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Interaction between research and education in four research profiles

— Can industry co-operation improve the link?

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ABSTRACT

This study attempts to provide a new perspective on current shifts in knowledge production through analysing the relationship between research and education. The study, based on interviews and questionnaires, focuses on the interaction within applied research centres with a close industry co-operation. The results suggest that the interaction between research and education benefits from a collaborative environment since: researchers hold positive attitudes toward integrating research, education and collaboration, and students are given the opportunity to work within applied research projects. The findings are discussed in terms of researchers' ability to handle their scholarly tasks of research, teaching, and collaboration, and the importance for acknowledging research collaborations from both research and teaching perspectives.

Key words: Research and teaching links, collaboration, applied research, undergraduate education

Innehållsförteckning

Abstract	2
1. Introduction	4
2. Research and teaching links in Swedish higher education.....	5
3. Previous research on research and teaching links	7
3.1 Research and teaching integration outside the traditional setting....	8
4. Data.....	9
5. Results	11
5.1 Research and teaching interaction within the HEI.....	12
5.2 The research and education interaction outside the HEI	18
6. Discussion	19
References	24
Tidigare arbetsrapporter/working papers	27

1. INTRODUCTION

Universities are formally organised to produce advanced knowledge and excellent research, which together with education have been the main mission since the outset of higher education (Clark 1983). Higher education institutions (HEI) have continuously progressed through internal and external changes worldwide, despite national differences in traditions and political-economic systems; the most significant involved the increase in student numbers and different types of HEI (Johnstone, Arora, & Experton 1998). A further considerable change is HEI's increasing collaboration with their surrounding communities (see Freeman 1988, and Lundvall 1985).

In Sweden, support for collaboration between HEI and the regional community are illustrated through policies, and research foundations having criterion that encourage research projects to enhance collaboration.¹ One example is the Knowledge Foundation (KK) that invests more than 6 billion SEK to establish research environments with distinctive profiles at Sweden's new Universities and University Colleges. In the middle of the 1990's KK focused their research funding² on University Colleges (UC). This focus was implemented via three types of programs; projects, platforms, and profiles and included new Universities — as four UCs received “university status” at the beginning of the new millennium. The aim of KK's research funding was to invite all (at the time) UCs to establish a research platform, on the condition that they intended to develop contacts with the industry and service sectors and, to some extent, carry out research, with an aim to use the platform to reach scientific “excellence” to follow with an application for a “research profile”. A research profile was KKs attempt to further establish the collaborative research partnership. In 1997 eleven research profiles were financed with approximately 36 SEK million³, of which one half came from industry (a criterion for receiving research profile funding). The KK foundation did also signify the importance for connecting research with

¹ Manifests in the decision that all HEI should co-operate with the surrounding society stated in the higher education law from 1996 (law 1996:1392).

² KK have during the years developed four areas for research finance. 1, Research at new universities and university colleges, 2, Forestry research, 3, Phd programs, 4, Public research institutes. This study will analyse the platform research belonging to part 1.

³ This can be compared with Sweden's total block grants in 1998, being 19.264.994 SEK Million

education when adding this as a further criterion for receiving research funding. The criterion served as an example of the increasing attention the interaction between research and education has received from researchers as well as financiers.

The KKs financed research profiles offer an opportunity to explore the link between research and education in collaborative research environments. Is there a connection and in what way? The aim of the article is to explore HEIs' three different missions — research, education, and collaboration — to see whether and how the research at chosen research profiles has an impact on the HEI's undergraduate education. The main question concerns the researchers' attempts to integrate teaching and research within the research profile and their attitude towards such integration. The paper has been divided into five sections and starts with a section presenting significant Swedish policies and reforms and changes in research collaborations influenced by theories of Mode 2 and Triple helix. The next section presents frameworks for studying research and teaching links from which different frameworks are used for the following analyses. The following section presents methods and results from interviews and questionnaires and the final section encloses a discussion and a conclusion.

2. RESEARCH AND TEACHING LINKS IN SWEDISH HIGHER EDUCATION

Swedish reforms and policies have revealed a long standing attempt to maintain a balance between research and education. It started in 1852 it was decided that the nation's professors should carry out research in addition to teaching (Strömholm 1994). However, approximately 100 years later, in 1958, teaching only positions were introduced. This can be regarded as one of the starting points for a division between teaching and research (Andolf 1975).

The higher education reform in 1977 extended the HEI mission to include all post-secondary education and research, and a number of UCs with only undergraduate education was established. The higher education law, 1977:218, also decided that all post upper secondary education should have a scientific base and as a result the relation between teaching and research became an issue for debate since the new educational

frameworks lacked a scientific tradition (Björklund 1991). Several organisational structures complicated the integration of teaching and research, e.g. the new UCs lacked a research organisation with block grants to advance research on their own, the block grants were separated among education and research and the internal organisation for undergraduate education and research differed (Fritzell 1998).

In 1993 a change occurred and the somewhat milder framework; education should rest on a scientific or artistic base was introduced.⁴ In 1997 UCs received their own block grants, which gave them an opportunity to establish a foundational research base and have a chance to connect teaching with research. The same year, criteria for becoming a university were developed, an emphasis on research and research results. In 1999 UCs had the right to apply for examination rights in doctoral education within one or several research areas. The development of UC goals to reach university status and the national quality measurement of higher education have resulted in a renewed interest for research on teaching and research links since it was generally regarded as an indicator of quality in education.

In parallel with the continuing acknowledgement for integrating research and teaching, the interest for collaboration between HEI and the industry progressed. As a result of the industrial crisis in the 1970's, it became apparent that governments and industry needed to include knowledge institutions in collaborations. Research was no longer purely connected to a specific intuitions and collaborative networks gained status. This increasing emphasis on networks between the actors was encapsulated in theories such as Mode 2 (Gibbons et al 1994, & Nowotny et al. 2003) and Triple Helix (Etzkowitz & Leydersdorff 2001). The common factor between the theories was their emphasis on research as not only occurring in traditional university settings but also within other institutions and the industry with an emphasis on an active two-way interaction between science and the surrounding environments (Nowotny et al. 2003).

⁴ Higher Education Law 1992:1434

The KK research profiles function as an example of research collaboration suggestively inspired with the Mode 2 and Triple Helix frameworks. The research profiles can be described as platforms for interactive co-operation with HEI researchers, having a constant dialogue with the industry. Research varies between being directly linked to solving the industries' problems to verifying research methods and discussing problem in co-operation with regional actors. The majority of researchers from the different research profiles expressed in the interviews that they regarded their research as applied and viewed the close connection to the industry as essential. The issue is whether this close connection between the HEI and the industry is beneficial or harmful for the interaction between research and education. Previous research has not highlighted this area of teaching and research and the concept of research and teaching links has never been uniformly defined in Sweden.

3. PREVIOUS RESEARCH ON RESEARCH AND TEACHING LINKS

In Sweden, Björklund (1990) has attempted to clarify the issue and focused on teachers' role to encapsulate current research in the teaching as well as using their research as a foundation for teaching with more specialised subjects to be able to follow current research. Still, policymakers mostly focus on teachers with doctoral degrees or whether undergraduate education provides students with opportunities for further research studies. Internationally, the topic have received an increasing attention over the years by scholar such as, Gellert (1990), Ramsden & Moses (1992), Smeby (1998), Jenkins (2004), Gordon et al. (2003), and Boyer (1990). The research area is broad and stretches over different types of associations between education and research and to different levels within the higher education system. As with all issues related to higher education, research and teaching connections need to be analysed from the system levels, individual academic, departmental, institutional and national (see Jenkins, 2004).

Boyer (1990) developed a framework focusing on teaching and research links at an individual level through focusing on the individual research roles in academia. He attempted to clarify the scholar's role by sorting it into four major areas, scholarship of discovery, integration, application/service and teaching. Boyer (1990) highlighted the importance for teachers to have an interest to follow the research area and build

education around relevant research material. But all scholarships should be intertwined and equal attention should be given to application/service, and integration.

Application/service and integration are emphasised in research-intensive centres that are relatively separate from other divisions within HEI. Zubrik, Reid, & Rossiter (2001) argue that research-intensive environments hold a high number of researchers not prioritising teaching but their research. One factor for research and teaching links being more complex in specialised research environments and new research areas is believed to be that researchers have a larger need to remain informed about the ongoing research in such environments (see Neumann (1992), and Rowland (1996). Smeby (2003) supported this notion by suggesting that research and teaching links differ between “hard” and “soft” disciplines and that researchers more specialised on technology, experience more difficulties in relating to education. On the other hand, several studies have emphasised that research-intensive environments result in a dynamic and inspirational environment for students’ learning (Skoie 2000, Hattie & Marsh 1996, Feldman 1987, Fox 1992).

3.1 RESEARCH AND TEACHING INTEGRATION OUTSIDE THE TRADITIONAL SETTING

Institutions that lack a research-intensive environment and have a scant research volume can enrol undergraduate students in research activities off campus in co-operation with the regional industry. Master and Bachelor theses in collaboration with the industry are regarded as a concrete example of such research-related education; the students learn problem solving which together with independent work is important for understanding the relations between research and teaching (Jenkins 2004). Zubrik, Reid, & Rossiter (2001) have carried out extensive research on applied research projects in Australia and found that students involved in collaborative research projects participate in the research process continuously making no distinction between research and practise. Aforementioned types of linkage between research, collaboration and education illustrates a framework for developing research and teaching links that can relate to academic and industry collaborations. Integration of teaching and research within collaborative research environments is still an understudied area so the KK

financed research profiles provide a good opportunity for further analysing the relationship between teaching and research in such environments.

Overall, previous research on specialised technology environments and research intensive centres suggest that there should be some difficulties in teachers' attitude towards linking research and education. These results form an interesting foundation for studying research and teaching integration within specialised research environments in Sweden. In order to study the integration of education, research, and collaboration it becomes necessary to focus the interaction on a level where the partners meet and form strong collaborations. In this study it is referred to as the collaborative level, where co-operation between the companies working with the research profile and the research profiles' researchers. The emphasis should be on the individual researchers' attitude towards integrating research and teaching and their ability to link their research with education. The integration is analysed through information activities; and practical output in terms of master and bachelor theses and student participation in research collaborations both within specialised centres at the HEI and within other research groups outside the HEI. Two of the studied research profiles are highly specialised whereas two have a multidisciplinary focus.

4. DATA

This study differs from previous research as the interaction is focused on the individual researchers' ability to integrate their scholarly tasks (see Boyer 1990) outside the traditional HEI setting (collaborative level). The study aims to contribute to previous research on the topic and add the collaborative level as a further level of significance when analysing teaching and research links. The relationship between the research profile and its department is also of interest when analysing the level of establishment of research and teaching links within the HEI. Questions of interest are: how does a potential link between research and education develop within a collaborative network? Do researchers with a focus on applied research also consider education as a core value?

The study builds on a combination of quantitative questionnaire data and interviews, commonly referred to as a mixed methodology. The questionnaires were constructed to find out differences between the research profiles whereas the interviews were used to explore on the issue to find distinctiveness within each research profile. Boyer's (1990) framework for teaching and research links focused on individual researchers' integration of scholarships and served as a framework when the questions to the individual researchers were developed.

The questionnaires were sent out to all members at the four research profiles; the head of the profile, researchers, doctoral students, as well as researchers and doctoral students from the industry. Each research profile varied in terms of number of active researchers and research areas, further explained in the table 1. The questionnaires had a 60 percent response rate. In addition, two different types of interviews have been performed; first in-depth structured interviews with representatives from each research profiles' management, one senior researcher and doctoral student from the HEI, and one researcher and doctoral student from the industry. Shorter telephone interviews were also performed with representatives for the profile management and departmental head, to see whether they wanted to add something in addition to the questionnaires. These shorter interviews were seen as largely complimentary.

Table 1: Type of HEI, number of staff and information regarding the four profiles' research area

Profiles' name and research area	Number of staff	Time period	Total funding from KKs foundation
Profile A Specialised technical research area, focusing on computer processing and software design	51	1998-2004 the research activities started with the profile funding but the HEI have focused on the research area since 1987	36 SEK Million
Profile B Multidisciplinary research centre, focusing on environmental issues	25	1998-2004 the research activities started in 1996	36 SEK Million
Profile C Multidisciplinary research centre, focusing on the new service economy	17	2001-2007 the research activities started in 1986	36 SEK Million
Profile D Specialised technical research area in applied signal processing	16	1998-2003 the research activities started with the profile funding	36 SEK Million

Source: The research profiles documents

5. RESULTS

The results collected from the interviews and questionnaires were analysed on the individual researchers' level within the research profile at the HEI and within the research profiles' research group outside the HEI. The interviews and questionnaires expressed how education and research occurring in the profiles related to education and whether the relationship was useful.

5.1 RESEARCH AND TEACHING INTERACTION WITHIN THE HEI

The research revealed that individual researchers possessed different views as to the definition of “research,” which is shown in table 2 below. Researchers from three profiles were very focused on application of research whereas researchers from one multidisciplinary profile (Profile B) were less focused on the applied part of research and rather emphasised the essence of new knowledge. Table 2 demonstrates opinions from the profile leaders, (the first column) and the different researchers (the second column) defining their views on what type of purpose research has and how research should be defined.

Table 2. Illustrating the question: “How would you define research?”

Profile	Head of profile	Individual researchers
A	“To colour the white marks on the knowledge map.”	“To solve industrial problems.” “To make issues connected to reality safe.” “To increase the knowledge volume.”
B	“Processes to gain new knowledge.”	“Research is unexplored areas.” “Research is new knowledge.” “To find connection between events with scientific methods”
C	“The small foundations that accumulate some type of truth.”	“New knowledge connected to a problem identify and document phenomenon.” “Research must be useful for a company.”
D	“Find solution to a problem from the real world.”	“To implement for real, new insights.”

Individual researchers’ attitude towards linking teaching and research

The researchers were given an opportunity to express their overall attitude towards linking their research with undergraduate education. The linking was regarded as significant for the respondents and the research was also considered to fit well with the

HEI's undergraduate programs, table 3 provides a more detailed description of the answers. The responses suggest that the researchers acknowledged integration between research and education as a natural part of their work since the questionnaires also reveal that most staff were unaware of the KK-foundation's criteria. In the questionnaires, this criterion is viewed as positive and essential for the majority of the researchers. However, at profile B the overall attitude proved to be slightly less positive (as expressed in table 4).

Table 3. Illustrating the question: "The research profile fits with the HEI's educational profile". The answer is expressed in percent.

	Agree	Agree to a certain extent	Do not agree	(n)	Missing
A	93	7		28	1
B	50	50		13	
C	78	22		9	
D	100			10	1

Table 4. Illustrating the question: "The KK foundations criteria for a connection between the research and education is important". The answer is expressed in percent.

	Agree	Agree to a certain extent	Do not agree	(n)	Missing
A	75	25		28	6
B	38	62		13	5
C	88	12		9	1
D	67	33		10	1

The profile leaders' attitude towards linking teaching and research

The profile leaders all held the link between research and teaching as important but showed different levels of ambition to work with the issue. They also received different levels of support from their departmental head, which illustrated different types of culture towards research and teaching links within the departments. At profile C, the profile leader regarded himself as both teacher and researcher making no distinction between the two areas. He also emphasised the necessity of using ones own research when teaching to undergraduate students, illustrated in the following quote:

”30 percent of our time is meant to be devoted to education so it would be stupid not to use ones own research as a base for this”

He was also aware of the KK-foundations criteria from the very start and regarded it as essential but stated that the foundation should have put more pressure on the HEI through also establishing a professorship that could work with the issue. He believed that this type of professorship could serve as a base for the younger researchers.

At profile B it was also expressed that the financier should have emphasised the importance for a link between education and research to the HEI management. Generally, work with linking research and education was not prioritised but some effects still appeared as a result of spillovers that occurred when individual researchers functioned as teachers, further explained in the quote below:

”We were first and foremost financed to establish a solid research profile that later could have spillover effects on the undergraduate education. But the KK foundation could use more pressure towards the HEI's management since they have the finance”

At profile D it was regarded as natural to link the two areas. The profile leader expressed in the interview that he believed the areas to be intertwined since the postgraduate education builds on a functioning undergraduate education.

”I regard it as natural since one destroy ones base for further research if not focusing on recruiting good students from the undergraduate education”

On the contrary, profile A's leader did not think that the criteria had been clear from the start but was more visible once the research profile started. He demonstrated an

initial lack of interest for relating research to education but believed the criterion to be useful;

” it is good wit the criterion, then the undergraduate education wont effect the research but there will be more demand on integrating the two”

Overall, the profile leaders have varied opinions concerning the fact that a research financier also has criteria asking for an interaction between the research and education, and further believed that the financier should have taken a larger responsibility for the interaction. The individual researchers were all positive towards integrating the areas and were also very informative as to their research during their teaching activities. Generally they held undergraduate education as important and did not consider the different roles of teaching, research and collaboration as mutually exclusive but rather interrelated, which challenge the previous research on specialised-research centres (Neumann 1992, and Rowland 1996.).

Head of the departments' view on linking teaching and research

All the departmental heads regarded the research profiles to be of high research quality and important for the HEI. In one case difficulties were visible in the relationship between the profile leader and the head of the department. In this case, the profile leader had difficulties co-operating with the departmental head during most of the research profiles activities. Thus, the ambition to link research with education through establishing an undergraduate program was rejected. This may not necessarily have been due to the co-operational difficulties but factors such as lack of finance and different type of priorities within the HEI, supports the impression that establishing an interaction that runs over different system levels can be very complex.

On the other hand, profile D experienced full support from their department head and the profile were regarded as a forerunner to the HEI. The same closeness between research profile and HEI was found within profile C and in this case the undergraduate

education had served as foundation for building a research profile at its initial phase. The profile was viewed as a centre that brought some excellence to the undergraduate students' portfolio.

Practical examples of interaction between research and teaching within a specialised research environment

The level of held research information activities to undergraduate students differed between the profiles. Subjects were uncertain of the number of activities that had occurred. For profiles A and C information to undergraduate students occurred more frequently but often indirect. For example, current research from the collaboration was persistently used in undergraduate education. Researchers informed about their research in undergraduate seminars and used the profiles research articles as a base for undergraduate education on both bachelors and masters levels. In profile C, a few courses touched upon the subjects and course literature was based on some of the research. This also occurred in first year courses though on a more general level.

In profile B, a large part of the interaction between undergraduate education and research came with the bachelor dissertations, which were linked to the profiles' research. Also single modular courses relating to the research occurred from first year until the master's level. An attempt to establish an undergraduate program that would relate the research profile and enhance the student flow between undergraduate and graduate studies was made. However, the program was not prioritised from the departmental head. This lack of support was regarded as a great set back for the profile leader who indented to establish the undergraduate program as a link between undergraduate and postgraduate education.

At profile D the researchers informed about their work to the undergraduate students on two occasions. First, before the students were recruited to the masters in engineering at the undergraduate level, and second, after two years of studies when the

students were to choose their area of specialisation. The aim was to recruit students to the applied signal processing program but also to introduce the possibility to encourage the interaction between undergraduate education and research. The head of the profile regarded it as natural for the research that occurred within the profile to interact with the undergraduate education since they also had established a few courses at a five credit level directly related to their research, described in the quote below.

”before they are recruited and after two years of studies when they are about to specialise we make them realise that applied signal processing is not so far away from what they are doing”

In profile A there were no expressed attempts to work towards more integration between teaching and research but there was a long-term close relationship with researchers from the industry and a number of guest lectures who attended the undergraduate program. No exact number was obtained and it was not clear whether this increased during the course of the research profile.

Relation between undergraduate education and postgraduate education

All research profile leaders expressed, in the interviews, an ambition to recruit PhD students from various backgrounds to avoid having a majority of doctoral student from their own HEI. At profile C, for example, the majority of Ph.D. students came from their own HEI and this was regarded as a failure on behalf of the profile leader. Profile D’s representative believed that their research profile was outside the traditional type of research and aimed for a varied selection of PhD students, as long as the students had a strong focus on application. Profile A had mixed groups of PhD students but the flow from master program to PhD program was frequent. Their future ambition is to aim for more types of recruitment tactics to get students from other HEI. This result illustrated that all profile heads agreed that PhD students ultimately should have mixed backgrounds. Such opinions do contradict expressed ambitions to have a good flow between undergraduate and postgraduate educations. Recruiting research students from the undergraduate programs is one certain method for keeping the undergraduate students updated on the research areas and possibilities and research overall.

5.2 THE RESEARCH AND EDUCATION INTERACTION OUTSIDE THE HEI

The collaborative level outside the HEI demonstrated practical examples from the interaction and flow between undergraduate and graduate education within the specialised research environment and collaborative companies.

Industry interaction as a means for linking research and education

The overall attitude to let undergraduate students co-operate with the research profile's co-operation companies was positive within profile C. It was regarded as a win-win situation as the students found it stimulating to work with concrete projects and the companies wanted help with specific research related tasks. Recruitment occurred during seminars or courses held by the research profile's staff. According to the head of the profile, the undergraduate students became "mini-researchers" and benefited from such projects in terms of practical contact with research and research projects' working process. Profile D has also encouraged students to participate in research that occur within the co-operation companies to increase their contact. Their research projects focused primarily on applied technology.

The staff within the research profile believed that the co-operation between the companies and the research profile also resulted in undergraduate education receiving more guest lectures from the industry. Such development demonstrates an interest from the industry's part to function in close coordination with the HEI outside the thesis work. Normally, the research profiles co-operation between the industry and undergraduate education mostly evolved around master theses work. This interaction focuses on a specific task or research problem and functions as the link between research and education. Profile B differs from the other research profiles since their collaboration on master level was less frequent, while bachelor theses were more

common. At profile A, co-operation around master and bachelor theses was not a new attribute but have occurred consistently previous to the research profile.

The collaborating companies have according to the questionnaires demonstrated an interest in undergraduate education. Table 5 illustrates that profiles C and D experienced significant interest in undergraduate education whereas the highly specialised profile A experienced a total positive feedback from the companies. In the multidisciplinary profile B, the collaboration companies do not appear to have been positively disposed to functioning with the undergraduate education although there was some level of interest. This would most likely demonstrate that companies benefiting from integrating education and research through theses work also find this to be a stimulating type of collaboration. The interview data also express that students are recruited to the industry after participating in research collaborations, which enhances students' employability.

Table 5. Illustrating the question: "Have collaborating companies showed an interest for the undergraduate education?" The answer is expressed in percent.

	Yes	No	(n)	Missing
A	100		28	6
B	63	37	13	5
C	86	14	9	2
D	78	22	10	1

6. DISCUSSION

Studies on the link between research and education are vast, complex and touch on fundamental questions within the higher education sector. Geschwind (2008) illustrates this in a literature review on research and teaching links and shows that research on

integration varies from the pedagogical aspect to issues of research policy but fails to include the collaborative research environments. This study demonstrates how a successful linking between research and education is possible through Triple-helix and Mode 2 type research collaborations. Evidently does the integration of research and education not only refer to what traditionally occurs between teacher and student at the institution but also within other constellations related to the industry with a stronger focus on application. There is no concept developed for studying the practical examples of research and teaching links in collaborative research environments but suggestively the interaction can be evaluated through analysing individual researchers' attitude to the interaction, the industry's interest in undergraduate students, as well as the students flow between different research environments.

Research and teaching in a collaborative environment within the HEI

Researchers need to encapsulate teaching, research, and collaboration to function as scholars in the new knowledge production. Boyer (1990) develops this and argued that a combination of all scholarships would be a gain for research as well as undergraduate education. Results from this study accordingly illustrates that the researchers from applied research environments have had the ambition and attitude to intertwine their task. This result is interesting when compared to previously discussed studies on specialised research environments and new research areas (Neumann 1992, and Rowland 1996). One reason for the difference in results may be the increasing dependence on networks and collaboration, which widen the research groups and brings in partners from the industry that has an economic interest in undergraduate students in terms of assistant staff.

However, researchers from one highly specialised research profile did not hold undergraduate education to be as important as the other profiles. Still, their teachers have been able to follow current research since they have been highly active in research through the research profiles and also indirectly integrated their research with their teaching. The research profiles' organisations is a successful example of a research

environment that inevitably allow for single researchers to link research and education since they often both research and teach their specialised subject. Applied specialised research does encourage for undergraduate students involvement as they also are needed for these work as previously discussed.

But it could also be complicated for a research profile to independently work with research and education linking to industry collaborations as the profile remains a centre within a larger organisation. The study illustrates that the individual researchers' ambition to link their research with teaching not always matched with the HEI's organisations. There is a potential conflict between the departmental level and research profile, which means that the conflict between research and teaching links is shifted from the individual researcher to the relationship between the profile leader and the departmental head. This relation has in one case clearly complicated the establishment for interaction between research and education at the HEI. The interview data illustrated that researchers experience that HEI interest goes to where the finance is and the HEI management would rather support new projects than profiles that no longer have a significant long term financier. This leaves us with the complicated issue of research finance and whether the profile ought to develop independent financing during its profile period or should be established within the organisation. A profile that has already been established in the HEI and that has high research status appears to have a stronger opportunity to work with integrating the areas of collaboration and education and research.

Research and teaching in a collaborative environment outside the HEI

Previous research (see Smeby (2003), Zubrik, Reid, & Rossiter (2001) suggest that there should be a difference in research and teaching links between "hard" and "soft" disciplines and less positive attitude towards linking teaching and research within research intensive centres. This study does not support that research intensive profiles focused on hard science have less integration between research and education in a collaborative environment outside the HEI. Researchers from the specialised research

profile have a more concrete and applied view on research and hold the integration between teaching and research as important. Within the research collaborations outside the HEI, integration occurs indirectly and through comprehensive research projects where there is no clear difference between research and practice. Specialised research environment within the research profiles appear to have been a creative environment for learning rather than an area lacking connection between scholarly tasks. This is also an advantage for the undergraduate education for HEI's with a less significant research volume and illustrate that HEI with a less traditional academic focus can encapsulate great capacity for individual researchers to integrate their different scholarly roles.

The research profiles' strong industry focus provided an opportunity for analysing how research and education could be practically joined within industry collaboration. To begin with, the research profiles' collaborative focus has been an advantage when attempting to enrol students in the research activities such as theses work and research projects. The phenomenon of using theses work as a bridge between research and teaching and collaboration is not a new concept but its implications are still underestimated and a large volume of research today occurs within the industry. To enrol students in research projects are described as a win-win situation, science related tasks become natural for the students and they enhance their chances for continuing employment. The research profiles demonstrate that research connection and employability are two interrelating concepts rather than mutually exclusive. Such industry research collaboration is an advantage for HEIs' with a small research volume. Thus, the analyses of integration of research and teaching should also occur within the collaboration environment analyses as a complementary to previous research from inside the traditional universities.

Issues for further discussion

Should the HEIs be better at integrating their undergraduate education with their research profiles? Such integration would be an advantage for the HEI when intending to attract undergraduate students since the profiles both offer increased employability

and research opportunities. This contradicts the discussion evolving around the Bologna process, which suggests that employability and education building on a scientific base is two separate and competing factors (Amaral & Magalhaes 2004). From analysing the link between applied research profiles and undergraduate education I would rather suggest that these two concepts are interrelated. Meaning that Mode 2 and Triple Helix type research indirectly creates research and teaching links within the industry, which also enhances employability for the undergraduate education. Whether this argument suffices for all higher education is not necessarily the case. But the variations demonstrated in the study support that employability and research and education links function reciprocally within collaborative research environments.

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