more difficult to show empathy towards students as teachers get further away in time from their own college experience (R6). On the other hand, two respondents expresses they feel teachers empathise too much with students sometimes (R6; R9), for example, giving a student extra time for handing in a paper after his rabbit died (R6). According to respondent 9 the faculty has become too customer oriented: students understand it is a privilege to study at a university and this kind of privileges bring along certain obligations. For example, the faculty has to be more strict and clear in maintaining deadlines.

It can be argued students feel that teachers do not have the time to show empathy towards them due to being involved in research. Students are not very positive about the influence of research involvement on teachers' ability to show empathy. Of the undergraduate students only 27 per cent and of the graduate students only 21 per cent responded positively to the statement given, see Figure 13 and Table 5. This low agreement can possibly be explained by the fact students indicated that they feel research involvement eats away time from the time teachers have available for supervising students, see section 5.1.4.

Empathy: Research involvement does not influence the ability of teachers to show empathy towards students. Not only do teachers tap their experience of having been a student themselves instead of their research experience when showing empathy towards students, showing empathy towards students is also influenced as teachers feel they are in a customer oriented position towards the student. From the viewpoint of the students teachers' ability to show empathy is compromised by their availability for supervision.

5.2.4 Authority

As a mode of teaching authority can be defined as the extent to which a student gives credibility to a teacher. Generally, teachers feel that being involved in research gives them authority over students. Three respondents felt authority is closely connected to enthusiasm (R8; R9; R10). According to respondent 8 teachers derive authority from the fact they conduct research on the topics they teach. If teachers have authority it does not matter any more if they can teach or not; students will listen anyway.

…als je heel veel kennis op een bepaald gebied hebt en je weet dat over te brengen, dan..wordt je…ja ben je meer een autoriteit en je geloofwaardigheid neemt toe. En ook al kun je dan niet zo heel goed doceren, dan maakt dat op dat moment niet zo heel veel uit. Want bent wel een expert op je gebied, en dat zien die studenten over het algemeen ook wel (R8).

From the undergraduate students 45 per cent responded positively to the statement given and from the graduate students 53 per cent, see Figure 13 and Table 5.

Authority: From these findings one can conclude research involvement gives teachers more authority. Teachers who are involved in research gain in credibility because they show the purpose of research in the matter they teach.

However, these results are contradictory to the findings from section 4.1, which show students feel the fact teachers are involved in research does not influence the quality of the course. But one can argue that teachers who are involved in research have more authority, students are basically indicating that the quality of the courses is improved in some way.

5.2.5 Supervision

Another mode of teaching is supervision. Supervision can range from supervising groups of students during assignments to supervising and mentoring students during their graduate thesis. Generally, teachers did not really know if research involvement is of influence on their ability to supervise. Respondent 9 felt someone not involved in research can be just as good or bad in supervising students as someone who is involved in research.

Students responded not very clearly as well. In the student survey supervision was questioned by the statement "Due to the involvement of my teachers in research I am better supervised (e.g. during writing thesis, project work)". From the undergraduate students 38 per cent responded positively and from the graduate students 44 per cent, see Figure 13.

Supervision: Research involvement does not have a clear influence on teachers' ability to supervise. From the single comment made on the influence of research involvement one can conclude there is no influence from research involvement on the ability of teachers to supervise. However, both undergraduate and graduate students were moderately positive. Thus one may conclude there is a slight, positive influence from research involvement on the ability of teachers to supervise.

5.2.6 Difficulty

The final mode of teaching to discuss is the difficulty of content taught. Teachers are able to tune the difficulty of the content they teach to the presumed ability of students. From the statements of the teachers it becomes clear research involvement does not have an apparent influence on teachers' ability to balance workload and difficulty, but external pressures like accreditation and time available for teaching. Respondent 7 says that teachers experience external pressure making teaching materials "look" not too easy. As a consequence teachers get the tendency to add teaching materials resulting in monstrous 200 page syllabi. According to respondent 8, teachers' ability to balance difficulty and workload is influenced by teachers' research obligations: the more research teachers undertake, the less time they have for individual students or to teach. Thus the difficulty level is compromised as well.

Students neither think being involved in research is of influence on their ability to balance difficulty and workload. From the undergraduate students only 22 per cent responded

positively to the statements given, from the graduate students only 23 per cent, see Figure 13 and Table 5. Thus, students generally do not respond positively to the influence of research involvement on this aspect.

Difficulty: From the above one can conclude teachers' ability to balance workload and difficulty is not influenced by their involvement in research, but by the time they have available for research and external quality indicators.

5.2.7 Influence of Teaching on Research Performance

Next to the influence of research involvement on personal teaching characteristics, the teachers were also interviewed about the influence teaching has on their research. An influence from teaching on research is perceived to be present, but relatively small and indirect. According to one respondent teaching can be of influence on research in some cases. For example, the way a teacher writes scientific papers. Respondent 6 feels the essence of research is to convey what one has thought up. Teaching is similar to doing research in that one has to think of how to convey information.

> ***Ik schrijf natuurlijk over vakgenoten, maar ik schrijf ook met het idee dat ik als het ware ook zo zou moeten kunnen uitleggen voor een groep goede studenten. … Ik vind dat de kern van wetenschap is dat wat je bedacht hebt ook kunt overbrengen. En onderwijs is natuurlijk bij uitstek een situatie waarbij je daar heel goed over moet nadenken (R6).***

Furthermore, two respondents explain that discussions with students about their research are influencing the directions of some research of teachers (R6; R8): information coming from assignments made by students during design courses or from undergraduate and graduate thesis can be used for own research or even alter the direction of one's research (R8). However, according to respondent 7 experienced researchers already encountered research situations students come up with. For example, students interpret research results from another viewpoint. Usually the researcher already thought of it and explains to the student why his interpretation is not correct.

Influence: From these statements one can conclude teaching influences research in the sense that one learns how to convey scientific information, and discussions with students to various extents alter the course of research, e.g. new ideas or steering research in another direction. However, these influences seem very small.

5.2.8 Evaluation Personal Teaching Characteristics

Within the interviews the respondents were asked to evaluate the extent to which they feel they possess the in the previously discussed personal teaching characteristics. In general, the respondents were quite satisfied about their competences. All respondents are most satisfied with their ability to enthuse students. All respondents are less satisfied with their ability to balance difficulty and workload.

Furthermore, the teachers were asked to indicate which teaching modes were affected by being involved in research. The teachers pointed to three personal teaching characteristics: the enthusiasm (R6; R8), authority (R6; R10), and organisation (R7; R10). Some respondents feel being involved in research does not have an influence on their teaching (R7; R9). Respondent 8 feels one can be taught certain skills necessary to teach but in the end "one has to have what it takes". Especially for the first year it is important to let teachers teach who have it in them to teach.

Evaluation: One can conclude teachers posses all the personal teaching characteristics pointed out by the theory. However, when asking them directly about the modes influenced by being involved in research, they point out their ability to enthuse students, their ability to organise their teaching, and their authority. However, the influence is small as personal ability is of bigger influence on teachers' ability to teach.

5.2.9 Influence of the Personal Teaching Characteristics on the Teaching – Research Nexus of the Faculty of EEMCS

On the basis of the findings one can argue research involvement has a positive influence on the integration of research in teaching by teachers' ability to enthuse in that students taught by teachers whom are involved in research have a higher interest in research. Furthermore, research involvement has a positive influence on the integration of research in teaching by authority. Students can be argued to internalise the matter taught to a larger extent as students give more credibility to teachers whom are involved in research as to teachers who are not.

No clear connection exists between research involvement and the organisation of teachers' teaching and teachers' ability to supervise students. Research involvement does not influence the ability of teachers to show empathy and teachers' ability to balance workload and difficulty. Finally, a small, positive, reversed influence from teaching on teachers' research as discussions with and research output from students can alter the direction of the teacher's research.

Both undergraduate and graduate students generally agreed with the statements of the respondents.

5.3 Abilities of Students

As presented in the theoretical model, other factors influencing the TRN are the characteristics of students. The manner the TRN is conveyed has to be tailored to the characteristics of students in order for the message to be understood by students. In the TRN literature, abilities of students have been pointed out to be of influence.

Within the document analysis no explicit statements concerning the abilities of students were revealed. Within the interviews the teachers were asked to evaluate the abilities of students: how they changed over the last ten years, and if or how they change the integration of research in their teaching. The teachers distinguished both negative and positive changes in the abilities of students.

On the one hand the abilities of students have deteriorated as students experience difficulty in applying methodological techniques and lack an academic attitude nowadays. Concerning the first problem respondent 8 expresses that many students entering the undergraduate programme have problems with and are not prepared for the large amount and difficulty of statistics and research skills they are being taught. Furthermore, respondent 9 says students are pointed to methodological techniques and theories taught in previous courses which they need to apply while writing their thesis. The consequence is that teachers have "to start from scratch", resulting in students that are less developed researchers at graduation as what one aimed for. Concerning the lacking academic attitude respondent 9 mentions that students have grown more independent but have grown impatient as well. Impatience hinders the development of an academic attitude, as this academic attitude expects from students to act

goal oriented. Also students are not very critical any more: nowadays students think one document found through Google should do the trick.

> ***… ze zijn ook veel vluchtiger geworden. En de academische werkhouding verwacht dat de studenten doelgericht bezig zijn, alles uitzoeken wat er uit te zoeken valt. Terwijl studenten denken "Ach, ik heb één documentje via Google gevonden, dus zo zit het". Weinig kritische houding hebben ten aanzien van de kwaliteit die ze zien en wat ze doen en het al gauw goed vinden (R9).***

In contrast, students are methodologically better prepared, more interested in methodology, and more inventive in gathering information within the graduate phase. First, students are methodologically better prepared for their graduate thesis due to the methodological abilities they have developed during their undergraduate project. In contrast with the statements of respondents 9 and 10 noticed that students are methodologically much better equipped when they start their graduate thesis in contrast to some years ago. According to respondent 10 this is the result of the undergraduate project students undertake at the end of their undergraduate. Second, nowadays students show an academic attitude in that they are more eager to learn more. Respondent 9 says that nowadays students are eager to learn how higher order statistics work. Finally, the students have become more inventive in gathering information. Respondent 9 thinks that students are nowadays more inventive in approaching people for information and searching literature over the internet.

> ***Maar ze zijn wel heel inventief in het benaderen van mensen om ze even uit te horen en in het zoeken van literatuur, via Google, via internet… (R9).***

However, the extent to which graduate students possesses certain abilities varies from student to student. According to respondent 6 the abilities of the students entering the graduate phase vary strongly. Respondent 6 evaluates the abilities with which the students enter the graduate generally as inadequate. Not only perceives respondent 6 a difference in ability between students coming from a university undergraduate or college undergraduate, respondent 6 also perceives abilities of students to vary internationally. For example, a college undergraduate has to get used to the way of working at a university and for example a student from China has to improve his or her English. For these reasons it has been decided to start with a series of workshops to align the abilities with which the students enter.

Abilities: It is clear students' methodological abilities and academic attitude are perceived to be changing. On the one hand the abilities of students have declined as students experience difficulty in applying methodological techniques and lack an academic attitude in the undergraduate phase. On the other hand students are methodologically better prepared and more interested in methodology, and students are more inventive in gathering information in the graduate phase. However, the abilities of students in the graduate stage can vary greatly.

To give a preliminary answer to the research question "How do student characteristics influence the TRN?" is that for the undergraduate stage students are pointed to research skills they should have acquired before. As a result the level of students that graduate is lower because students' abilities are not adequately developed to apply higher order research skills. For the graduate stage the TRN is affected in that workshops are developed to align the abilities of students with which they enter the graduate.

5.4 Ideological Values Steering the Teaching – Research Nexus

Within the theoretical framework, in line with Taylor (2007), ideological factors were presented as factors that influence the management of the TRN. Ideological factors are "those forces that impact upon the relationship between teaching and research drawn from an underpinning body of ideas, beliefs and philosophy". The ideological factors include the mission statement of the faculty, and the beliefs and values the faculty and its teachers hold.

Within the Faculty of BS the TRN is considered an automatism as teaching and research exists side by side. Within the document analysis the mission and vision of the Faculty of BS were revealed. The mission and vision state both teaching and research are of importance for the faculty. However, no vision is given about how both activities complement each other. The Faculty of BS' (2006, p.3) ***mission*** is "to take care of education and carry out research in the areas of Educational Sciences, Applied Communication Sciences, Psychology and Philosophy. Some vision points from the Faculty of BS are;

- "Aim for a national and international leading position in education and research and acknowledgement of in scientific, professional and social relationships.
- Besides academic development and disciplinary depth, the education aims for interdisciplinary and utilisation."

Within the interviews the teachers were asked what they know about existing (explicit) statements of the faculty on the importance of a TRN and the beliefs and values the teachers hold. The teachers did not know of the existence of any explicit statements on the TRN of the Faculty of BS. The teachers themselves feel teaching and research are intertwined. First, the TRN is considered an automatism as teaching and research are united in the staff of the Faculty of BS (R10);

> ***Ik denk dat iedereen daar erg positief tegenover staat. En dat komt natuurlijk, wat ik net al aangaf…. Je bent een deel bezig met onderzoek en een deel bezig met onderwijs en dat zijn in feite twee banen die in één persoon verenigd worden en dat is best lastig.***

Respondent 9 says that connecting research to teaching is the only way to survive in a setting in which teachers experience pressure to produce research. Respondent 12 feels a university is a place where students are being taught by teachers who are active in research and students are being involved in research.

Values: For the Faculty of BS clearly the TRN is perceived to be established automatically as teaching and research are united in the staff and students are integrated in the departmental research. In terms of Taylor (2007) one can argue the ideology is rather passive and mostly in the minds of the people: they are not shared and acted upon very much. The ideologies impact the TRN in that the positive views provide support for a TRN.

5.5 Management Mechanisms Steering the Teaching – Research Nexus

The TRN can be managed actively or passively by different management mechanisms. Within the theoretical framework the following passive management mechanisms were presented:

- curriculum development,
- appraisal, and

- quality assurance.

The presented active management mechanisms were:

- curriculum development,
- strategic and operational planning,
- resource allocation, and
- staff development.

University and faculty documents have been analysed to find out what management mechanisms are applied. Also, within interviews teachers were asked what management mechanisms they are aware of.

5.5.1 Curriculum Development

The first tool at hand for managing the TRN is curriculum development. A curriculum is "an interrelated set of plans and experiences that a student undertakes under the guidance of a school" (Marsh & Willis, 2003, p.13). According to Marsh and Willis (p.68), the word 'development' "suggests an unhurried, comprehensive, cyclical, and ongoing process in which careful thought and worthwhile actions constantly refine each other". The TRN can be managed by curriculum development which ensures that research is integrated in teaching via the practices discussed in section 5.1: materials and resources, contents of the study programme, and teaching methods.

Within the Faculty of BS, curriculum development is not applied as a management mechanism in the sense that a TRN is actively established. No strategies strengthening the TRN by curriculum development have been found in the faculty documents.

Within the interviews teachers were asked how curriculum development is applied to establish a TRN. Within the Faculty of BS the curriculum is negotiated by the programme director with the heads of the departments in which efficiency considerations play an important role. First, according to two respondents, the development of the curriculum takes place in negotiation between the programme director and the heads of the departments (R8; R9). The programme director has certain ideas about shaping the curriculum of his programme.

> ***Want hoe het onderwijs nu wordt ingedeeld, en dat is wel het spanningsveld hoor zoals het nu zit. De opleidingsdirecteur heeft een bepaald plaatje in zijn hoofd, nou zeg dit plaatje, maar hij moet dan wel aankloppen bij het afdelingshoofd "ik wil graag dat het onderwijs op deze manier wordt uitgevoerd". En dat maakt het lastig, want een afdelingshoofd heeft een eigen budget en die moet zeggen van "Nou inderdaad, ik kan het aanbieden in die vorm." Maar hij kan ook zeggen van: "Nee, dat kan niet, jammer dat dat beter is voor de opleiding, maar voor mijn afdeling is het beter dat we het in een iets andere vorm aanbieden". En daar zit een heel groot spanningsveld denk ik. En dat is wel belangrijk, want er is niet iemand met een totaal beeld van "dit wil ik en ik wil inderdaad die link tussen onderzoek en onderwijs heel goed neerzetten". Maar dat betekend wel dat we heel intensief onderwijs gaan neerzetten, nou dat kan niet 1, 2, 3 worden uitgevoerd. Gewoon vanwege de versnippering van het geld (R8).***

Second, efficiency considerations are an important factor influencing the curriculum. The head of a department has to deal with a budget, limiting the possibilities of the shape a curriculum can take (R8). Furthermore, respondent 9 explains courses are being integrated out of efficiency considerations. For example, the psychology, applied communication sciences and educational science have methodology courses. An advantage of this integration

is that the courses are being enriched by the viewpoints of the different fields of study. A downside is that students are being introduced to their own field of study in a lower extent.

Respondent 9 feels the best thing for programme directors would be to have a budget of their own to allocate courses to teachers. In the current situations the allocation of courses remains a political game: making sure all the relevant departments have an equal share of courses to teach.

Curriculum development: The extent to which the TRN is strengthened by curriculum development depends on the available budget as the curriculum development that takes place at the Faculty of BS is driven by negotiation in terms of money between the programme director and heads of the departments.

The curriculum development that takes place at the Faculty of BS does not come close to the definition of curriculum development given by Marsh and Willis (2003). Steering of the TRN through curriculum development takes place actively in the sense that the programme director tries to steer the shape of the curriculum through negotiation. However, the extent to which the curriculum can be shaped to the wishes of the programme director is heavily influenced by efficiency considerations.

5.5.2 Appraisal

Another tool for managing the TRN is appraisal. It is assumed that in case teachers are appraised less for their teaching than for their research activities, they will be inclined to invest more time and energy in their research activities, thereby harming their teaching. As a result the TRN could be weakened.

Within the Faculty of BS appraisal is not applied as a management mechanism in the sense that a TRN is actively established. No strategies strengthening the TRN by appraisal have been found in the faculty documents.

From the statements the teachers made in the interviews it becomes clear that teachers are mainly praised for their research activities and hardly for their teaching. According to several respondents, research plays a larger role than teaching in assessment and promotion (R6; R8; R13). Although the department looks at teaching performance when promoting a teacher to associate professor, research performance plays a much larger role (R6). According to respondent 8 academic staff is being appraised on the basis of their publications. Teachers receive hardly any appraisal when they teach well.

Respondent 6 feels teaching should play a larger role in promotion. On the other hand respondent 6 felt the teaching system has an internal mechanism for appraising good teaching: good teachers attract more students wanting to write their thesis with them.

> ***… ik denk dat het systeem zelf wel een beetje heeft ingebouwd dat als je een goede docent bent dat je ook afstudeerders trekt. En afstudeerderbegeleiding heeft toch wel een beetje de rol van "als het niet te veel wordt, dan wordt het lastig". Maar als je er helemaal geen hebt, dan krijg je ook van "he, niemand wil bij hem afstuderen of niet bij haar". Dan is er iets aan de hand. Dus dat is wel een soort ingebouwde prikkel dat je ook niet de docent wil zijn waar geen afstudeerder op afkomt (R6).***

However, according to respondent 13, if a university let teaching performance play a larger role in assessment and promotion, the university's reputation will fall.

Appraisal: Appraisal is being applied as a management mechanism, but this weakens the TRN in that it stimulates research over teaching. However, appraisal for teaching is already inherent to teaching as good teachers attract more graduate thesis students.

5.5.3 Quality Assurance

Quality assurance may strengthen the TRN as it pays attention to the way research is integrated in teaching.

Within the Faculty of BS, the quality assurance for teaching consists of a variety of evaluations that are applied in a cyclical way. Within the document analysis, no specific quality assurance strategies concerning the integration of research in teaching were revealed. Only statements that depict the general quality assurance at the Faculty of BS were revealed. The goal of the BS internal quality assurance is threefold (Van Diepen, 2003, p.1):

- Preparation for the external quality assurance;
- Efficient and effective education; and
- Efficient and effective educational management.

The most important concept of the internal quality assurance at the Faculty of BS is the so called "quality circle". This quality circle has four quality demands (p.1):

A. Quality criteria for each object;
B. Evaluation procedure aimed at these criteria;
C. Discussing evaluation results with relevant actors;
D. Translation in improvement plans.

The objects the quality assurance system is aiming at are: goals, content curriculum, educational process, assessment, results, study ability, and the organisation containing personnel, services and resources and quality care (pp.1-2). In Appendix V these objects are put in relation of the four quality demands of the quality circle.

In addition to the internal quality assurance system, all the study programmes of the University of Twente and other Dutch universities and colleges (HBOs) are accredited by the Accreditation Organisation of the Netherlands and Flanders (NVAO) once every six years. Without accreditation the study programmes do not receive funding and students participating do not receive a monthly scholarship from the government (NVAO, Feb.2003, p.13). The accreditation framework is composed of the topics "goals study programme", "programme", "staff allocation", "resources", "internal quality assurance", and "results". For the topic programme the following criteria apply to the TRN (p.8):

- Students develop their knowledge in interaction between teaching and research;
- Recent developments and theories from the scientific area are integrated in teaching; and
- The study programme guarantees the development of academic skills.

Generally, the integration of research in teaching is evaluated as sufficient for the study programmes at the Faculty of BS (QANU, Oct. 2006; QANU, May 2007).
A separate quality assurance system for research is applied at the different research institutes of the University of Twente. Within the document analysis of the University of Twente it was revealed that the University of Twente (n.d.) has set up protocols for evaluating research: one for every discipline and one for the research institutions as a whole. The disciplines conduct a self evaluation every three years and are externally accredited every six years by an external committee. For these evaluations ***the Standard Evaluation Protocol 2003-2009 For Public Research***

Organisations of the VSNU, NOW and KNAW (Jan. 2003) is applied. This protocol assesses research according to the following criteria:

- Quality (international recognition and innovative potential)
- Productivity (scientific output)
- Relevance (scientific and socio-economic impact)
- Vitality and feasibility (flexibility, management and leadership).

Although the TRN is not a criterion for evaluation the executive board will ask researchers to pay special attention to their teaching (3TU, May 2008, p.8).

Recently, the research of the discipline educational sciences, conducted at the research Institute for Behavioural Research (IBR), has been evaluated as excellent (UT Nieuws, June 5th 2008). According to the evaluations of the QANU a sufficient interaction of research and teaching is established within both the undergraduate phase and the graduate phase of the study programmes at the Faculty of BS (QANU, Oct. 2006; Dec. 2006; May 2007).

Within the interviews the teachers were questioned about how courses, study programmes and teaching performance are evaluated. No specific quality assurance strategies concerning the integration of research in teaching were revealed within these interviews. From their answers the following evaluation procedures were revealed:

- Annual evaluations with students (R6);
- Day of the education (R6; R8);
- Electronic questionnaire via Internet (R6; R7; R8);
- Informal feedback meeting with some students during the course (R6; R7; R8; R10);
- Oral evaluations via the student association (R6);
- Response groups (R6; R8);
- Semester evaluations (R9; R10);
- Visitation by external committee (R8);

The current quality assurance system is criticised as the system is perceived to focus too much on the perspective of the students. Several respondents commented the current system of evaluation is too student centred (R7; R8; R9). Also, too little attention is paid to the development of content, difficulty and skills development over the years (R7);

> ***… er wordt maar zelden mee teruggekeken, naar is er een bepaalde opbouw in de inhoud en de moeilijkheidsgraad en de vaardigheden en ambities die je hebt als docent tussen de dingen die je in het eerste en het tweede en het derde en het vierde jaar doet (R7).***

According to respondents 6 and 9 plans exist to introduce minimum requirements for courses and teachers in the nearby future. The development of a new course will then be guided, tested and revised by an educationalist. Before it can start, the course has to be accredited. Although respondent 6 expects at least some resistance by teachers he feels this is an important step to persuade teachers of the importance of good teaching.

Quality Assurance: Although the quality assurance systems treat teaching and research as two separate activities and the integration of research in teaching is only evaluated on a higher level, the external evaluations by the QANU prove that the quality assurance in place is effectively applied as a management mechanism to strengthen the TRN.

On the one hand, the current quality assurance system does not strengthen the TRN as the integration of research in teaching is not part of the "day-to-day", student centred quality assurance system for teaching. The integration of research in teaching is only touched upon

on during external accreditation once every six years, and separate quality assurance systems exist for research and teaching. On the other hand, the study programmes need to be evaluated positively by this external accreditation committee as they depend on funding and are disciplines stimulated to pay attention to their teaching while evaluating their research. Furthermore, the positive external evaluations of both the integration of research in teaching and research proof the quality assurance systems are working. However, the TRN can be strengthened further by letting educationalists support teachers in integrating research in teaching in the nearby future.

5.5.4 Strategic and Operational Planning

Within the theoretical model presented in section 2.2.4, strategic and operational planning is a mechanism which actively manages the TRN. Within strategic operational planning it can be made explicit how teaching contributes to the achievement of the strategic goals of the faculty. Operational planning on the other hand can make explicit how teaching should be organised or operated to achieve these goals. Especially the task definitions of the academic staff are used to plan how teaching should be operated within a faculty.

Within the University of Twente teaching and research are treated as two distinct tasks as research and teaching are organisationally separated by putting the research task in research institutes. According to Carugati and Sangiorgi (2006, p.60), "the organisational and governance structures of the University of Twente were modified in order to better meet institutional objectives by separating education and research and to increase organisational transparency".

Within the Faculty of BS, strategic and operational planning are not applied as a management mechanism in the sense that a TRN is actively established. No strategies strengthening the TRN by strategic and operational planning have been found in the faculty documents.
Within the interviews teachers were asked which policies stimulating the integration of research and teaching they would know. Furthermore, teachers were asked what their opinion about these policies is. Most respondents stated they would not know if there were explicit policies stimulating the teaching research nexus (R6; R7; R8; R9; R10).

Several teachers were critical about the introduction of research institutes. Teachers feel the TRN is weakened in the sense that the establishment of research institutes pulls apart teaching and research as research is relocated in these research institutes and teaching remains in the faculties (R6; R12). Teachers fear that the establishment of research institutes would lead to an implicit classification of good and bad teachers. Respondent 6 feels the fact that teaching and research are pulled apart by the funding model may make teaching a waste bin. Teachers who hardly publish do not have an active attitude to attract research funding and cannot do research. To let them "generate money" they are given more teaching responsibilities. According to respondent 6, the risk exists that these low quality researchers are low quality teachers as well. Of course low teaching performance is addressed during the teacher's performance interview, but a teacher who does not have the intrinsic capabilities to be a good teacher will never become a good teacher (R6).

> ***Maar het hele systeem van de UT nogmaals, waarin onderwijs en onderzoek zo uit elkaar gehaald worden. Leidt er ook toe dat onderwijs, als ik het heel lelijk zeg, een soort afvoerputje kan worden. Dus mensen die te weinig publiceren, te weinig een actieve houding hebben om onderzoeksgeld binnen te halen. Die hebben dus geen onderzoeksfinanciering, dus die kunnen geen onderzoek doen. Om die mensen dan toch als het ware geld te laten genereren, als je het heel lelijk zeg, want ze moeten dat salaris moet terugbetaald worden. Of moet inverdiend***

worden, moeten ze dus onderwijs geven. En als je pech hebt kunnen dat ook wel wat mensen zijn die niet zulke goede docenten zijn. … Dan kun je natuurlijk wel degelijk mensen in zo'n functioneringsgesprek aanspreken op het slechte onderwijs. Maar iemand dat ook niet echt in zich heeft, zal nooit de sterren van de hemel doceren (R6).

However, not all teachers perceive a weakening of the TRN as research and teaching are still united in the same persons. Respondent 12 pointed to the fact that academic staff members have research as well as teaching obligations: 99% of the staff working for the research institute works for the faculty as well.

Another danger is perceived by teachers in the fact that the heads of departments have two bosses: the dean and the scientific director are forced to come to mutual agreement (R12). Finally, a policy that strengthens the TRN is letting professors who are active in research programmes teach first year introduction courses (R12).

Several respondents feel it would be more effective to facilitate new initiatives to integrate research in teaching than to create additional regulations to improve the TRN. According to respondents 7 and 10, steering the TRN from above is not effective: more facilitation should become available for new initiatives to integrate research in teaching. Respondent 10 is of the opinion that forcing teachers to apply to new regulations such as, for example, integrating research in teaching only creates new fields of tension. According to respondent 7 initiatives should be left to the people on the work floor: if a teacher has developed a successful method to integrate teaching and research other teachers will copy this method. According to respondent 7, the current quality assurance system does not leave much space for such innovations. However, work pressure plays a restricting factor as well.

Respondent 13 feels the university should establish relationships with a certain number of foreign universities with similar scientific activities. Professors and associate professors should exchange a certain amount of their research programmes with these universities. This way, students do not only come across important academics in their field of study through scientific literature but also actually meet them. Students should know the five most important academics in their field of study.

Strategic and Operational Planning: One may conclude that the management of the TRN through strategic and operational planning is rather passive. One strategy steering the TRN is giving academic staff both teaching and research responsibilities. For the undergraduate phase there is an additional strategy stating professors are active in the first year of the undergraduate programme. The strategy to create a matrix shaped organisation contains a risk in that the dean and scientific director come to mutual agreement.

Furthermore, it can be concluded the TRN should not be more actively managed in terms of strategic and operational planning, but more passively in terms of facilitation of new initiatives improving the integration of research in teaching.

5.5.5 Resource Allocation

Two main types of resource allocation can be distinguished: funding and time allocation. One can argue funding and time allocation strengthen the TRN in that they stimulate integrative activities, for example by allocating money and time to initiatives that are meant to improve the integration of research in teaching.

Funding

Within the document analysis a funding strategy strengthening the TRN is the sub component "research and teaching" that assures that the for the study programmes necessary amount of research is conducted, especially for Alfa study programmes as they are taught at the Faculty of BS. According to the university model (University of Twente, Sept.2007), the funding the faculties receive consists of two compartments: research and teaching. The research compartment contains a sub component called "research and teaching". The goal of this component is to safeguard the necessary amount of research conducted at the departments for the alpha and gamma study programmes at this university, as these study programmes have more students and less income from research compared to the beta study programmes. The amount of research conducted in the departments teaching courses especially plays an important part in the accreditation of graduate study programmes. 30 per cent of the money of this sub component is allocated to the undergraduate study programmes and 70 per cent to the graduate study programmes.

Within the interviews teachers were asked how teaching and research are being funded by the Faculty of BS. No teacher knew about the existence of any funding strategies for activities that integrate research in teaching. Several negative comments were made about the funding model described above. Firstly, teachers feel the research institutes have gained in power to influence the study programmes as the funding for research contains a teaching component which is hard to trace in terms of research. According to respondent 12, the money from the research and teaching component used to flow straight to the chairs teaching the courses. With the current model the money flows through the scientific director. This way the scientific director will get the opportunity to steer, making sure the direction of the research remains within the lines of the research institutes. Respondent 9 felt that the scientific director will be given influence on the study programmes themselves as well. Moreover, respondent 13 says that the research and teaching component is hard to trace: it is hard to trace whether the money is actually spent on research.

Secondly, research and teaching are pulled apart as research is perceived to be more profitable than teaching. Possibly this view is even strengthened by the fact that the amount of funding for teaching has been lowered. Generally, research is perceived by teachers as more profitable than teaching (R6; R8; R9). Respondent 6 feels this funding model forces teachers to choose between teaching and research. In case teachers automatically receive funding for teaching when conducting research, they can be good researchers and good teachers at the same time. Furthermore, respondent 6 explains that in earlier times the research and teaching component used to be much higher. Nowadays this component is much lower, especially for the undergraduate education.

> ***Dat docenten dus moeten kiezen tussen onderwijs en onderzoek. In plaats van dat het als een samenhangend geheel wordt aangeboden. He, waarin je dus als je onderwijs geeft automatisch, misschien moet je dan wel aan bepaalde voorwaarden voldoen, daar kun je wel allemaal aparte systemen voor gaan bedenken, maar dat je dus ook automatisch onderzoeksfinanciering krijgt. Dus dat je de reputatie als wetenschapper overeind kunt houden en tegelijkertijd ook een goede docent kunt zijn (R6).***

However, it is not all bad news. Respondent 6 feels one is becoming aware of the downsides of separate funding: for example, the accreditation of teachers and courses. Respondent 6 feels one has to think of reintegrating teaching and research financially, but doubts if this is still possible with the research institutes in place.

Funding: Although integration of research in teaching is established by introducing a teaching component in the research funding model, as a management mechanism funding is weakening the TRN in that it stimulates research over teaching.

One can conclude the current funding model applied at the Faculty of BS is influencing the Teaching – Research Nexus positively in that the research component contains a sub-component aimed at safeguarding the research volume necessary for the alpha and gamma study programmes. However, it remains a fact that teaching and research are funded rather separately. A possible negative side effect of this sub-component is that the scientific director has an indirect possibility to interfere with the contents of the study programmes. Furthermore, it is hard to trace if the research and teaching component is actually spent on research meant for the study programmes.

Time Allocation

Within the document analysis no information about time allocation to activities that integrate research in teaching was revealed. From the interviews it becomes clear that no specific time is allocated to the integration of research in teaching, but time allocation is defined in terms of time for teaching or time for research. Within the interviews the teachers were asked about how much time is allocated to teaching and research.

The teachers indicate four negative consequences of the current funding model. First of all, the current funding model stimulates research over teaching. As a consequence a shift is taking place in time allocation to research. According to respondent 13, performing good research is time consuming, difficult, and demands lots of energy, concentration and cooperation with colleagues. Moreover, the university's funding model draws additional attention to research, which respondent 13 feels is not recognised very well at this university yet. Therefore the Faculty of BS is seeking a balance between time allocated to research and teaching;

> ***Dat probleem is een bestaand probleem. Dat hoor je ook vaak dat mensen… Ja, een dag kun je maar één keer besteden. Wetenschappelijk werk is tijdrovend, het is moeilijk, het vraagt heel veel inspanning, langdurige concentratie, samenwerking vaak met collega's. Je wilt natuurlijk ook opbrengst hebben, dus je maximaliseert de kansen dat je ook de opbrengsten verzilvert. Dat maakt het doen van onderzoek gewoon buitengewoon ingewikkeld. … Daar gaat dus daardoor heel veel tijd heen, naar het onderzoek. En soms wel meer tijd, als je dat afzet tegen de tijd die voor onderwijs beschikbaar moet zijn. Daarnaast, als je een premiering stelt dat binnen de universiteit wordt gebruikt de bekostiging ook nog sterk op die onderzoeksresultaten, dan trek je nog meer aandacht natuurlijk naar die kant van de zaak. Nou dat is ook nog onderkend op deze universiteit. Wat wij nu doen is toch zoeken naar een evenwicht tussen die twee (R13).***

A second consequence of the current funding model on time allocation is that choices about teaching methods are made on basis of efficiency. Respondent 6 considers the time available for research to be of influence on the manner of teaching. To attain a research reputation researchers need a minimum amount of time to do research. As a result teachers with a heavy teaching load try to make their teaching responsibilities less time consuming to leave more time for research. According to respondent 6 the current "hour model" does not stimulate to keep a good balance between teaching and research;

> ***Wij hebben hier eigenlijk een systeem dat je eigenlijk heel weinig onderzoekstijd krijgt als je geen geld inverdient. Je krijgt een halve of een hele dag per week onderzoekstijd, dat is alles.***

Dat is veel te weinig om je reputatie als wetenschapper overeind te houden. Dus wat krijg je dan, dat docenten natuurlijk gaan proberen om hun onderwijs niet zo extreem tijdrovend te laten maken dat ze ook niet die ene dag in de week niet meer hebben. Dus mensen gaan dan toch op het aantal uren zitten dat daarvoor is ingecalculeerd. We hebben een soort urenmodel. En ja, dat stimuleert dan niet om dat in goed evenwicht te houden (R6).

Thirdly, little time is left to innovate courses as teachers experience increasing teaching loads. Respondent 7 says teachers with large amounts of teaching responsibilities, e.g. a large number of courses and graduate thesis students to supervise, hardly have time to prepare for or innovate courses. By having such a heavy teaching load extra revenues for teaching are earned, but it takes time before this money can be spent on hiring additional staff.

Finally, time available for teaching is further limited as researchers try to attract as much research funding as possible, creating a lack of capacity for teaching. According to respondent 6, in case a research group attracts an extensive amount of research funding, a lack of teachers is created. As a result temporary teachers are hired who get no opportunity to do research. Respondent 6 feels such developments can endanger the connection between teaching and research as well. However, respondent 6 does not receive any signals teaching is harmed by this lack of time yet.

Time allocation: The current funding model weakens the TRN as it stimulates time allocation to research over time allocation to teaching. As a result little time is left for teaching to be innovated or teaching methods are chosen on the basis of efficiency.

One can conclude a delicate balance between time invested in research and time invested in teaching exists: a balance that seems to have the tendency to incline to research. The fact that performing good research consumes a lot of time and the current funding model makes research activities financially more attractive, pushes teachers to invest a minimum amount of time in teaching. Furthermore, there is a lack of teaching staff. As a result teachers with no research responsibilities are hired or teachers have no time left to innovate courses.

5.5.6 Staff Development

Staff development can be applied in the establishment of a TRN in that teachers are taught and coached in how to integrate research in their teaching.

From the document analysis it becomes clear that the University of Twente has a broad spectrum of courses to develop research and teaching skills, in which the academic staff can take part. Offered teaching courses are in the area of preparation for teaching, designing a course, the organisation of teaching, supervising, assessment, and educational policy (ITBE, 2007). Within the documents of the Faculty of EEMCS one specific statement about how staff development is applied to strengthen the TRN can be found: besides research performance, employees will be appointed on the basis of their teaching ability as well. The UFO system offers the basis for dealing with tasks and roles, and performance agreements made on them. The system makes it possible to recognise and acknowledge outstanding performances of teachers and professors(BS, 2006a, p.16).

Within the interviews the teachers were asked about possibilities to develop their teaching and research skills. Types of performance development that were pointed out by teachers were coaching, the possibility to take courses and peer reviews. First of all, the annual performance interview can be seen as a type of coaching. From this year on, the programme director has to write a report on the teachers' teaching performance for the teachers'

professors (R6). These professors will discuss the report with the teachers during their annual performance interview (R6; R7; R8; R10). Within this annual performance interview the teacher discusses his teaching and research performance and how to improve both.

Secondly, the possibility to follow courses was pointed out by the teachers. According to respondent 6, research groups have some budget for their staff to take courses to develop their research and teaching skills. In case a teacher has to take a course and not enough money is available, he can ask, according to respondent 6, for extra budget at the dean (R6). The courses in the area of teaching and research offered by the educational service are open to all academic staff (R6; R7). New teachers take the DUIT-course, which is given by the educational service (S&O) of the University of Twente (R6; R8). For other teachers the offered courses can be taken voluntary (R8).

Another possible method of staff development is peer review. A condition for peer review is that teachers are open to criticism. According to respondents 8 and 10, an additional type of evaluation from a teacher's perspective could be peer review. However, respondent 8 says teachers consider themselves experts with which one does not like to tamper. Teachers are willing to invest time in peer reviewing each other. Additionally, respondent 10 says teachers are very open to each other. According to respondent 10, peer review already takes place in case a course is taught by multiple teachers. Furthermore, some teachers assess each other's tests already: not only for validity but for overlap in course content as well. Moreover, according to respondent 6 teachers are already looking at exams in couples and discuss representative examples of corrected exams with the teacher who made the exam.

Staff Development: Although staff development is applied as a management mechanism, neither existing staff development activities nor staff development activities under development are specifically aimed at the integration of teaching and research. Or at least the teachers do not know of their existence. In this sense staff development does not contribute to the development of a strong TRN.

Teachers have the opportunity to develop both their teaching as research skills. Teachers develop themselves mainly through courses and coaching. However, teachers hardly take part in the courses offered. New forms of staff development like peer reviewing of exams are being developed currently.

5.5.7 Teaching – Research Nexus Management at the Faculty of BS

Answering the fifth research question, "How is the TRN managed at the different faculties?" one can conclude that the TRN at the faculty of Behavioural Sciences is rather more weakened by management than strengthened. In general, management is not absent but some measures only strengthen one side of the TRN, which is mostly the research side. Only a few management mechanisms strengthen the TRN.

Management mechanisms strengthening the TRN are: quality assurance, and strategic and operational planning. First of all, quality assurance is effectively applied as a management mechanism. Although the quality assurance systems treat teaching and research as two separate activities and the integration of research in teaching is only evaluated on a higher level, the evaluations of the QANU prove that the quality assurance system is working for the TRN as well.

Second, the management of the TRN through strategic and operational planning is present but rather passive. One strategy steering the TRN is giving academic staff both teaching and

research responsibilities. For the undergraduate phase there is an additional strategy stating professors are active in the first year of the undergraduate programme. The matrix shaped organisation of teaching and research contains a risk in that the dean and scientific director come to mutual agreement.

Appraisal is being applied as a management mechanism, but it weakens the TRN in that it stimulates research over teaching. However, appraisal for teaching is already inherent to teaching as good teachers attract more graduate thesis students.

Funding weakens the TRN as the applied funding model, despite a teaching component, is integrated in the research funding and makes performing research more profitable than teaching. The current funding model is of influence on other management mechanisms like curriculum development and time allocation. Curriculum development is applied as a management mechanism as well, but is influenced by funding as courses are negotiated between the programme director and the heads of the departments in terms of money. In this sense curriculum development does not strengthen the TRN. The current funding model further weakens the TRN as it stimulates time allocation to research over time allocation to teaching. As a result, little time is left for teaching to be innovated and teaching methods are chosen on the basis of efficiency.

Although staff development is applied as a management mechanism, neither existing staff development activities nor staff development activities under development are specifically aimed at the integration of teaching and research. Or at least the teachers do not know of their existence. In this sense staff development does neither strengthen nor weaken the TRN.

5.6 Conclusion

The shape of the Teaching – Research Nexus (TRN) is determined by practices integrating research and teaching, organisational characteristics, contents of study programmes, and visibility of performed research for students. Possible influences on the management of the TRN might come from the personal teaching characteristics, student characteristics and ideological values.

The Teaching Research Nexuses

As could be read in section 5.1.5, the following TRNes for the undergraduate and graduate study programmes of the Faculty of BS can be described. Within the undergraduate phase, teaching methods that can be applied to large groups are being applied, like lectures and tutorials. Content is taught via theoretical, methodological and design courses. Research skills are presented explicitly, but research content remains implicit. Theory and methodology are taught separately, but come together in the design courses for which students tackle design problems in a scientific way. Furthermore, students are taught methodological techniques, participate in experiments, and are integrated in the departmental research projects to a certain degree during the design courses. However, although students are pushed to follow the steps of the empirical cycle and practice these methodological techniques, students do not have a clue about how to conduct research when they start their undergraduate project. Because a clear link is missing between the theoretical and methodological courses, students have problems establishing this link themselves during the design courses.

For the graduate phase the size of the groups of students attending courses is smaller, making it possible to apply more time intensive teaching methods such as papers, group discussions, presentations and assignments. Content wise, research skills are taught less explicitly and

research content more explicitly. The graduate phase is about orientation on research topics for the graduate thesis and extending and applying research skills. Orientation on a topic for the graduate thesis takes place by taking courses on topics students are interested in or by taking part in research projects. Research skills are extended by assignments, papers, workshops, or presentations of PhD-students about their research. Students learn to apply the acquired research skills by, for example, joining research projects and writing their graduate thesis. However, no explicit methodology courses are taught any more during the graduate phase.

The integration of research in teaching differs between the undergraduate and graduate phase in that certain types of teaching methods are more often applied within the graduate phase than within the undergraduate phase, establishing a deeper integration of research in teaching. Types of teaching methods that establish a deeper integration of research in teaching, like papers, group discussions, presentations and assignments, are time consuming, restricting the application of these teaching methods to small size groups of students that generally only exist during the graduate phase. In terms of research content the undergraduate and graduate study programmes differ in that undergraduate courses teach the general established techniques, while within the graduate courses the research actually conducted at the chairs of the departments is integrated.

About the experiences, visibility and evaluations of the TRN by students of the Faculty of BS, a story similar to the one about the Faculty of EEMCS can be told. The TRN is working well both for undergraduate and graduate students. On the one hand students appreciate a Teaching - Research Nexus. The Teaching - Research Nexus is not very visible to students as they are not very integrated in research. Neither undergraduatenor graduate students experience many research situations, undergraduate students experience even less research situations than graduate students. On the other hand students perceive teaching and research as two separate worlds: students feel they learn from the research conducted by their teachers. Although graduate students are slightly more integrated in research than undergraduate students, the TRN is as visible and evaluated as positively by graduate students as by undergraduate students.

Personal Teaching Characteristics

In case of the Faculty of BS, although teachers posses all the personal teaching characteristics, being involved in research only has a positive influence on the teachers' ability to enthuse and their authority. Both personal teaching characteristics strengthen the Teaching - Research Nexus. Research involvement does not influence teachers' abilities to organise their teaching, to empathise with students, to supervise students, and to balance workload and difficulty of the matter to teach. Both undergraduate and graduate students generally agreed with the statements of the respondents.

Abilities of students

When students enter the undergraduate programmas at the Faculty of BS , their methodological abilities and academic attitude, and information retrieving abilities are perceived to be changing. However, one can distinguish two groups: undergraduate students having difficulty in applying methodological skills and lacking an academic attitude. They are pointed to methodological skills they have learned before and pushed to follow the steps of the empirical cycle and not rush to the conclusions. On the contrary, graduate students are methodologically better prepared as a consequence of the undergraduate project and more often posses an academic attitude in that they are eager to learn new methodological skills. In

general graduate students have better developed information retrieval capabilities as they are better able to find literature over the Internet and by asking people for information.

Ideological Values

Also for the Faculty of BS in terms of Taylor (2007) one can argue the ideology is rather passive and mostly in the minds of the people as it is not shared and acted upon very much. Within the Faculty of BS the TRN is established automatically as teaching and research are united in the staff and students are integrated in the departmental research.

Management Mechanisms

The TRN at the faculty of Behavioural Sciences is rather more weakened than strengthened by management. In general, management is not absent but management measures like appraisal and funding only strengthen one side of the TRN, which is mostly the research side. Management measures that strengthen the TRN are: quality assurance, as the positive QANU evaluations prove the quality system is working, and strategic and operational planning as permanent academic staff is given both teaching and research responsibilities, and professors are active in the first year of the undergraduate study programmes. Management mechanisms that weaken the TRN at the Faculty of BS are: appraisal in that it stimulates research over teaching by means of assessment and promotion; and funding as the current funding model makes research activities more profitable than teaching, therefore stimulating research over teaching. The management mechanisms curriculum and time allocation are influenced by funding as money plays an important role within the negotiations between the programme director and chairs and the financial attractiveness of research pushes teachers to invest more time in research. Finally, staff development does not have a clear influence on the TRN for the Faculty of BS.

6 Discussion

The main research question this thesis wants to give an answer to is;

> ***How can the faculties most effectively manage their activities in order to create an optimal synergic link between university teaching and research?***

To answer this question two faculties which fields of studies one could differ to a large extent in their nature were studied; the Faculty of Electrical Engineering, Mathematics and Computer Sciences (EEMCS), and the Faculty of Behavioural Sciences (BS). The study contained: an analysis of national, university and the faculties' documents; interviews with 12 teachers of different rankings from both faculties; and a student survey that was conducted among 165 students of the Faculty of EEMCS, and 267 students of the Faculty of BS.

As previously described, the TRN of the Faculty of EEMCS and Faculty of BS will be discussed according to the TRN Management model (Figure 3, p.30) in section 6.1, to come to a conclusion on the main research question in chapter 6.2 and recommendations for strengthening the Teaching – Research Nexus (TRN) in section 6.3.

6.1 The Teaching – Research Nexuses Compared

A clear definition of what a TRN ***is*** or ***should be*** does not exist. Rather, the TRN indicates a relationship between teaching and research that can take many shapes. The goal of this section is to analyse the differences of the TRNes of the Faculty of Electrical Engineering and Computer Sciences (EEMCS) and Faculty of Behavioural Sciences (BS). The comparison is based on the research results from chapters 4 and 5. Tables 6 and 7 summarise the findings from chapters 5, the Faculty of EEMCS, and 6, the Faculty of BS.

6.1.1 Comparison of the Teaching – Research Nexuses

In line with Neumann (1992) teachers try to transmit advanced knowledge and the most recent facts from the research conducted by themselves and colleagues in their field of study. Undergraduate courses teach the general established techniques, whereas within the graduate courses students apply the previously acquired basic skills and get integrated in departmental research projects. For both the faculties within the undergraduate phase more traditional teaching activities are taking place whereas within the graduate phase more research like activities takes. However, the extent to which research methodology is made explicit within the undergraduate study programmes differs for the faculties: the Faculty of BS teaches methodology explicitly in methodology courses, whereas the Faculty of EEMCS teaches methodology implicitly within project courses. The extent to which research methodology is made explicit in the undergraduate study programmes does not have a clear influence on the extent to which undergraduate students are integrated in research. Within the graduate phase research is integrated implicitly in teaching at both faculties, which is reflected in the fact graduate students from both faculties are as integrated in research.

Thus in terms of research content the TRNes at the Faculty of EEMCS and Faculty of BS start out very differently for the undergraduate phase. However, the TRNes end up looking similar to each other in the graduate phase. Within the graduate phase students apply the research skills they acquired in the undergraduate phase. Furthermore, students get integrated in the departmental research within research courses and the graduate thesis.

Table 6

Summary of the Teaching – Research Nexus at the Faculty of EEMCS.

Variables	***Main findings***
TRN	• Research methodology is taught implicitly. Within the undergraduate study programmes research is content in the sense that research is used as a means to illustrate general theories. Within the graduate programme research becomes the topic itself, and students develop an academic attitude, acquire extensive knowledge and gain practical research experience. • Within the undergraduate study programmes school like types of teaching methods including assignments, labs and lectures are being applied. Whereas within the graduate study programmes research like types of activities, including research projects and conducting research for the graduate thesis, are taking place. Teaching methods are partially selected on the basis of efficiency considerations. • Students are not very integrated in research as they do not experience many research situations during their study. On average graduate students experience more research situations during their study programme than undergraduate students. • Ongoing research activities at the faculty and conducted by teachers are as visible to graduate students as to undergraduate students . • Students do not perceive the quality of the study programme to be improved by the involvement of teachers in research. However, students feel they can learn from being involved in research
Personal Teaching Characteristics	Research involvement has a positive influence on teachers' ability to enthuse, to supervise and teachers' authority.
Abilities of students	Students lack analytical and conceptual abilities, but have better developed practical, and communicative abilities and ability to see connections between the matter taught.
Values, beliefs and mission	• The mission states teaching is to produce the future researchers. • Integration of research in teaching is considered an automatism
Management mechanisms	• Management mechanisms strengthening the TRN are: quality assurance, and strategic and operational management. • Management mechanisms weakening the TRN are: appraisal, time-allocation, and staff development

The number of research situations experienced by students confirms the view of teachers that graduate students are more integrated in research than undergraduate students. For both faculties graduate students experienced interestingly more often research situations like: discussing scientific work of a guest speaker, discussing scientific work of their professor or his assistant, engage in the preparation of a research project, prepare a thesis or a research paper, present a research project in a seminar, or read a scientific report of their teacher.

These research situations reflect that graduate students apply their research skills in research situations more often.

Table 7
Summary of the TRN at the Faculty of BS.

Variables	***Main findings***
TRN	• Research methodology is taught implicitly. Within the undergraduate study programmes research is content in the sense that research is used as a means to illustrate general theories. Within the graduate programme research becomes the topic itself, and students develop an academic attitude, acquire extensive knowledge and gain practical research experience. • Within the undergraduate study programmes school like types of teaching methods including assignments, labs and lectures are being applied. Whereas within the graduate study programmes research like types of activities, including research projects and conducting research for the graduate thesis, are taking place. Teaching methods are partially selected on the basis of efficiency considerations. • Students are not very integrated in research as they do not experience many research situations during their study. On average graduate students experience more research situations during their study programme than undergraduate students. • Ongoing research activities at the faculty and conducted by teachers are as visible to graduate students as to undergraduate students . • Students do not perceive the quality of the study programme to be improved by the involvement of teachers in research. However, students feel they can learn from being involved in research
Personal Teaching Characteristics	Research involvement has a positive influence on teachers' ability to enthuse, and teachers' authority.
Abilities of students	In general students have improved information retrieval abilities. Within the undergraduate phase students lack methodological skills and an academic attitude, whereas within the graduate phase students have developed a good academic attitude and are eager to acquire new methodological skills.
Values, beliefs and mission	Integration of research in teaching is considered an automatism.
Management mechanisms	• Management mechanisms strengthening the TRN are: quality assurance, and strategic and operational management. • Management mechanisms weakening the TRN are: appraisal, and staff development • Management mechanisms that do not have a clear influence on the TRN are: curriculum development and time-allocation.

A clear difference exists between undergraduate study programmes at the Faculty of EEMCS and undergraduate study programmes at the Faculty of BS. Whereas for the undergraduate study programmes of the Faculty of EEMCS research methodology remains implicit in the sense that research methodology is not explicitly discussed during for example research projects, for the BS' undergraduate study programmes research methodology is explicitly taught in specially developed methodology courses and students apply the methodology they have been taught during these methodology courses explicitly in the design courses. However, for the undergraduate students of the Faculty of BS a clear link between methodological skills and the "explicit" application of these acquired skills is still missing. Furthermore the faculties differ in that undergraduate students of the Faculty of EEMCS experience less research situations than the undergraduate students of the Faculty of BS. The other way around, the undergraduate students of the Faculty of BS are less aware than undergraduate students of the Faculty of EEMCS of the research taking place at their faculty.

In general, the image that graduate students are more integrated in teaching is confirmed as graduate students have experienced more research situations than undergraduate students, see in Figure 15 in Appendix VI. When comparing both faculties in terms of research situations experienced by students, it appears that students from the Faculty of EEMCS are as integrated in research as students from the Faculty of BS as they have experienced respectively 21% and 25% of the indicated research activities. As one can see in Figure 15 in Appendix VI the faculties differ in the extent to which students have experienced certain research situations. However, these differences balance each other out in the sense that students of the Faculty of EEMCS experience certain research situations more often whereas the students of the Faculty of BS experience certain other research situations more often. A similar balance in differences exists for the undergraduate and graduate students.

Furthermore, graduate students are in general slightly more aware of research activities taking place at their faculty than undergraduate students, see Figure 16 in Appendix VI. Also, undergraduate students of the Faculty of EEMCS are more aware of ongoing research than undergraduate students of the Faculty of BS. At first hand it appears that students of the Faculty of BS are less integrated in research than students of the Faculty of EEMCS, as 47% vs. 57% of the given research activities are visible. However, when taking a closer look to the different phases, it becomes clear it is the undergraduate students of the Faculty of EEMCS that are more aware than undergraduates students of the Faculty of BS of ongoing research activities undertaken by teachers. See Figure 16 in Appendix VI.

Third, graduate students are in general more aware of ongoing research activities of teachers, see Figure 17 in Appendix VI. In terms of students' awareness of the research activities undertaken by their teachers the finding that graduate students are more integrated in research than undergraduate students is only reflected in the Faculty of EEMCS. On average, undergraduate students experienced 58% of the ongoing research activities versus 66% by the graduate students at the Faculty of EEMCS. For the Faculty of BS undergraduate students experienced 54% and the graduate students 56%. When taking a closer look at the study phases again it becomes clear that undergraduate students of the Faculty of EEMCS are more aware of the ongoing research activities of their teachers than undergraduate students of the Faculty of BS.

Finally, graduate students value the TRN more highly than undergraduate students. See Figure 18 in Appendix VI Undergraduate students of the Faculty of BS evaluate the TRN higher than undergraduate students of the Faculty of EEMCS, but are also more negative

about the influence of research involvement on the availability of teachers and time allocated to the development of research competences.

One can conclude graduate students are generally more integrated in research than undergraduate students. When comparing the two faculties it becomes clear that the faculties mainly differ in the extent to which students are integrated in teaching for the undergraduate phase: undergraduate students of the Faculty of EEMCS being more integrated in research than undergraduate students of the Faculty of BS. About the implicitness/explicitness of research methodology one can conclude that teaching research methodology explicit does not improve the visibility of research as one would expect.

The fact the TRNes of both faculties look alike for the graduate curricula is reflected in the fact that graduate students from both faculties are integrated in research in terms of research situations experienced, as in awareness of research activities taking place at their faculty, and as in research activities conducted by their teachers.

6.1.2 Personal Teaching Characteristics Compared

The teacher can be perceived to be the central actor in conveying the TRN to the students. In this respect the performance of teachers and its effects on the TRN are of great importance. This section takes a closer look at how the teachers of the Faculty of BS perform a set of indicators.

In line with Jenkins ***et al.*** (1998) research involvement has a positive influence on the TRN as teachers who are involved in research are better able to enthuse students and have more authority. Also in line with Jenkins ***et al.*** (1998) supervision has a positive influence on the TRN. However, this influence is diminished by time allocation to research. Research involvement does not have a positive influence on teachers' ability to organise their teaching, and to balance workload and difficulty.

The findings about the personal teaching characteristics at both faculties are in line with Jenkins ***et al.*** (1998) as teachers who are active in research are given more authority and are better able to enthuse. However, it is not clear if teachers are better supervisors as well. For both faculties research involvement has a positive influence on the TRN as students are taught by teachers who are involved in research. Students who are taught by teachers who are involved in research have a higher interest in research: teachers who are involved in research are better able to enthuse students. Furthermore, for both faculties research involvement has a positive influence on the integration of research in teaching by authority: students can be argued to internalise the matter taught to a larger extent as students give more credibility to teachers who are involved in research as to teachers who are not. However, for the Faculty of EEMCS research involvement has also a minimising effect on the TRN as time consuming leaves little time for the organisation of one's teaching. The faculties differ in the influence research involvement has on teachers' ability to supervise. Supervision can be argued to integrate research in teaching as it enhances the effectiveness of teaching methods like the undergraduate project and the graduate thesis. However, few students agree as they indicate research involvement has a negative influence on the time teachers have available to supervise.

In general, graduate students are not more positive about the influence of research involvement on teachers' personal teaching characteristics. Undergraduate students of the Faculty of BS perceive a greater influence of research involvement on personal teaching

characteristics than undergraduate students of the Faculty of EEMCS. See also Figure 19 in Appendix VI.

6.1.3 Abilities of students Compared

Another factor influencing the TRN is the student characteristics. The manner the TRN is conveyed has to be tailored to the students' characteristics in order for the message to come across. In the TRN literature, student ***ability*** has been pointed out to be of influence.

In case a faculty is experiencing a structural problem in diminishing basic skills, the TRN is affected in that, if at all, less time is available for topics that demand higher order skills. However, in case the changing abilities are perceived to be the result of the motivation of student, e.g. a lacking academic attitude, the integration of research in teaching is not influenced. The findings are in line with Neumann (1992) as students' abilities and motivations influence the TRN.

Within both faculties the TRN is weakened as basic abilities, like analytical, reflective and methodological skills are declining or even lacking. However, for the Faculty of BS these declining skills are the result of a lacking academic attitude. Furthermore, in the Faculty of BS a second group of students that are methodologically able and eager to learn more about methodology is emerging.

The faculties respond differently to the changing abilities of students. The Faculty of EEMCS responds to the changing abilities of students by fixing the lacking abilities or omitting topics from the content that assume higher order abilities from the students. However, the Faculty of BS does not respond to changing abilities by adjusting the content of the courses but points students to theories and techniques they have studied in earlier courses.

One can conclude that the nature of the changing abilities of students of the Faculty of EEMCS differs from the nature the changing abilities of students of the Faculty of BS. The Faculty of EEMCS has to deal with a structural problem of diminishing analytical and conceptual abilities of students which are fixed. The findings about changing abilities of students at the Faculty of BS provide evidence for the "intangible connection" of Neumann (1992) that assumes a TRN develops in students an approach and attitude towards science. The diminishing abilities of students of the Faculty of BS are part of a lacking academic attitude and the in section 6.1.2 discussed missing links between methodological and other courses in the undergraduate phase. However, within the graduate phase students possess an academic attitude.

6.1.4 Ideological Values Compared

Within the theoretical framework, in line with Taylor (2007), ideological factors were presented as factors that influence the management of the TRN. Ideological factors are "those forces that impact upon the relationship between teaching and research drawn from an underpinning body of ideas, beliefs and philosophy". The ideological factors include the mission statement of the faculty, and the beliefs and values the faculty and its teachers hold.

The beliefs and values of the teachers show proof for Neumann's (1992) global connection, and Hattie and Marsh's (1996) conventional wisdom model, as academics of both faculties believe that research and teaching are complementary activities. The fact teachers adhere to their role as a teacher as well as to their role as a researcher disputes the differential model of Hattie and Marsh (1996). When comparing the ideological values of the Faculty of EEMCS to

the ideological values of the Faculty of BS, it becomes clear both faculties and its staff support the TRN: teachers in both faculties hold positive beliefs and values about the existence of a TRN. The ideology that a TRN has to exist is shared passively and hardly acted upon within both faculties. In terms of Neumann, Hattie and Marsh, the ideological values held by the faculties differ: at the Faculty of EEMCS teaching is aimed at producing the future scientists that secure the scientific research, whereas at the Faculty of BS teaching and research are "just" two tasks of a faculty that naturally coexist.

6.1.5 Management Mechanisms Compared

The TRN can be managed actively or passively by different management mechanisms. Within the theoretical framework the following management mechanisms were presented;

- curriculum development,
- appraisal, and
- quality assurance.
- strategic and operational planning,
- resource allocation, and
- staff development.

In line with Taylor (2007) his model, the faculties hold passive values about the TRN and manage the TRN passively. Both faculties differ hardly in the way they manage the TRN within their study programmes. Management mechanisms applied by the faculties rather stimulate research, not teaching. The management mechanisms that are applied are quality assurance, and strategic and operational planning strengthen a TRN at both faculties.

Both faculties apply quality assurance, and strategic and operational planning to strengthen the TRN. At first hand quality assurance does not seem to strengthen the TRN as the quality assurance systems of both faculties treat research and teaching as two separate activities. However, positive evaluations of the Quality Assurance Netherlands Universities (QANU) about the integration of research in teaching prove the quality assurance systems are effective in steering the TRN within both faculties. The Faculty of EEMCS and Faculty of BS apply strategic and operational planning in a comparable way as they give academics both teaching and research responsibilities. This type of management corresponds with the fact both faculties believe that a TRN is automatically established as both responsibilities are united in one and the same persons. Furthermore, in line with Taylor (2007) the TRN is managed more actively within the undergraduate phase than the graduate phase as professors participate actively in the undergraduate study programmes.

Within both faculties the Teaching - Research Nexus is weakened by the management mechanisms: appraisal, funding and time allocation. Appraisal weakens the TRN as academics are mainly appraised and assessed on the basis of their research performance and not their teaching. Funding stimulates research over teaching as the funding model applied by both faculties makes research more profitable than teaching. Time allocation is influenced by funding as academics are pushed to invest more time in research.

Two management mechanisms that do not have a clear influence on the TRN of both faculties are curriculum development and staff development. In the case of staff development the TRN is strengthened as the programme director addresses chairs from fitting research areas to teach certain courses. However, within the Faculty of BS the negotiations on the allocation of and teaching methods applied within courses are influenced by the amount of money and time available. Second, the findings are in line with Coate ***et al.*** (2001) and Hattie and Marsh (1996) as scarcity of resources are a key factor in negative relations between teaching and

research. Staff development does not have a clear influence on the TRN as there are no specific development programmes or tools for staff development on integrating research in teaching. Within the Faculty of EEMCS academics receive coaching from their professors which is mainly aimed at research. Thus for the Faculty of BS no influence of staff development exists, whereas for the Faculty of EEMCS a negative influence of staff development on the TRN exists.

6.1.6 Differences in Teaching – Research Nexuses

One can conclude that the Teaching - Research Nexuses existing at the faculties do not differ much from each other as the faculties do not differ much in the way they manage their Teaching - Research Nexus. Only two clear differences in the Teaching - Research Nexuses have been found between the faculties: the extent to which research methodology is taught explicitly within the bachelor study programmes, and the extent to which bachelor students are integrated into research. Within the way the teaching-research nexuses are managed no clear differences were found.

6.2 Conclusion

In accordance with Schimank and Winnes (Dec. 2000) the University of Twente too gravitates towards a post-Humboldtian pattern. The belief that teaching and research are complementary activities, the Humboldtian pattern, is rooted within this university but not communicated actively among the academics of the different faculties. Differentiation in roles, the organisation and resources for teaching and research pushes towards the implementation of a post-Humboldtian pattern. However, this pattern does not restrict academics to teaching, as Schimank and Winnes claim, but to research.

Within this move to a post-Humboldtian pattern some pressures similar to those depicted by De Weert (March 2004) are observed within the faculties. First of all, the two-cycle structure of bachelor and master is creating a divide between undergraduate and graduate training. For both faculties a stronger TRN is established within the graduate phase than within the undergraduate phase. The curricula are developed in ways that mirror or support research processes within the disciplines. In general, for the undergraduate phase the research undertaken by teachers themselves and other academics is used to illustrate the matter teachers are teaching. Teaching methods applied within the undergraduate phase are rather traditional: methods that are mainly included are: lectures, tutorials and student labs. Furthermore, students are provided training in relevant research skills and knowledge. The faculties differ in the extent to which research methodology is taught explicitly. In the Faculty of EEMCS research methodology is taught rather implicitly within project courses. The line of thought at this faculty is that students “learn by doing”. In contrast, for the Faculty of BS research methodology is taught rather explicitly. In each of the undergraduate programmes specific courses teach students how to design research, gather data, and how to quantitatively and qualitatively analyse data. Within design courses students apply the methodological skills and theoretical knowledge they have acquired. However, a clear link between the three types of courses is missing.

Interestingly, the TRNes within the faculties’ graduate programmes are quite similar to teach other. For both the faculties research undertaken by teachers themselves and other academics is the topic itself in the courses they teach. Students are involved in staff research. Also, research methodology is taught implicitly as students are expected to practice the research skills they have acquired during the undergraduate phase in the research they undertake within their graduate phase.

Still both undergraduate and graduate students of both faculties are not very integrated in research as they experience only a few types of research situations within their study programmes. Graduate students experience more types of research situations than undergraduate students, but on average both groups of students experience only very few research situations. Furthermore, research activities undertaken by teachers and other academics at the faculties are as visible to undergraduate as to graduate students. Also, students do not see their study programmes benefiting from the existing TRNes. On the contrary, students believe they can learn from being integrated in research. Therefore they want to be more involved in the research taking place at their faculties.

Another possible pressure on the TRN that could be identified from the literature was the dissimilarity between the abilities underlying good teaching and those underlying good research (De Weert, 2004). Teachers were asked what personal teaching characteristics were influenced by research involvement. By being involved in research teachers gain in authority towards students and are better able to enthuse students. To a lesser extent teachers are also better supervisors of students. In line with Jenkins ***et al.*** (1998) one can argue these three personal teaching characteristics strengthen the TRN as students who give more credibility to their teacher and are more enthusiastic are better able to develop an academic attitude and acquire research skills. Supervision strengthens the TRN as it enhances the teaching methods applied. Interestingly some personal teaching characteristics like supervision and organisation of ones teaching are influenced to a larger extent by time available for teaching then by the fact teachers are involved in research. Thus teachers derive some personal teaching characteristics from their research activities, but the effect is diminished by the restricted time available for teaching. Little evidence can be found for the assumption one is a good teachers if one is a good researcher.

Additionally, student abilities tend to pressure the TRN. Abilities of students influence the TRNes in that they diminish the time available for teaching higher order research skills and theory. For the Faculty of EEMCS this is caused by missing basic abilities that are fixed first. For the Faculty of BS the influence of abilities of students differs between the undergraduate and graduate phase. For the undergraduate phase diminished time available for teaching higher order research skills is present as well. Diminished teaching of higher order skills and knowledge is the result of a lacking academic attitude and the missing links between the different types of courses. However, for the graduate phase students possess an academic attitude and are eager to acquire new research skills. On the other hand abilities of students vary greatly within the graduate phase, needing workshops to align the abilities with which students enter the programmes.

Finally, the management mechanisms applied by both faculties rather weaken the TRNes present. Management mechanisms that are generally applied to strengthen the TRN are quality assurance, and strategic and operational planning. At first hand, quality assurance seems to weaken the TRN as quality assurance for teaching and research are treated separately at both faculties. However, positive evaluations about the integration of research in teaching proof quality assurance in fact is strengthening the TRN on a meta level. In both faculties the TRNes are managed more actively for the undergraduate phase than for the graduate phase as professors are obliged to teach undergraduate courses.

In accordance with De Weert (March 2004) the increasing separation of financial support for teaching and research is pressuring the TRN as well. Funding stimulates undertaking research over teaching as the funding model applied makes research more profitable than

teaching. As a result academics are pushed to allocate more time to research and less time to teaching and mainly appraised and promoted on the basis of their research performance. Moreover, teachers choose their teaching methods on the basis of efficiency considerations instead of effectiveness, and are the personal teaching characteristics "organisation" and "supervision" affected as teachers do not have sufficient time to organise their teaching and supervise students in a proper way.

Two management mechanisms do not have a clear influence on the TRN: curriculum development and staff development. Curriculum development does not have a clear influence on the TRN as on the one hand the programme director addresses chairs to teach research courses, but on the other hand choices about which chairs will teach what courses and how the courses are taught are made on the basis of amount of money and time available. Staff development does not have a clear influence on the TRN as all types of help available aim either at improving teaching skills or research skills.

No conclusion can be drawn on the effects of different management styles as the ways both faculties manage their TRNes do not differ much from each other. However, in line with Taylor (2007), one can conclude that faculties who hold passive values about the TRN, manage the TRN passively as well.

6.3 Directions for Strengthening the Teaching – Research Nexus

As the Teaching – Research Nexus model shows (Figure 3, p.30) a Teaching – Research Nexus is established and influenced by three actors within a faculty: the students, the academics and the faculty as a whole. Their actions are based upon values they hold about the existence of a TRN. The following recommendations are directed at those actors that can actively steer a TRN: the teacher and the faculty. The recommendations are aimed at "relieving" the pressures upon the TRNes; 1) the two-cycle structure, 2) differing abilities for teaching and research, 3) diminishing student abilities, and 4) increasing separation of financial support for teaching and research.

6.3.1 Recommendations Towards the Faculties

The final research question of this thesis is "How can the management of the TRN be optimised for the different study phases and faculties?". The view here is that, seen the heavy workload of academics and the large number of activities academics account for, the solution does not lie in additional regulations for, but in facilitation of the establishment a stronger TRNes. Teachers already agree with the necessity and value of a TRN and therefore willingly to contribute to the establishment of it. However, teachers face many pressures to invest more time and energy in research while teaching loads are growing as well. As a result little time is left to innovate and thus strengthen the TRN. Therefore, the following strategies will be recommended to the faculties (Jenkins, Healy and Zetter, Apr. 2007; Jenkins & Zetter, 2003; Zubrick ***et al.***, Apr. 2001);

Develop departmental and disciplinary understanding. First of all, the TRN can be strengthened by establishing positive underlying values about the existence of a TRN among the faculty's academics. It may be clear that the staff of both faculties supports the existence of a TRN, but ***how*** teachers perceive a nexus to exist is not communicated or discussed within the faculties and departments. For establishing a strong TRN a mutual understanding is necessary. Such decisions can be prompted by departmental seminars, away-days and publications (Jenkins, Healy and Zetter, Apr. 2007; Jenkins & Zetter, 2003).

Develop staffing policies. Second, the faculty can further strengthen the TRN by "formalising" the importance of both roles. This would relieve the exerted pressure from the current funding model to spend more time and energy into research activities. An important bottleneck for the TRN is the limited amount of time teachers have available for both teaching and research. If one wants teachers to establish a TRN it has to be included as part of their role as a teacher. Therefore the following strategies in the area of staff development and appraisal can further strengthen the TRNes;

- ***Make the nexus a central consideration in hiring new staff (Jenkins et al., Apr.2007; Jenkins & Zetter, 2003);***
- ***Make the nexus a central consideration in promoting staff (Zubrick et al.,Apr. 2001);***
- ***Make the nexus central or intrinsic to role description and workload planning (Jenkins et al., Apr.2007; Jenkins & Zetter, 2003);***
- ***Make the nexus central to role descriptions for leadership positions (Jenkins et al., Apr.2007; Jenkins & Zetter, 2003);***
- ***Development of better and, where possible, common metrics for teaching and research (Jenkins et al., Apr.2007; Jenkins & Zetter, 2003).***

Finally, support for integrating research in teaching is practically lacking at the University of Twente. Skills, knowledge and roles of staff play a key role in supporting or obstructing a TRN. Since abilities for teaching and research are not the same, support has to be offered to academics to become both good teachers and researchers and making a bridge between both types of activities. Moreover, offering support and appraisal for establishing a TRN shows the faculty values the existence of such a TRN. Examples of how staff can be supported in integrating research in teaching are;

- ***appraisal and promotion(Jenkins et al., Apr.2007; Jenkins & Zetter, 2003); or***
- ***arranging seminars and exchanges to learn from other departments (Zubrick et al.,Apr. 2001).***

6.3.2 Recommendations Towards the Teachers

Generally, students are not very aware of and the necessity of a TRN. By making explicit to students how research actually takes placed and what they can learn from it students might appreciate research more and see the use of acquiring research skills and knowledge for their later career. For the teachers, the following suggestions will be made with regard to curriculum development strategies for linking research and teaching at the level of the modules and courses within the undergraduate and graduate phase. These recommendations are aimed at instilling a positive approach towards the existence of a TRN. Furthermore, the recommendations are aimed at strengthening the TRN within the undergraduate phase. Of course they can be applied within the graduate phase as well;

Make students learn and assess students in ways that mirror research processes: from the statements of the teachers and document analysis it becomes clear the study programmes already mirror research processes to some extent. However, students are not very aware of this fact as they do not see the links between parts of their study programme and do not perceive to have experienced a lot of research activities, especially within the undergraduate phase. Selected upper level undergraduate students and graduate students can be organised to support student inquiry in introductory courses.

Develop student awareness of learning from staff involvement in research: although students have indicated they can learn from research undertaken by their teachers, they do not feel they are currently learning from this research. Thus students are shown they are already learning from research taking place in and outside their faculty.

Develop understanding of how research is organised, commissioned and funded in the discipline and institution: Although students see to a high extent that research is taking place at their faculty, they do not seem to know how research is organised. By developing this understanding in students, they might appreciate research more.

Develop student involvement in research: students indicated they want to be more involved in research.

Limit the negative consequences for students of staff involvement in research: for example manage the student experience of the days when staff are 'away' doing research. Students feel teachers are not always as contactable and their ability to supervise suffers from it.

Research and evaluate the student experience of research and feed that back in the curriculum: students do not always experience the TRN as teachers expect them to do so. Therefore it is important to research and evaluate this and adjust the curriculum to make the value of research in teaching more clear to students.

Support students in making clear to them the employability elements of research: this is important for the large part of students who seek employment outside research and therefore may not appreciate the value of a TRN.

7 References

Scientific Literature

Altbach, P.G., & Boyer, E.L. (1996). ***The International Academic Profession: Portraits of fourteen countries.*** The Carnegie Foundation for the Advancement of Teaching. San Francisco, CA: Jossey-Bass Inc..

Brew, A., & Boud, D. (1995). Teaching and Research: Establishing the vital link with learning. ***Higher Education, 29***, 261-273.

Carugati, F.F., & Sangiorgi, S. (2006). Interlink Project: Evaluation and accreditation systems in Europe. A case study: the Netherlands and Twente University. In Orsinger, C., ***Assessing Quality in European Higher Education Institutions: Dissemination, Methods and Procedures.*** Heidelberg: Physica-Verlag.

Coate, K., Barnett, R., & Williams, G. (2001). Relationships Between Teaching and Research in Higher Education in England. ***Higher Education Quarterly, 55***(2), 158-174.

Colbeck, C.L. (1998). Merging in a Seamless Blend: How Faculty Integrate Teaching and Research. ***The Journal of Higher Education 69***(6), 647-671.

De Weert, E. (2001). The End of Public Employment in Dutch Higher Education? In Enders. J. (Ed.), ***Academic Staff in Europe: Changing Contexts and Conditions.*** Retrieved on June 29th, 2008, from http://books.google.nl.

De Weert, E. (March 2004). The Organisational Determination of the Teaching and Research Nexus. Paper for the international colloquium ***Research and Teaching: closing the divide?***, Winchester, UK.

Entwistle, N., & Tait, H. (1990). Approaches to learning, evaluation of teaching, and preferences for contrasting academic environments. ***Higher Education, 19***, 169-194. Retrieved on May 25th, 2007, from Springerlink.

Gibbs, G. (2001). ***Analysis of strategies for learning and teaching.*** Higher Education Funding Council for England, Bristol. Retrieved on June 7th, 2007, from http://www.hefce.ac.uk/

Gottlieb, E.E., & Keith B. (1997). The academic research-teaching nexus in eight advanced-industrialized countries. ***Higher Education, 34***, 397-420. Retrieved on April 19th, 2007, from Springerlink.

Griffith, R. (2004). Knowledge production and the research-teaching nexus: the case of the built environment disciplines. ***Studies in Higher Education, 29***(6), 709-726. Retrieved on April 19th, 2007, from EBSCOhost.

Hattie, J., & Marsh, H.W. (1996). The Relation Between Research and Teaching: A Meta-Analysis. ***Review of Educational Research, 66***(4), 507-542.

Hattie, J., & Marsh, H.W. (2004). ***One journey to unravel the relationship between research and teaching.*** Retrieved on April 19th, 2007, from http://www.solent.ac.uk/ExternalUP/318/hattie_and_marsh_paper.doc

Jenkins, A. (2004). ***A guide to the research evidence on teaching - research relations.*** The Higher Education Academy. Retrieved on April 19th, 2007, from http://learn.royalroads.ca/teaching/Resources/Teaching_research%20relations.pdf

Jenkins, A., Blackman, T., Lindsay, R., & Paton-Saltzberg, R. (1998). Teaching and research: Student perspectives and policy implications. ***Studies in Higher Education, 23***(2), 127-141. Retrieved on April 19th, 2007, from Informaworld.

Jenkins, A., Healey, M. & Zetter, R. (Apr. 2007). ***Linking research and teaching in disciplines and departments.*** The Higher Education Academy. Retrieved on April 19th, 2007, from http://www.heacademy.ac.uk/

Jenkins, A., & Zetter, R. (2003). ***Linking Research and Teaching in Departments.*** LTSN Generic Centre. Retrieved on April 19th, 2007, from http://www.qub.ie/

Leišytė, L. (2007). ***University Governance and Academic Research: Case studies of research units in Dutch and English universities.*** Enschede: University of Twente, CHEPS.

Lindsay, R., Breen, R., & Jenkins, A. (2002). Academic Research and Teaching Quality: the views of undergraduate and postgraduate students. ***Studies in Higher Education, 27***(3), 309-327. Retrieved on April 19th, 2007, from EBSCOhost.

Marsh, H.W., & Hattie, J. (2002). The relation between Research Productivity and Teaching Effectiveness: Complementary, Antagonistic, or Independent Constructs? ***The Journal of Higher Education, 73***(5), 603-641.

McInnes, C., Griffin, P., James, R., & Coates, H. (2001). ***Development of the Course Experience Questionnaire***. Camberra: Department of Education, Training and Youth Affairs. Retrieved on July, 2007, from www.dest.gov.au.

Neuman, R. (1992). Perceptions of the TRN: a framework for analysis. ***Higher Education, 23***, 159-171. Retrieved on April 19th, 2007, from Springerlink.

Neuman, R. (1994). The TRN: Applying a Framework to University Students' Learning Experiences. ***European Journal of Education, 29***(3), 323-338. Retrieved on April 19th, 2007, from JSTOR.

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

Schimank, U., & Winnes, M. (Dec. 2000). Beyond Humboldt? The relationship between teaching and research in European university systems. ***Science and Public Policy***, December 2000, 397-408. Retrieved on June 1st, 2008, from IngentaConnect.

Taylor. J. (2007). The teaching research nexus: a model for institutional management. ***Higher Education, 54***(6), 867-884. Retrieved on September 16th, 2007, from SpringerLink.

Verburgh, A., Elen, J., & Clays, C. (2007). The Relation between Teaching and Research: The Perception of First Year Students at the University of Leuven, in EUI-Net, ***Teaching and Research Synergy in the context of University-Industry cooperation.*** Retrieved on July 6th, 2007, from http://www.securio.nl/IER/T_RS_pnPDF.pdf#page=32

Zubrick, A., Reid, I., & Rossiter, P. (2001). ***Strengthening the Nexus between Teaching and Research.*** Australian Department of Education, Training and Youth Affairs. Retrieved on June 7th, 2007, from www.dest.gov.au.

National/International

Ministerie van OC&W (June 2006). ***Vaststelling van een nieuwe regeling voor het hoger onderwijs en onderzoek (Wet op het hoger onderwijs en onderzoek): Memorie van toelichting.*** Retrieved on Juli 14th, 2007, from www.minocw.nl.

NVAO (2003). ***Accreditatiekader bestaande opleidingen hoger onderwijs.*** Den Haag: NVAO. Retrieved on July 18th, 2007, from http://nvao.net.

QANU (2004). QANU-Kader: ***Gids voor de externe kwaliteitsbeoordeling van wetenschappelijke undergraduate- en graduateopleidingen ten behoeve van accreditatie.*** Versie 3.1. Utrecht: QANU. Retrieved on July 18th, 2007, from www.qanu.nl.

QANU (Aug. 2004). ***Mathematics.*** Retrieved on June 25th, 2008, from www.qanu.nl.

QANU (Dec. 2004a). ***Computer Science: Revised Edition.*** Retrieved on June 25th, 2008, from www.qanu.nl.

QANU (Dec.2004b). ***Elektrotechniek.*** Retrieved on June 25th, 2008, from www.qanu.nl.

QANU (Oct. 2006). ***Communicatiewetenschap.*** Retrieved on June 25th, 2008, from www.qanu.nl.

QANU (Nov. 2006). ***Electrical Engineering 1999-2004.*** Retrieved on June 25th, 2008, from www.qanu.nl.

QANU (Dec. 2006). ***Onderwijskunde.*** Retrieved on June 25th, 2008, from www.qanu.nl.

QANU (Sept. 2007). ***Informatica.*** Retrieved on June 25th, 2008, from www.qanu.nl.

QANU (Oct. 2007). ***Wiskunde.*** Retrieved on June 25th, 2008, from www.qanu.nl.

QANU (May 2007). ***Psychologie.*** Retrieved on June 25th, 2008, from www.qanu.nl.

VSNU, NWO & KNAW (Jan. 2003). ***Standard Evaluation Protocol 2003-2009 For Public Research Organisations.*** Retrieved on June 25th, 2008, from www.vsnu.nl

University of Twente

De Kuyper, P. (June 5th, 2008). ***Onderwijskunde loopt met onderzoek voorop.*** Enschede: UT Nieuws. Retrieved on June 25th, 2008, from www.utnws.utwente.nl.

University of Twente (2006a). ***Concept Nota Onderzoeksbeleid Universiteit Twente 2006-2010: Focus op Excellentie, Innovatie en Valorisatie.*** Retrieved on July 5th, 2007, from www.utwente.nl.

University of Twente (2007a). ***Feiten en Cijfers: Ingeschreven studenten EWI.*** Retrieved on June 19th, 2007, from http://www.utwente.nl/feitenencijfers/

University of Twente (2007b). ***Feiten en Cijfers: Ingeschreven studenten GW.*** Retrieved on June 19th, 2007, from http://www.utwente.nl/feitenencijfers/

University of Twente (2007c). ***Functie Niveau Matrix versie 3.*** Retrieved on July 5th, 2007, from www.utwente.nl.

University of Twente (Sept. 2007). ***Notitie uitwerking Herzien UT-verdeelmodel. Kenmerk: FEZ/380.127.***

University of Twente (n.d.). ***Protocollen onderzoeksbeoordeling Universiteit Twente.*** Retrieved on June 25th, 2008, from www.utwente.nl.

3TU (May 2008). 3TU Standard Research Evaluation Protocol. Retrieved on June 25th, 2008, from www.utwente.nl.

Faculty of EEMCS

EEMCS (Feb. 2006a). ***Telematica: Zelfevaluatierapport 2006 van de undergraduateopleiding.*** Enschede: Faculteit EWI, afdeling Informatica.

EEMCS (Feb. 2006b). ***Technische Informatica: Zelfevaluatierapport 2006 van de undergraduateopleiding.*** Enschede: Faculteit EWI, Afdeling Informatica.

EEMCS (Feb. 2006c). ***Computer Science: Self-evaluation report 2006 of the graduate's programme.*** Enschede: Faculty EEMCS, Department of Computer Science.

EEMCS (Feb. 2006d). ***Telematics: Self-evaluation report 2006 of the graduate's programme.*** Enschede: Faculty EEMCS, Department of Computer Science.

EEMCS (Feb. 2006e). ***Zelfevaluatie-rapporten 2006: Supplement bij de zelfevaluatierapporten 2006 voor de opleidingen Technische Informatica (undergraduate), Telematica (undergraduate), Computer Sciece (graduate), Human Media Interaction (graduate), Telematics (graduate).*** Faculteit Electrotechniek, Wiskunde en Informatica (Afdeling Informatica).

EEMCS (Jul.2006). ***Strategisch Plan EWI 2006-2009.*** Kenmerk: EWI06/B:Mhn/629bsc. Retrieved on June 19th, 2007, from www.ewi.utwente.nl/intranet.

Faculty of BS

BS (Mar. 2005a). ***Zelfstudie 2005: Undergraduate of Science opleiding Educational Design, Management & Media.*** Enschede: Universiteit Twente, Faculteit Gedragswetenschappen.

BS (Mar. 2005b). ***Zelfstudie 2005: Graduate of Science Programme Educational Science & Technology.*** Enschede: Universiteit Twente, Faculteit Gedragswetenschappen.

BS (May 2005a). ***Zelfstudie 2005: Graduate of Science opleiding Toegepaste Communicatiewetenschap.*** Enschede: Universiteit Twente, Faculteit Gedragswetenschappen.

BS (May 2005b). ***Zelfstudie 2005: Graduate of Science opleiding Communication Studies.*** Enschede: Universiteit Twente, Faculteit Gedragswetenschappen.

BS (2006). ***Faculteit Gedragswetenschappen: Faculteitsreglement.*** Kenmerk: BFD-GW/2006-322a/pz. Retrieved on June 19th, 2007, from www.gw.utwente.nl/intranet

BS (Feb. 2006). ***Zelfstudie 2006: Undergraduate en Graduate of Science Psychologie.*** Enschede: Universiteit Twente, Faculteit Gedragswetenschappen.

BS (2008). Faculteit Gedragswetenschappen (GW). Retrieved on April 28th, 2008, from www.gw.utwente.nl

Van Diepen, J. (Nov. 2003). ***Korte notitie kwaliteitszorg. Kenmerk: 03.009.*** Retreived on June 13th, 2007, from www.gw.utwente.nl.

Appendix I Measurements for Strengthening the TRN

Examples of measurements undertaken to strengthen the nexus within institutions are (pp.62-5):

- ***Achieving a better balance between individual and departmental reward systems;***
- ***Strategic policy alignment;***
- ***Transparent outcomes promotions and appointments exercises;***
- ***Extending institutional learning from the outcomes of strategically funded projects; and***
- ***The development of better, and where possible, common metrics for teaching and research.***
- ***Schemes that reward departments and schools, not just individuals;***
- ***Promotions practices that reward good teaching as well as research;***
- ***Openness and transparency in promotions decisions when the criteria are changed to embrace a wider range of scholarly activity;***
- ***Mentoring within and among departments and schools for mutual learning;***
- ***Practical assistance with knowing where to publish research in pedagogical approaches and in what forms;***
- ***Staff mentoring to enhance postgraduate research supervision; and***
- ***Career-focused staff development seminars that assist staff to better manage the complexity and change of academic staff.***

Factors outside or beyond the institution that strengthen the nexus are (pp.66-7):

- ***Professionally mandated curriculum and pedagogical changes;***
- ***Seeking solutions to professional practice issues and problems;***
- ***Publishers' demands for new kinds of student text; and***
- ***Interfaces between policy and practice.***

More specific to undergraduate education, identified mechanisms for encouraging linkages between teaching and research are (pp.67-8):

- ***Being more strategic in organising student project work around existing or developing staff research interests;***
- ***Seeking and valuing the contribution of students in developing research methodology and analysis through their involvement in work-in-progress seminars;***
- ***Acknowledging the contribution of students make to academics' work through their literature searches, field data, dissertations and work and life experiences; and***
- ***Considering how research and teaching might be linked through external organisations, such as through students' actual or potential employees, who could provide venues for developing research skills.***

Some identified impediments to an integration of teaching and research are (pp.71-8):

- ***The persistent problems with reward systems;***
  - ***Inadequate evaluation system;***
  - ***Undervaluing diversity;***
  - ***Limited ability to dispense tangible rewards;***
- ***The underestimated need for change;***
- ***Tacitly accepting a teaching/research dichotomy;***
- ***The rewarded quantity rather than quality in research;***

- ***The changing nature of academic work practices; and***
- ***The challenge to build community, departmental and campus life.***

Different impediments to the nexus across the three institutions are related to factors as (p.xii):

- ***The number of research-only and teaching-only (part-time) staff;***
- ***Types of teaching undertaken – especially service teaching;***
- ***Types of research undertaken;***
- ***The rate of knowledge change within the discipline;***
- ***The composition of the student body including the cohort size and the proportion of international students;***
- ***The number and diversity of postgraduate students; and***
- ***Involvement in offshore and distance education.***

Recommendations for "underestimating the need for change" are (pp.73-5):

- ***Administrators need to reinforce their university's vision and values in every available context;***
- ***Heads of departments/schools need to be effectively trained and rewarded to lead their academic units;***
- ***Administrators and the head of departments/schools need to grapple with the summative and formative aspects of staff review for both teaching and research;***
- ***Institutions need to develop more effective evaluation systems, especially teaching, which incorporate peer review; and***
- ***Institutions need to reward departmental as well individual achievement.***

Further recommendations are (pp.80-81);

- ***Asking scholars to highlight their most important and influential work in both teaching and research for appointment and promotions;***
- ***Incorporating evaluations of scholarship related to both teaching and research in appointments and promotions;***
- ***Wherever possible, incorporating teaching-only (part-time) and research-only staff within academic units in the unit is key decision making processes; and***
- ***Establishing formal organisational connections or links between specialised research centres and departments/schools that allow opportunities for senior undergraduates and honours students to have 'affiliations' during their studies.***

Appendix II Interview Schedule

Interview schedule TRN

- Wat is mijn functie in het geheel van het interview
- Onderwerp onderzoek
- Doel onderzoek
- Benodigde tijd voor het interview
- Waarom de teacher is geselecteerd voor het interview
- Hoe de gegevens verwerkt worden en wanneer de teacher het onderzoeksverslag zal ontvangen
- Vooruitblik over de structuur van het interview

Algemene vragen

1 Geslacht Man ☐ Vrouw ☐

2 Leeftijd ..... jaar

3 Binnen hoeveel hoger onderwijs instellingen heeft u gewerkt? .....

4 Hoeveel jaar bent u werkzaam geweest binnen het hoger onderwijs (inclusief dit jaar)? ..... jaar

5 Hoeveel jaar bent u werkzaam geweest buiten het hoger onderwijs (inclusief dit jaar)? .....

6 Wat is uw huidige academische functie binnen de universiteit/faculteit? HL ☐ UHD ☐ UD ☐ Docent ☐ Promov ☐

7 Hoeveel mensen werken binnen het team waartoe u behoort? ..... personen

8 Beoefent u nog werk buiten de University of Twente? Ja ☐ Nee ☐

9 Hoeveel jaar werkt u nu al binnen de University of Twente (inclusief dit jaar)? ..... jaar

10 Hoeveel jaar geeft u les in het hoger onderwijs? …… jaar

11 Hoe bent u bij de University of Twente terechtgekomen?

12 Hoeveel uur besteedt u per week aan; Onderzoek (bv. literatuur lezen, schrijven, experimenteren, veldonderzoek)

13 Wat voor soort onderzoek doet u?

14 Hoeveel academische bijdrages heeft u voltooid in de afgelopen drie jaar? (bv. Bijdrages aan boeken, publicaties, conferenties)

15 Hoeveel uur besteedt u per week aan; Doceren (voorbereiden, instructie, adviseren studenten, lezen en beoordelen van werk van studenten)

16 Hoeveel uur besteedt u aan dienstverlening? (bv. diensten aan cliënten, betaald of onbetaald consultancy, publieke of vrijwillige dienstverlening)

17 Hoeveel uur besteedt u aan beheer/bestuur? (bv. commissies, departementale vergaderingen, “paperwork”)

18 Wat voor research commitments heeft u? (bv. contracten e.d.)

19 Gezien uw eigen voorkeuren, liggen uw interesses voornamelijk in doceren of in onderzoek?

Curriculum and Research based Learning

20 Kunt u aangeven waar er sprake is van onderzoekgebaseerde leren binnen het programma?
- Opbouw onderwijsprogramma
- Inhoud curriculum
- Pedagogische onderwijsvormen / uitvoering curriculum
- Beoordelingsmethodes

21 Hoe worden onderzoeksmethoden/vaardigheden/ethiek onderwezen en geoefend?
- Opbouw?
- Variëteit?

22 Kunnen studenten deelnemen in departementale onderzoeksprojecten?

23 Wat zijn de mogelijkheden voor studenten om onafhankelijk onderzoek te doen binnen het programma?

24 In hoeverre wordt u als docent vrijgelaten in het integreren van uw onderzoek binnen het curriculum of vakken?

25 Hoe beoordeelt u de kwaliteit van de nieuwe studenten als u kijkt naar de vaardigheden die ze meebrengen? ☐ ☐ ☐ ☐ ☐

26 Hoe zou u deze kwaliteit vergelijken met de kwaliteit van de studenten van voorgaande jaren?

27 Welk effect heeft de kwaliteit van studenten op de integratie van onderzoek in uw onderwijs?

28 Hoe zichtbaar is het onderzoek voor de undergraduate en graduate studenten?

29 Worden de onderzoekskennis en –vaardigheden die studenten zich eigen maken duidelijk gemaakt in de leeruitkomsten?

30 Hoe denkt u dat studenten tegen de integratie van onderzoek in onderwijs aankijken?

31 Welke invloed heeft het geven van (onderzoeksgebaseerd) onderwijs op uw onderzoek?

Teaching Skills

		++	+	0	-	--
32	Hoe beoordeelt u uw volgende vaardigheden/de mate waarin u deze bezit?					
	a. Mate van organisatie/helderheid van stof naar de studenten toe	☐	☐	☐	☐	☐
	b. Vaardigheid om studenten te betrekken, motiveren, enthousiast te maken voor wat u doceert	☐	☐	☐	☐	☐
	c. Begrip naar studenten toe/ inlevingsvermogen in studenten	☐	☐	☐	☐	☐
	d. Het hebben van geloofwaardigheid, een autoriteit zijn naar studenten toe	☐	☐	☐	☐	☐
	e. Vaardigheden als begeleider van studenten	☐	☐	☐	☐	☐
	f. De afstemming van de moeilijkheidsgraad/hoeveelheid werk	☐	☐	☐	☐	☐

33 Welke specifieke onderwijsvaardigheden worden naar uw mening met name versterkt door onderzoeksactiviteiten?
- Hoe beïnvloeden deze onderwijsvaardigheden elkaar?

34 Welke omstandigheden beïnvloeden uw manier van doceren? (bv. Aantal/type vakken, faciliteiten, aantal studenten)

35 Worden uw onderwijsvaardigheden geëvalueerd?

36 Hoe worden uw onderwijsvaardigheden geëvalueerd?
- Welke onderwijsvaardigheden worden geëvalueerd?
- Door welke personen worden deze geëvalueerd?
- Hoe evalueren deze personen uw onderwijsactiviteiten?

		++	+	0	-	--
37	Hoe beoordeelt u deze manier van evalueren	☐	☐	☐	☐	☐

38 Hoe zouden volgens u deze vaardigheden geëvalueerd moeten worden (als men met name naar de integratie van onderzoek in onderwijs wil kijken)?/Wat heeft u aan deze manier van evalueren?

		++	+	0	-	--
39	Hoe beoordeelt u de faciliteiten en bronnen die u ter					

ondersteuning van uw werkzaamheden nodig heeft? (Bv. (school)ruimtes, instrumenten, ICT, secretariële ondersteuning) ☐ ☐ ☐ ☐ ☐

40 Welke verdere (directe en indirecte) vormen van ondersteuning/stimulering zijn er beschikbaar ter bevordering van uw onderwijsvaardigheden?
(bv. cursussen, lesmateriaal, begeleiding/mentoring, Subsidie volgen opleiding, promotie, beloning goed onderwijs)
- Welke andere staf- en universiteitsstructuren zijn er ondersteuning van de integratie van onderzoek in het onderwijs?
- Voelt u zich gewaardeerd als onderwijzer?

41 Wat hebt u aan deze vormen van ondersteuning? Welke ondersteuning ontbreekt er nog?

42 Hoe beoordeelt u de kwaliteit van de ondersteuning die u geboden wordt? ++ + 0 - -- ☐ ☐ ☐ ☐ ☐

Management, Organisational Structure and Staffing at Departmental level

43 Zijn er specifieke programma's en/of structuren die de integratie van onderzoek in onderwijs ondersteunen ontwikkeld?
- Specifiek onderwijsbeleid/Practices/Strategieen
- Strategische en operationele planning en institutionele audit
- Curriculum vereisten
- Roosters (bv. 3-5 urige blokken/minder gefragmenteerd rooster)
- Undergraduate awards/onderzoeksprogramma's

44 Hoe worden de links tussen onderzoek en onderwijs/leren gearticuleerd in de onderzoek- en onderwijsstrategie binnen de faculteit/afdeling?

45 Hoe worden de onderwijs- en onderzoeksactiviteiten georganiseerd, gemotiveerd en bekostigd?
- Worden ze gemanaged tot samenwerking?
- Zijn alle onderzoekers betrokken bij het onderwijs?
- Hoe linken onderwijs- en onderzoeksteams en hoe wordt dit gefaciliteerd?
- Zijn onderzoeksclusters ook onderwijsteams?

46 Welk profiel wordt er gegeven aan (discipline gebaseerd) pedagogisch onderzoek?
- Hoe wordt dit onderzoek verspreid en toegepast binnen de programma's?
- Wat zou hieraan verbeterd kunnen worden?

47 Hoe beoordeelt u de (mate van) integratie van onderzoek in het onderwijs de faculteit? ++ + 0 - -- ☐ ☐ ☐ ☐ ☐

48 Wat zou er volgens u aan de huidige manier van integratie van onderzoek in onderwijs moeten veranderen?

Appendix III Student Survey

Student Questionnaire

BS and EEMCS

Center for Higher Education Policy Studies

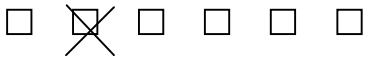
University of Twente

You are invited to take part in this survey **if** you are a student at either the faculty of Electrical Engineering, Mathematics and Computer Sciences (EWI) or the faculty of Behavioral Sciences (GW).The purpose of this survey is to find out more about how students experience courses at both faculties. The results of this survey will be used to improve the courses by the faculties later on. The information you give will be treated confidentially. Your help will be very much appreciated

This form will only take around ten minutes to complete. To fill in the questionnaire please follow the instructions below.

Directions for Filling Out the Questionnaire

Please follow the instructions below;

Ticking an answer option…….	
Write text clearly……..……	Write text ____
Tick **ONE** of the boxes on the scale……	
In case you want to correct your answer; blacken the incorrect tick, thick the right box and underline this box……	

A General Questions

Please fill out the following questions;

Age: _____

Gender: Male ☐ Female ☐

Faculty of Study: EWI ☐ GW ☐

Study Programme (e.g. INF, PSY): _____

Degree: Undergraduate ☐ Graduate ☐

Previous education: VWO/Abitur ☐ HBO/ Polytechnic ☐ BSc./BA Univers. ☐

Year of Study at University of Twente (e.g. 1, 2, 3): _____

B Study Programme Experience Questionnaire

The purpose of the following statements is to collect students' perceptions of the course of their study programme. Please evaluate the following statements on basis of experiences made while following courses from your study.

Indicate the extent to which you agree with the following statements; (++ = fully agree, + = agree, 0 = neutral, - = disagree, -- = totally disagree, NA = not applicable)

	++	+	0	-	--	NA
The teachers motivate me to do my best work….....	☐	☐	☐	☐	☐	☐
The workload is too heavy……	☐	☐	☐	☐	☐	☐
The teachers put a lot of time in commenting on my work…..	☐	☐	☐	☐	☐	☐
When having problems or questions, I am having difficulty contacting my teachers……..	☐	☐	☐	☐	☐	☐
The teachers seem more interested in testing what I had memorized than what I had understood……	☐	☐	☐	☐	☐	☐
The teachers make a real effort to understand difficulties I might be having with my work……	☐	☐	☐	☐	☐	☐
My teachers are extremely good in explaining the topic they are teaching…….	☐	☐	☐	☐	☐	☐

	++	+	0	-	--	NA
The teachers normally give me helpful feedback on how I was going…….	☐	☐	☐	☐	☐	☐
The sheer volume of work to be got through in the courses means it can not be at all thoroughly comprehended……...	☐	☐	☐	☐	☐	☐
The topics of the courses are relevant and up to date……...	☐	☐	☐	☐	☐	☐
I am satisfied with the quality of the courses……...	☐	☐	☐	☐	☐	☐
It is made clear what resources were available to help me learn..	☐	☐	☐	☐	☐	☐
The study materials are clear and concise……	☐	☐	☐	☐	☐	☐
The courses stimulated my interests in the field of study….....	☐	☐	☐	☐	☐	☐
I find the courses motivating……	☐	☐	☐	☐	☐	☐
The courses provide me with a broad overview of my field of knowledge…….	☐	☐	☐	☐	☐	☐
Within the courses, it is clear what is expected of me……..	☐	☐	☐	☐	☐	☐
The resources (e.g. library, text books, labs, work places) were appropriate for me to do my very best in getting the highest attainable grade for the courses.....	☐	☐	☐	☐	☐	☐

C Research Activities within the Faculty of your Study Programme

I know that within the faculty of my study programme there are….

Research seminars and conferences…….	☐
Research institutes and research centers……...	☐
Research areas in which the faculty has a national and international reputation……	☐
Often research posters prepared……...	☐
Professors and assistants who write books, journals and other scientific work……..	☐
Often research reports prepared……	☐

I know the teachers of my study programme are:

- Undertaking research…… ☐
- Preparing a PhD…… ☐
- Writing publications……. ☐
- Supervising assistants and project collaborators in their scientific work…….. ☐
- Supervising students in their scientific work…… ☐

Which of the following situations have you experienced already?

- A guest speaker discussing his/her own scientific work during a lecture or seminar……. ☐
- A professor or assistant discussed his/her own scientific work during a lecture or seminar……... ☐
- I read a scientific article or report written by one of my teachers ☐
- I attended a research seminar that was not part of my regular classes……... ☐
- I participated in a conference or research day, organized at the University of Twente…… ☐
- I participated as a subject or teacher in a scientific research.. ☐
- Within a seminar I did a research project……. ☐
- I prepared a thesis or research paper…… ☐
- I was actively engaged in the practical preparation of research project……... ☐
- I was active as a student assistant……..... ☐
- I contributed to the preparation of a paper or poster for a scientific conference or study day…… ☐
- I contributed a scientific article or another form of scientific output…… ☐
- I contributed to scientific advice…….. ☐
- I developed my competencies in research techniques (e.g. taking interviews, analyzing data from laboratories, statistical techniques)…… ☐

D	Use of Research in your Study Programme						
Indicate the extent to which you agree with the following statements.		++	+	0	-	--	NA
When I registered for my study programme, I was very aware of the scientific reputation of the staff working in the department of my study……...		☐	☐	☐	☐	☐	☐
When I registered for the courses, I was *not* aware at all of the scientific reputation of the teacher of the courses……		☐	☐	☐	☐	☐	☐
I think it is very important for the quality of the courses that the professor and his/her assistants are active in research……..		☐	☐	☐	☐	☐	☐
Professor and assistants who are *not* active in research, spend more time in supervising students……		☐	☐	☐	☐	☐	☐
I learn most when I'm involved in a research project……..		☐	☐	☐	☐	☐	☐
I think it is important that the professors and assistants report on their own research during their classes……		☐	☐	☐	☐	☐	☐
In my programme, too little time is devoted to the development of research competencies……..		☐	☐	☐	☐	☐	☐
I would like to be actively involved in the research of the professors and assistants……...		☐	☐	☐	☐	☐	☐
The teaching is very effective when they give research tasks (e.g. exercises on problem solving, development of a research project, giving a presentation of own research)……		☐	☐	☐	☐	☐	☐

Indicate the extent to which you agree with the following statements. Due to the involvement of my teachers in research….	++	+	0	-	--	NA
I understand the subject better……..	☐	☐	☐	☐	☐	☐
I developed sensitiveness for methodological problems……..	☐	☐	☐	☐	☐	☐
I am more interested in the domain of my study …….	☐	☐	☐	☐	☐	☐
I am more aware of the issues in this discipline……...	☐	☐	☐	☐	☐	☐
I can develop my research competencies better……...	☐	☐	☐	☐	☐	☐
I am better supervised (e.g. during writing thesis, project work).	☐	☐	☐	☐	☐	☐
I am shown more empathy towards me as a student……	☐	☐	☐	☐	☐	☐
I give more Authority towards them……	☐	☐	☐	☐	☐	☐
I am more motivated to do my best……..	☐	☐	☐	☐	☐	☐

	++	+	0	-	--	NA
I am more enthusiastic about the course……..	☐	☐	☐	☐	☐	☐
He/she is less available for giving help……	☐	☐	☐	☐	☐	☐
The content of the course is more up-to-date……...	☐	☐	☐	☐	☐	☐
The workload and difficulty of the course is more balanced…...	☐	☐	☐	☐	☐	☐

End

Thank you for filling out this questionnaire!

Appendix IV Explanation Teaching Methods

Teaching methods that can be used during courses are:

Assignments:	Assignments are very diverse and can be used as a part of any other teaching method.
Books and literature:	Reading literature can be used as a teaching method to carry over information about scientific theories and as a tool to acquire skills.
Student labs:	During laboratories students practise their practical skills like programming a programme.
Lectures:	During lectures the teacher discusses scientific theories students study.
Project work:	During projects a small group of students is put to work on a small scale problem, experiencing the act of doing research on a simplified level.
Research papers:	Students learn how to write a scientific paper.
Research projects:	By following courses of a chair students get interested, follow more courses from that chair, do their graduate thesis at that chair, and before they graduate they ended up as an assistant in a research project. Working as research assistants, students look over the shoulders of researchers and pick up what doing research is about (R1).
Tutorials:	Tutorials are used for students to practice skills.

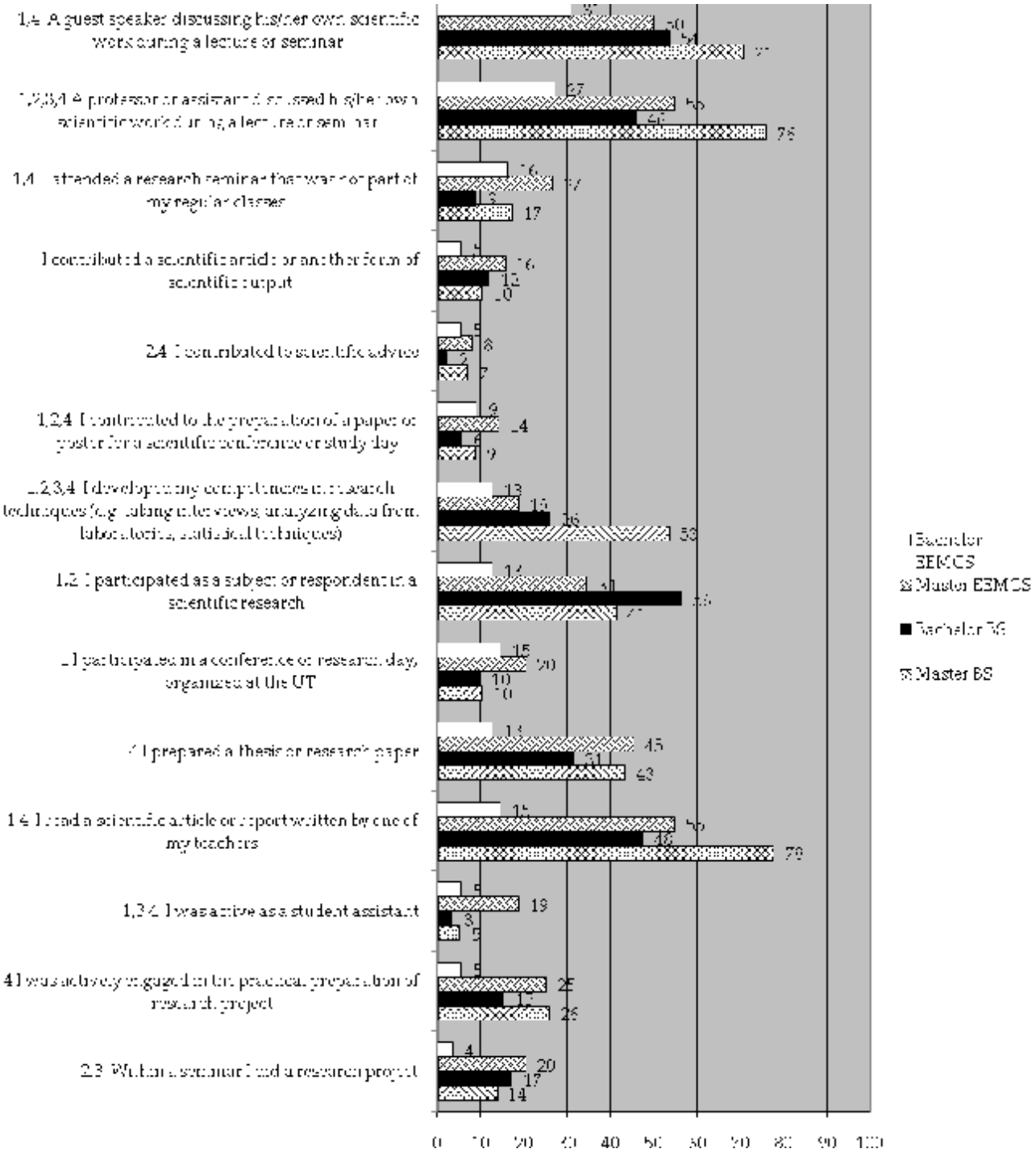
Appendix V Evaluation Objects Faculty of BS

Figure 14. Evaluation objects in relation to quality circle (Van Diepen, 2003, p.3)

Demands Actor & ***Action*** Objects	A Determination quality criteria	B Evaluation procedure	C Consultation with relevant actors	D Plans for improvement
1 Competences	Programme director Dean ***Assessing competence profile with motivation***	Programme director, Exam committee, ***Are our competences still chosen correctly?***	Study programme committee, Teachers, Students, Alumni, Professional area ***Reflection on output B and looking ahead***	Programme director, Exam committee ***Set new goals on the basis of B and C, and implementation of rows 2 (and 3,4)***
2 Content curriculum	Programme director Dean ***Assessment***	Programme director, OSC, Alumni Teachers ***Are the contents still up-to-date?***	Study programme committee, Teachers, Students, Alumni, Professional area ***Reflection on output B and looking ahead***	Programme director, Exam committee ***Set new goals on the basis of B and C, and implementation of rows 3 and 4***
3 Educational process	Programme director ***Assessment***	OSC, Teachers, Students ***Course evaluations during and after terms***	Study programme committee, Teachers, Students ***Commenting output B and looking ahead***	Programme director, Teachers ***Revising teaching methods etc.***
4 Assessment	Exam committee ***Determining Assessment policy***	Exam committee, Teachers ***Is the assessment satisfactory? Course evaluation, Reviewing of exam items and assessment.***	Study programme committee, Teachers, Students ***Commenting output B: what has to be (better) assessed judging one's experience and wishes***	Programme director Exam committee ***Improving assessment to assess more effectively the set programme goals***
5 Results	Exam committee ***Determines specific and assessable standards for exit characteristics and assessment of these exit characteristics***	Exam committee ***Reviewing thesis, portfolios, including assessment***	Study programme committee, Teachers, Students plus external clients ***Commenting output B: satisfy the results and standards one's expectations?***	Programme director, Exam committee ***Determine cause and remedy, implement in rows 2,3 and 4***
6 Study ability	Programme director OSC ***Determine standards Monitoring, Return statistics***	Programme director OSC ***Are the set standards aligned with the set targets, satisfies the study progress?***	Students, Teachers, Study advisor, Thesis coordinator ***Satisfies the evaluation B? New personal wishes?***	Programme director Teachers, OSC ***Remove obstacles study progress in curriculum or organisation***
7 Organisation study programme	Programme director Dean ***Record organisational demands in the faculty's strategic plan***	Programme director, Head OSC, Students ***Trace obstacles in organisation personnel, resources, and quality assurance***	Programme director, Dean, Chairs, Head OSC, Students ***Discuss obstacles B with party involved***	Programme director, Dean, Chairs, Head OSC ***Implement measures on the basis of B and C***

Appendix VI Figures Chapter 6

Figure 15. Experienced Research Situations by Students of the Faculties of EEMCS and BS, in%, answer category "yes".



Question: Which of the following situations have you experienced already?

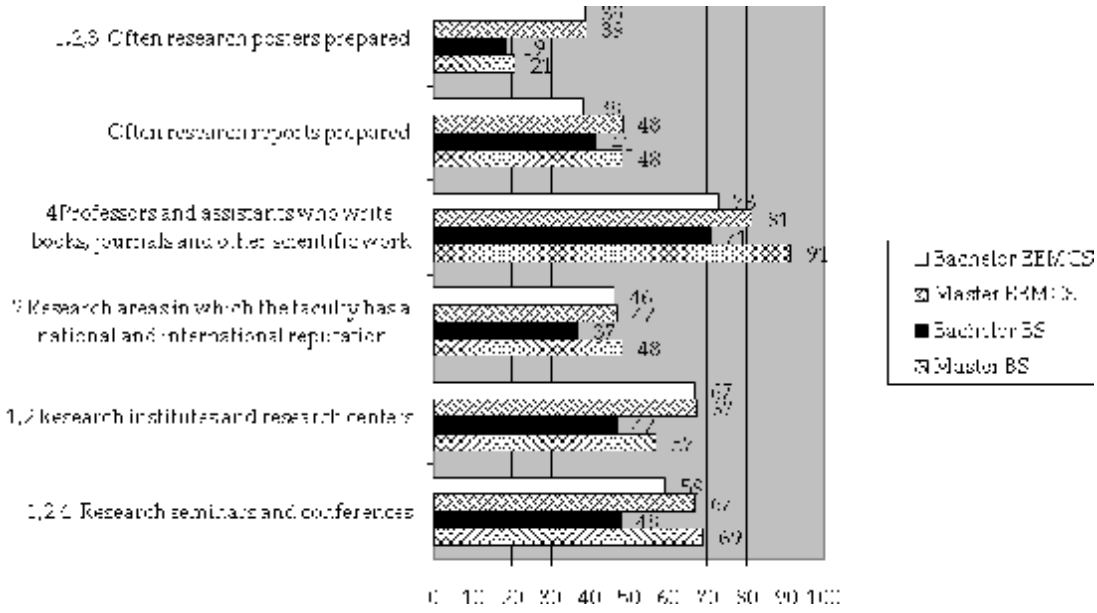
[1]EEMCS vs. BS ***p***<.10

[2]BSc. EEMCS vs. BSc. BS ***p***<.10

[3]MSc. EEMCS vs. MSc. BS ***p***<.10

[4]BSc. vs. MSc. ***p***<.10

Figure 16. Student's Awareness of Research Activities conducted at their Faculty, in %, answer category "yes".



S

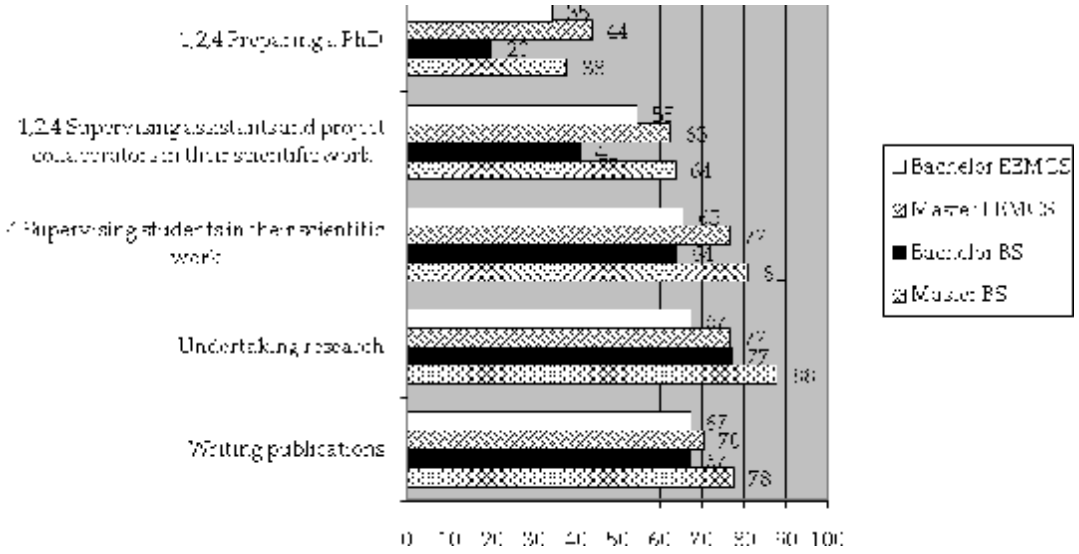
tatement: I know that within the faculty of my study programme there are ….

[1]EEMCS vs. BS ***p***<.10

[2] BSc. EEMCS vs. BSc. BS ***p***<.10

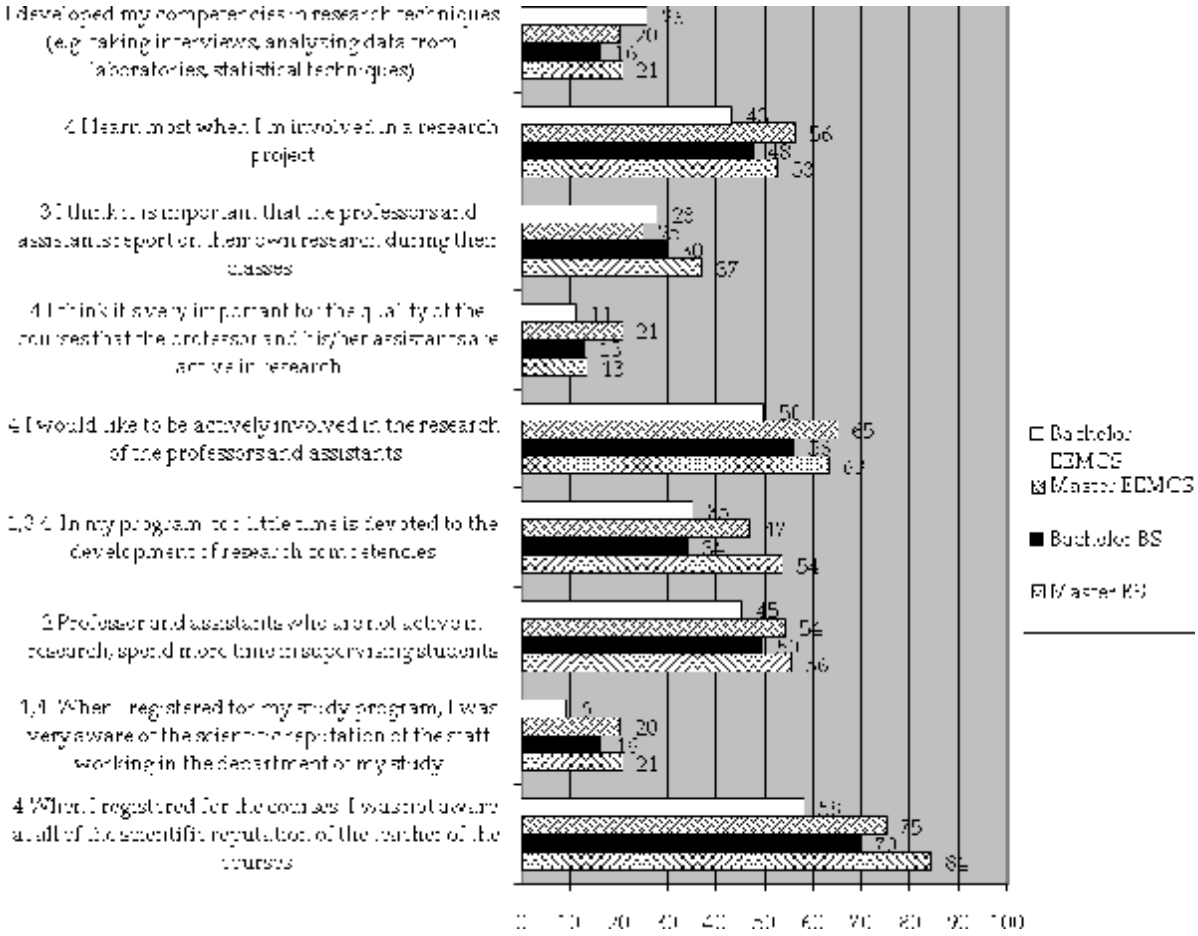
[4]BSc. vs. MSc. ***p***<.10

Figure 17. Student's Awareness of Research Activities Conducted by their Teachers, in %, answer category "yes".



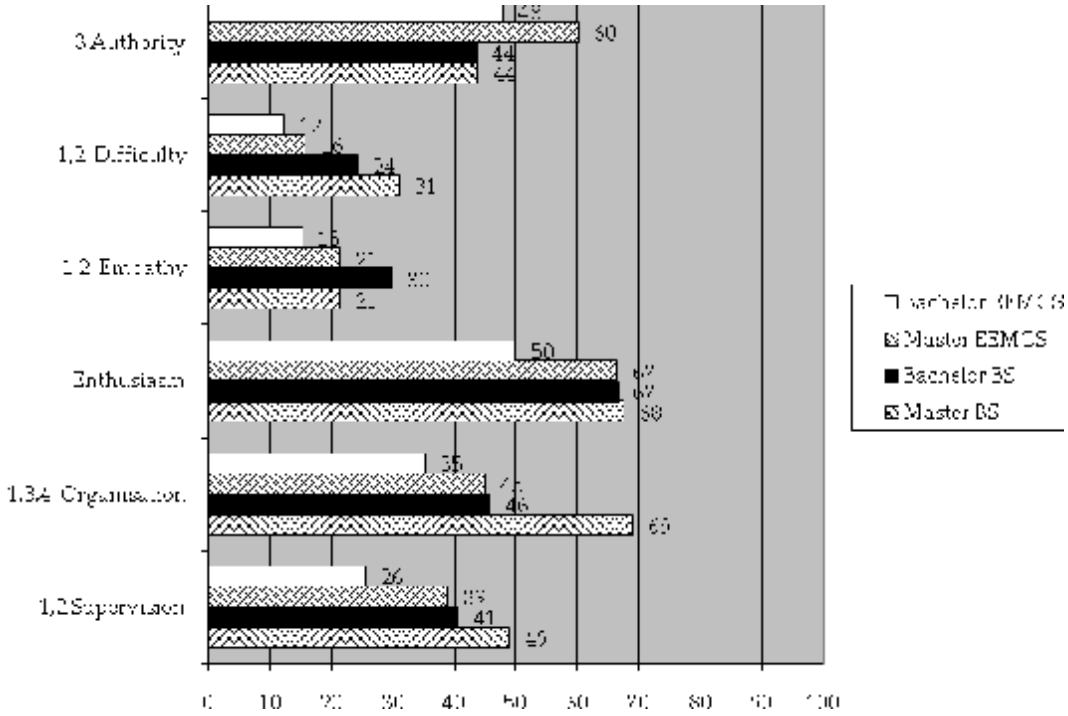
Statement: I know the teachers of my programme are ….
[1]EEMCS vs. BS ***p***<.10
[2] BSc. EEMCS vs. BSc. BS ***p***<.10
[4]BSc. vs. MSc. ***p***<.10

Figure 18. Student's Evaluation of the TRN, in %, answer categories ++ and +*



Question: Indicate the extent to which you agree with the following statements.
*on a 5 point scale from ++ "fully agree" to – "totally disagree".
[1]EEMCS vs. BS ***p***<.10
[2] BSc. EEMCS vs. BSc. BS ***p***<.10
[3]MSc. EEMCS vs. MSc. BS ***p***<.10
[4]BSc. vs. MSc. ***p***<.10

Figure 19. Student's Awareness of Research Activities, in %, answer categories ++ and +*



Statement: I know that within the faculty of my study programme there are…..
* on a 5 point scale from ++ "fully agree" to -- "totally disagree".
[1]EEMCS vs. BS ***p***<.10
[2] BSc. EEMCS vs. BSc. BS ***p***<.10
[3]MSc. EEMCS vs. MSc. BS ***p***<.10
[4]BSc. vs. MSc. ***p***<.10

Table 8
Statements Given about Personal Teaching Characteristics in the Student Survey

Mode of Teaching	***Statements***
	Due to the involvement of my teachers in research…..
Organisation	I understand the subject better.
Enthusiasm	I am more interested in the domain of my study.
	I am more motivated to do my best.
	I am more enthusiastic about the course.
Supervision	I am better supervised (e.g. during writing thesis, project work).
Empathy	I am shown more empathy towards me as a student.
Authority	I give more credibility/authority towards them.
Difficulty	The workload and difficulty of the course is more balanced.