- Research-teaching linkages

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain: Theology

Faculty: Theology

Department: Theology

1. **What are you doing to maintain or develop strong research-teaching linkages?**

   The Faculty of Theology is working in different ways to ensure the research-teaching linkage:

   - All lecturers and professors employed by the faculty have 20% research and 30% or 50% research respectively within their employment.
   - All research disciplines at the faculty have research seminars where actual research is presented and discussed. Students on a higher level (D and E) participate in these research seminars when writing their master thesis.
   - Students at higher levels, writing their master thesis, are (often) supposed to attend the public defence of doctoral thesis at the faculty as a compulsory moment of their master thesis course.
   - Occasionally lecturers bring their undergraduate students to trial lectures for appointment as a docent/associate professor.
   - When the faculty invites international guest lecturers our students are invited to attend to their lectures and participate in their seminars.
   - The faculty invites all employed lecturers to apply for funds (controlled by the faculty itself) to enable them to get more time for their research so they can apply for promotion as docent/associate professor. One aim is also to get research stimulated lecturers back into our educational program.
   - Several courses at the faculty are directly related to ongoing research projects, e.g. "The Dead Sea Scrolls", 7,5 hp, "Welfare and Values – an Introduction", 7,5 hp and "Human and Inhuman", 7,5 hp.

2. **Why are you doing it this way?** We think this is a fruitful way of proceeding.

3. **How are you going about doing this in concrete terms?** Cf paragraph 1.

4. **What are the main results?** The constructive outcomes of involving students on a higher level (master level) in the ongoing research projects of the faculty, e.g. inviting them to and making them active participants of our research seminars.

5. **Advice for others wishing to do something similar.** Use your research seminars, open lectures etc to integrate students at higher levels into the research domain, the students do not only participate in the intellectual conversation, but contribute to it.

6. **Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar**

Maria Essunger, Director of Studies at the Department of Theology
maria.essunger@teol.uu.se

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain: Humanities and Social Sciences

Faculty: Law

Department: Law

1. What are you doing to maintain or develop strong research-teaching linkages?

The basis of the Law Programme is that the implementation of the programme shall be conducted in such a way that there is a close relationship between research and education. To achieve this, the Faculty use a very large proportion of researchers as teachers actively participating at all educational levels. This includes duties as seminary teachers, the construction of seminar questions and themes, examiners, supervisors and examiners of final theses and leading teams of teachers. The expansion we are undergoing at the moment also means that new researchers are recruited and research environments are strengthened, *i.e.* a strong contribution to the strengthening of the research-teaching linkage at the Faculty.

2. Why are you doing it this way?

Research and teaching are mutually enhancing in the sense that the teaching can be research related, while the research itself may be favored by ideas and other inputs during the work with the preparation of teaching materials and discussions during seminars. In other words, the faculty is convinced that there must be a direct involvement by active researchers as teachers in the law programme in order to develop strong research-teaching linkages.

3. How are you going about doing this in concrete terms?

The researchers take active part in the teaching at the compulsory courses (at least 50 hours per academic year for researchers and at least 80 hours per year for doctoral candidates of their respectively annually required teaching duty). The researchers also participate in the construction of seminar materials, act as seminar teachers, give lectures, supervise theses and act as examiners. The seminars, theses subjects and examination questions are often based on current ongoing research at the Faculty. In the lecturers' teaching, discussions with students are continuously linked to ongoing research. Through writing assignments and various methodological exercises students are trained in a scientific approach to the subjects. We also have research lectures during the courses addressing the forefront of research of the subject matter of the lecture.

4. What are the main results?

The main results of the Faculty's research efforts in education are that students develop a good understanding both of current research issues, and methodological issues. In the research evaluation of the University of Uppsala 2010-2011, (Quality and Renewal 2011, An Overall Evaluation of Research at Uppsala University, KoF11, pp. 244, 246) the expert panel spoke in a positive way of the legal research at the Faculty, and also made a connection to the expansion in the number of students with accompanying recruitment of researching teachers.

5. Advice for others wishing to do something similar.

The Faculty's is convinced that researchers must be involved in the preparation of courses from an early stage and also be given an active role in the teaching.

6. Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar

Olle Mårsäter, Director of Studies, Faculty of Law, olle.marsater@jur.uu.se

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary Domain: Humanities and Social Sciences

Faculty: Arts

Department:

1. What are you doing to maintain or develop strong research-teaching linkages?

General principles within the Faculty of Arts are to assign use primary sources rather than textbooks whenever possible and and to conduct teaching in seminar form rather than as large lectures in order to help the students better understand the nature of scholarship and academic discussion and argumentation. Naturally, the use of primary sources and the seminar form increases with the level of instruction. The Faculty also gives the departments the resources necessary for teachers to keep their courses up to date with research developments in the relevant fields..

In addition to these general principles, the Faculty of Arts has initiated the development of seven interdisciplinary research areas, called research nodes, where students on the advanced level (Masters) are actively involved in research. The theses produced within the nodes are not merely unified thematically, but are are produced within framework of the nodes as part of a larger program of research. This means the students must be trained to develop research questions and select and apply adequate methods and theories so as to be able to conduct independent high quality research..

2. Why are you doing it this way?

The Faculty has ascertained that this method provides the best possible training with the resources available. By being actively engaged in on-going research within the Faculty, the students get first-hand experience of academic research: how it is conducted, organized and managed.

3. How are you going about doing this in concrete terms?

The seven research nodes are all multi-disciplinary, involving two or more departments. The nodes cover a broad range of topics and themes, from "Mind and Nature" to "The Good City". The Faculty has appointed younger faculty and research associates as node directors.. The students apply to the nodes in which they're interested, and are selected by the directors. Students are then fully integrated as active participants in all aspects of the development of research activities within the node. Each node has a budget of 1 500 000 SEK per year for at least three years. Thus the project as a whole has a budget of 10 500 000 SEK per year.

4. What are the main results?

The project has just begun, so no results are yet available. In terms of educational aims and concrete results issuing from the initiative, it is expected that the students will produce better theses. It is also hoped that the nodes will strengthen recruitment to the advanced level as well as interdisciplinary and interdepartmental co-operation, and enhance student employability.

5. Advice for others wishing to do something similar.

Allow sufficient time for collaboration in the development of multi-disciplinary research themes to evolve.

6. Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar

Faculty director of studies Oskar Pettersson
Oskar.Pettersson@uadm.uu.se

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain: History

Faculty: Arts

Department:History

1. What are you doing to maintain or develop strong research-teaching linkages?

We have initiated a workshop within the master programme Early Modern Studies. Northern Europe 1450-1850. This is part of a course which is devoted to the thesis work process and the students' theses are presented at a concluding workshop in the presence of several established researchers. During the course, which runs for a year, the students meet different researchers who discuss the research work process with them from different perspectives.

2. Why are you doing it this way?

In this way the students are able to discuss the craft of research with established researchers and not only with their supervisors. Further, it serves the purpose of making it clearer for the students from the start of the programme when they are expected to be finished, which is at the workshop. This will raise the graduation rate and help students avoid spending too much time on their thesis work.

3. How are you going about doing this in concrete terms?

The course consists of a number of seminars in the presence of different PhD's and professors. The focus is on the thesis work ending with a workshop where the thesis is defended. To the workshop, which takes place annually, we invite key note speakers. This year professor Amanda Vickery, University of London, will participate and comment on the students' theses.

4. What are the main results?

This is the first year we arrange such a workshop, which takes place at the end of May. The main results so far are that all the students within the programme are focusing on defending their theses at this workshop. We also have been able to muster a rather large number of qualified researchers from inside and outside the department (totalling about 15 PhD's and professors) as invited guests who besides the students will take part in the discussions.

5. Advice for others wishing to do something similar.

Arranging a workshop for students with invited key note speakers could be expensive and it is not always possible to arrange with international guests. But also a key note speaker from the home department will raise the expectations from the students that this is an important event. Try to arrange with different researchers from the department to participate at least some time during the workshop. In that way students will be able to benefit from the perspectives from several researchers who can share with them their experiences how to do research.

6. **Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar**

Erik Lindberg
Department of History
Erik.lindberg@hist.uu.se

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain: Humanities and Social Sciences

Faculty: Language

Department: All

1. What are you doing to maintain or develop strong research-teaching linkages?

As the students progress there is gradual change in the literature as text books are replaced by research articles and monographs. Reading analysing research results, rather than presentation of research, develop the students' ability to evaluate the strengths and weaknesses of methods and conclusions. Forms of examinations also change as the students advance. Whereas exams during the earlier parts of the studies typically involve written tests with specific questions, they are more geared towards essays during the later phases. Finally, large parts of the teacher-student contact takes place during seminars in which students are trained to present and discuss own and other's findings. Students on higher level (writing bachelor thesises and up) are encouraged to also take part in the regular research seminars. Particularly on the advanced level this is recommended.

In addition to these general principles of securing research-teaching linkages the faculty board has also decided to implement three specific strategies to enhance these linkages:

a) *Conference grants*: The faculty board has assigned a sum of money to make it possible for master-level students (second cycle) to attend research conferences within their disciplines.
b) *Participation in research projects*: the departments are creating ways of incorporating students in research projects.
c) *Presentation of on-going research*: Head of departments are responsible for organizing workshops and "theme-days" in which students on all levels are informed about and introduced to the research at the department.

2. Why are you doing it this way?

The faculty board has concluded that the three strategies will bridge the gap between the generic research skill, that the students acquire, and participation in real research. While this is common in the medical and natural sciences it is still quite rare within humanities and social sciences.

3. How are you going about doing this in concrete terms?

Participation in research projects can be achieved in two ways. If the student is assigned a problem to solve, then the outcome of the participation will be a degree project. It is also possible for students to be involved as assistants, i.e. collecting and systematizing a material that a researcher then will analyse. In this case the student would participate as a kind of internship.

4. What are the main results?

The three strategies are still in the early phase of implementation.

5. Advice for others wishing to do something similar.

Involve researchers and explain how strategy b may be of benefit for themselves.

6. Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar

Lars Hagborg: lars.hagborg@uadm.uu.se

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain: Humanities and Social Sciences

Faculty: Social Sciences

Department:

1. What are you doing to maintain or develop strong research-teaching linkages?

Within the Faculty of Social Sciences we only employ teachers with a doctor's degree. The majority of senior lecturers have research time within their appointment. And the majority of our full professors have teaching on undergraduate and graduate level within their positions.

2. Why are you doing it this way?

This must be the most central way to guarantee research-teaching linkages.

3. How are you going about doing this in concrete terms?

See question 1.

This means that we do not hire junior lecturers with a few exceptions.

4. What are the main results?

A very high degree of teachers who have a doctor's degree.

5. Advice for others wishing to do something similar.

6. Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar

Ewa Hjertsén, The Office for Humanities and Social Sciences, ewa.hjertsen@uadm.uu.se

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain:

Faculty: Faculty of educational sciences

Department: Department of education

1. What are you doing to maintain or develop strong research-teaching linkages?

The department is currently working with an overview do ensure the courses offered at the department have a sufficient base in the research produced at the department. PhD-students, international guest researchers and postdoctoral employees are involved in education. The faculty is hosting a centre for subject didactics. The aim of this centre is to further improve the research- teaching linkages concerning subject didactics in the teacher training programs.

2. Why are you doing it this way?

Some parts of the department have in earlier days been dominated by teachers without a PhD-degree. It has been an active goal to get a better balance especially among the teachers at the teacher training programs. Now about 50 % of the teachers have got a PhD.

3. How are you going about doing this in concrete terms?

The department has a work in progress when it comes to integrate perspectives on sustainable development in the pre school teacher training program (education and sustainable development is one of the strong research area at the department). In the process when all universities and colleges had to reapply for their degree awarding powers for teacher education programs an explicit aim was to connect the courses in the teacher training program to researchers in that area. All the groups working with courses in the new teacher training program was lead by scientific competent persons. One of the research groups (dealing with) reading an writing among young children also have started research groups including university teachers without a PhD. Other instruments to ensure research- teaching linkages have been to introduce new and relevant literature in English in different courses and to ensure the students got relevant education in academic writing.

The department have also started an overview with the aim to link firs cycle courses more directly to second cycle courses. The aim is to make sure different research groups takes responsibility for different courses. In addition to this one of the directors of studies have got grants from the unit of pedagogical development at UU to make a study on how to improve

the teacher students skills in academic writing in relation to the essay they write on the last semester on their education. Another university teacher have got grants for a project aiming to investigate how the progression in courses and students learning can be improved by working with reflection.

4. What are the main results?

The department has gone through a shift of competence, where scientific trained teachers now take more and more part of the education. The goal is to include scientifically competent persons in all courses at the department and to ensure that the scientific base of curriculum studies is solid in the teacher training programs. All programs and courses at the department are in a context strongly influenced by research.

5. Advice for others wishing to do something similar.

Be brave enough to take an open discussion about the importance of scientific competence in different courses and programs. It is important to think in strategic terms when it comes to research-teaching linkages in relation to the aim of different courses.

6. Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar

Department of education: Eva Forsberg: Eva.forsberg@edu.uu.se
Department of education :Karin Hjälmeskog: karin.hjalmeskog@edu.uu.se
Department of education :Jonas Almqvist: jonas.almqvist@edu.uu.se
Department of education: Peter Waara: peter.waara@edu.uu.se
Department of education :Caroline Liberg: Caroline.liberg@edu.uu.se

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain: ***Medicine & Pharmacy***

The research-teaching linkage is highly prioritised in the programs within the disciplinary domain of medicine and pharmacy (DDMP). Quality assurance programs/activities are continuously ongoing at all levels, i.e. courses, programs, faculty/domain, to ensure high quality teaching based on science and to provide the students with a clear and natural link between research and teaching. Some specific and more focused developmental initiatives have been performed during 2010-2012 and they are reported accordingly in Report 1. Other continuous efforts are accounted for here, in Report 2.

1. What are you doing to maintain or develop strong research-teaching linkages?

The majority of the teachers are active researchers updated with the latest research that they convey to the students. Many courses also employ external teachers that can bring research knowledge from outside the home faculty, for example from other universities, clinical research centres, or drug industry. The instructors are often PhD students.

The premises for lectures, seminars, clinical and laboratory practice are located close to the research laboratories and other research facilities. The students therefore have researchers close by and contact can be made on a daily basis at all times during their studies.

The students train critical scientific thinking and argumentation in a number of courses during their education at the university. Many courses at the advanced level are highly research oriented. The students performing a degree project within DDMP are often involved in research projects.

2. Why are you doing it this way?

University education has a responsibility to prepare students for a future with escalating demands to assimilate and critically evaluate new information. This is important both for everyday life and professional work since our students will contribute to the development of society in small and large. The knowledge they acquire in our programmes shall be based on scientific evidence. Students that have gained an understanding of the realm of science will be better armed, and with a network of experts, they will also know where to turn for answers and help.

3. How are you going about doing this in concrete terms?

Throughout the programs, the students will train how to search for scientific literature and practise scientific critical thinking and argumentation in activities such as journal

clubs. Scientific articles are used in various teaching items such as seminars and during laboratory practise. In some programs there are also specific educational elements that focus on scientific thinking, writing, etc. The students train communication of research results both at the basic level where they for example present laboratory results and to a high degree at the advanced level; they are for example expected to give an oral presentation and a written report after the project. There is a progression with higher demands towards the end of the programs. The expectations on the students are gradually increased and during the first course they can read and summarize a scientific article and towards the end they may review and discuss articles during the elective courses.

The students performing a degree project within DDMP are often involved in research projects. The projects can either be a focused research project or a literature review covering a specific research area. Irrespectively of what, the project is individual and the students are expected to work independently and be responsible for a study under supervision of research active teachers with a deep knowledge in the study area.

At the start of the project, the students are introduced to scientific work and are informed about the assessment criteria used in examination of the project. The students then train and practice scientific thinking, problem solving, research ethics, etc., as a natural part of their project. If the students participate in the regular day-to-day activities in the research group, they are also expected to take part of journal clubs, research seminars and progress meetings. The students will train communication of research results; it is mandatory to give an oral presentation and a written report after the projects and often peer-reviewing are practised. The presentations have to be prepared and performed according to instructions that have a high degree of similarity with scientific manuscripts and conference oral communications.

The students have the option to perform their project outside the home faculty either at Uppsala University, another University in Sweden or abroad so they have excellent opportunities to choose a project that fits with their individual interests.

In addition to these general activities that permeate all programs within the DDMP we here give some specific information about how we secure the research-teaching linkages:

During the elective courses of the *bachelor and master programs in pharmacy* the research-teaching linkage is especially evident. The courses mirror the research activities in the faculty of pharmacy and are highly research oriented and also give insight in worldwide research. The courses give excellent opportunities to practise communication, discussion and argumentation. In many courses there are specific research lectures to inform the students about ongoing research in the faculty and to inspire to scientific work. The teachers include research hot topics in their teaching, by using new drugs in individual assignments and literature exercises and describe new treatment strategies and clinical trials. The results from different assignments and the bachelor and master projects are presented orally and in a written report and often peer-reviewing are practised. Besides presentations at the departments, the degree projects are presented at a symposium (Examenssymposium) where the majority of the students present posters and a few have an oral communication for the audience of

teachers, students and next of kins. The faculty and the "Mentorsakademin" (alumni that acts as mentors for the students) regularly arrange study visits to a number of potential working places for a pharmacist and these visits include research facilities.

For more that fifteen years, *Uppsala Graduate School in Biomedical Research, UGSBR*, has been given particularly talented students the opportunity to embark one year of lab rotations. The school has as its prime objective to give university students, heading for a research education, a deeper knowledge about research and development, increasing possibilities to make active choices among the multitude of biomedical research fields and to establish productive national and international contacts. Admission is highly competitive and only the most motivated students with the best potential for at future in research are accepted.

Other specific examples:

- Involve the students in existing clinical projects during their degree project and encourage clinical contacts to present ideas for new student projects. In addition to research, the students are also involved in clinical development and quality work. *Nurse program*
- During the 5th semester the students spend one week with a PhD student to closely follow experimental bench work. The students give an oral presentation and make a written report of the experimental activities in the form of a scientific paper. *Bachelor program in biomedicine*
- The possibility to enter the UGSBR research school as part of their master program allows specifically research oriented students to dive deeper into on going research. *Master programs in biomedicine, infection biology, nuclide technology and molecular medicine*
- Take home exams and journal clubs during the courses "Advanced neurobiology" and "Drug targets" train and improve critical and scientific thinking and learn about recent research findings. Prior to these educational activities the students have a lecture about critical scientific reading to acquire some practical "tools" to start the process of critical thinking. The journal clubs have increased the student's independent thinking and they discuss scientific problems and studies more freely. *Master program in biomedicine*
- To improve supervision, scientific thinking, scientific writing developmental work regarding performance, evaluation and feed-back regular meetings between examiners and students are scheduled in the degree project. *Biomedical scientist program*

4. What are the main results?

The students will gradually be introduced to research during the program and they will progressively learn scientific thinking as they proceed towards the end of the program. Many teachers meet the students several times during the program, from the basic courses to the elective courses and the degree project. A higher degree of ability to work independently, to solve problems and to discuss scientific questions more freely is taken as evidence for an increased maturation.

The thesis projects are often a stepping-stone to further PhD studies. The meeting between supervisors and students over a common scientific problem might ignite the spark for a life long research commitment. This is most obvious for students graduating from UGSBR, where 80-90% continue with PhD studies.

Many students perform their project abroad, either through exchange programs or as free-movers (through personal contacts between teachers/researchers). We frequently hear positive remarks about our students' competence.

5. Advice for others wishing to do something similar

The most important is to create a research-friendly atmosphere with easy access to researchers and their activities on a daily basis, to inspire the students by making efforts to describe ongoing research in a way that the students can grasp. Include individual training during the program and, of particular importance, during the undergraduate project. The innate curiosity of the students must be fertilized and encouraged. Never stop asking "why"!

6. Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar

Göran Akusjärvi, bachelor program in biomedicine
Bryndis Birnir, master program in biomedicine
Pia Ek, Biomedical scientist program
Ronnie Hansson, Master of Science in Pharmacy
Emma Lundkvist, Bachelor of Science in Pharmacy and master programmes in pharmacy
Björn Wikehult, nurse program

Disciplinary domain: Medicine and Pharmacy

Faculty: Medicine

Department: Department of Medical Sciences, Medical Program

Project title/developmental activity: Scientific Development program for medical students/Teaching-Research integration

1. What did you do?
The Medical program in Uppsala has developed a course in scientific development throughout the new 5,5 year medical curriculum.

2. Why did you choose to do what you did?
Medical students complained about not being prepared scientifically for the master thesis work during semester 10 and 11 of the medical program and for their scientific lifelong learning.

3. How did you go about your work in concrete terms?
The managing board of the medical program of Uppsala Medical School initiated a multi-professional group including student representatives to develop a course in scientific development running through the full five and a half year program.

4. What were the results?
Students in the medical program will learn to read, judge and interpret scientific literature throughout the program and also write master thesis using a half time checkpoint for formative assessment and opposition (both receiving and giving) as part of the final examination.

5. Who and roughly how many people have been involved in the developmental work in some way or other?
The original working committee was divided in two working groups each consisting of about five people. In total about ten people has been involved in the practical discussions and developmental and implementation work with the course.

6. Strategy for possible further implementation.
The group who designed and managed the first phase of the work will be replaced by another, smaller implementation committee. Existing faculty will be involved in a large scale during autumn 2012.

7. Advice to others wishing to do something similar.
Start with the learning goals for the course and develop material and teaching opportunities backwards.

8. Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar
Eva Tiensuu Jansson, Johan Sundström, Maria Magnusson and Martin Wohlin, Department of Medical Sciences, Eva.Tiensuu_Janson@medsci.uu.se, martin.wohlin@medsci.uu.se

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain: Science and Technology

Faculty: Faculty of Science and Technology

General reflection:

Within the Science and Technology faculty the integration and linkages research-teaching are broadly present. Thus professors, lecturers and the assisting PhD-students are researchers and teachers, in the same person. This is one way of maintaining and developing strong research-teaching linkages. The faculty is fortunate in having many world leading scientists being teachers in our educations. We welcome students in our laboratories and scientific environments where they do various projects and thesis works. Thus any exam works, on master or bachelor level, are often a student performing research under supervision and guidance – representing a research-teaching link. Clearly, research and teaching are characterized by mutualism, a vivid teaching environment is beneficial for research and vice versa. Furthermore, a scientific approach to do educational research and didactics within the faculty is illustrated by two examples (1&4) below.

Examples attached:

1. Research in teaching and learning in computing and engineering in higher education
2. A scientific method course in the beginning
3. Protein engineering
4. Physics Education Research and strengthened scholarly practice

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain: Disciplinary Domain of Science and Technology

Faculty: Faculty of Science and Technology

Department: Department of Information Technology

Example 1:

Research in teaching and learning in computing and engineering in higher education

1. What are you doing to maintain or develop strong research-teaching linkages?

Uppsala Computing Education Research Group, UpCERG http://www.it.uu.se/research/group/upcerg_new, conducts research in computing and engineering education in higher education, with a particular focus on student understanding and support for innovative curriculum development. The research has dual aims: (1) UpCERG has pragmatic aims, with the focus on improvement on teaching and learning in our own setting as well as in education of computing and engineering at large, and in a world-wide context. (2) The research of UpCERG is based on theoretically sound theories and frameworks, offering the tools to act, and take part in, the international development within research in engineering and computing education.

UpCERG disseminates the insights and the results in several ways, formal as well as informal. For example, the group has a good publication record (http://www.it.uu.se/research/group/upcerg_new/publications); two of its active researchers are active in TUR; the research questions and insights gained influence the teaching at the department and the faculty, and are frequently discussed among colleagues. In these ways, UpCERG contributes with a rigorous, research-based scholarly perspective on teaching and learning within the disciplines in question.

2. Why are you doing it this way?

The research group stems from an interest to develop teaching and learning on a rigorous research based base. The do so, the group learned the need to become a part of the development of the theories within the field. In other words: to be an internationally important research group within this field, the groups has to span the field from practice to theory.

The international recognition is important, both for the development of the group and its research per se, but also for its recognition within the faculty. The group has an important impact in discussions on teaching and learning due to its theoretical base.

3. How are you going about doing this in concrete terms?

UpCERG research areas include globalisation and culture, student conceptions and ways of understanding computing, learning professional skills, and technology supported education.

Our research is driven by a desire to contribute to the body of Scholarship of Learning and Teaching that informs educational practice. The aim is to explore and develop undergraduate and graduate education in computing, and related fields, through the use of rigorous research methods. Research foci are chosen with a view to their potential impact on computing and engineering education.

4. What are the main results?

The results are at different levels: At a pragmatic level, the group contributes, through its results and the insights of the group members, to the scholarly debate on teaching and learning in science and technology at different contexts, for example at the department, at the faculty, at the university, as well as in national and international settings.

The research results forwards the knowledge on students' learning on computing and engineering, and from here, offers advice on teaching and learning within the field.

5. Advice for others wishing to do something similar.

UpCERG has some advice to offer:

1. Collaborate with others, at a local, national and international level. As in science and technology, research in teaching and learning in science and technology cannot be performed in isolation, but is a result of collective efforts.
2. It is important for the recognition of the research that it is performed in a rigorous, theoretically sound manner. This holds at several levels:

    a. Within the research communities of the different fields of science and technology, that form the base for the teaching and learning in question,
    b. Within the community of science and technology education,
    c. Among teachers and students in science and technology.

6. Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar

Anders Berglund, Department of Information Technology, Anders.Berglund@it.uu.se

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain: Science and Technology
Faculty: Faculty for Science and Technology
Department: Biology Education Centre (IBG) & IEG

Example 2: A scientific method course in the beginning

1. **What are you doing to maintain or develop strong research-teaching linkages?**
   In the biology education programme one of the first courses for most students is a course on the Evolution and diversity of organisms (15hp) and in this course there is a field course on the Scientific method. This part is now (from autumn 2012) highlighted separately in the course "Professional qualifications in Biology and the Scientific method (5hp)".
   The scientific method is taught as a "learning by doing" course at a biological field station (http://klubban.ibg.uu.se/?languageId=1) in a marine environment. The aim is to provide a theoretical and practical experience by formulating a hypothesis and prediction, design an experiment or comparison to test this, gather results and compile it, draw conclusions and present this orally and in a short written report. The projects are performed in smaller groups under interactive supervision, during 4 days.

2. **Why are you doing it this way?**
   The aim is to very early on (first weeks) of the education provide students with an understanding of where scientific knowledge comes from, how the hypothesis based way of thinking is a general tool for understanding and learning. We are doing this at a biological field station because it is easy to access marine organisms that can be used in often observational experiments, the questions can be formulated in various ways by the students, the experiments can be designed by the students and data can be collected and analysed. The course also provides good opportunities for group interactions and teaching can be combined with learning the diversity of marine organisms.

3. **How are you going about doing this in concrete terms?**
   The scientific method is presented and all steps (hypothesis, prediction, test, result, discussion/conclusion) the problems are formulated and worked through in practise by the students (i.e. no given recipes to follow). This gives a foundation for understanding science and to critically view what is taught in books, lectures etc. The practical way of working empirically gives strong hands on experience and the stimulating interactive environment is beneficial.

4. **What are the main results?**
   Students enjoy the process and the logic of the scientific method, the basics from the course is applied throughout their education and lives.

5. **Advice for others wishing to do something similar.**
   Allow time and room for scientific curiosity and with guidance into the scientific method students will have a tool to be used throughout their lives.

6. **Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar**
   Course leader; Ingrid Ahnesjö (Ingrid.ahnesjo@ebc.uu.se)
   See also a pedagogical project on critical thinking by Felix Ho
   http://www.teknat.uu.se/digitalAssets/90/90846_182-FelixHo.pdf

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain: Science and Technology
Faculty: Faculty of Science and Technology
Department: IBG & ICM

Example 3: Protein engineering

1. What are you doing to maintain or develop strong research-teaching linkages?
In the course 'Protein engineering, 1BG301, we are bringing in an actual research problem to the course, with the aim to supervise the students in such a detailed way that they will be able to take part in solving the actual problem.

2. Why are you doing it this way?
The course comes at a stage in the students education when they are prepared for a challenge, to make use of the knowledge they already have, and to let them experience the value of deeper knowledge and to experience the stimulation of solving a real problem, which is of importance for not only our research, but also for all the international collaborators and industries that are involved in the project. One of several goals is to bring self-confidence to the students and to stimulate creativity. We also stimulate them to identify their special talent.

3. How are you going about doing this in concrete terms?
The students (30 usually) work in groups of 3. The problem (this year how to modify a potential drug target (enzyme) such that it can be crystallized and provide high resolution structural data). In the introduction of the course theoretical background is given and they are asked to come up with a research plan for how they will solve the problem (each group make up their own plan, and this is graded, both the plan and the presentation). We provide them as much of knowledge that we can i.e. in literature presentations they had to relate how crystal packings are constructed and how other scientists have solved the problem. With web practicals they are guided into a detailed analysis of the problem and also guided how a solution could be designed. It all ends up in design of DNA primers that they will then use to mutate, truncate, elongate or use for gene shuffling. In the last 3.5 weeks of the course (7 weeks totally) they are performing what they have planned, which means genetic modification, protein expression in large scale, purification and crystallization. The work and documentation is done under GLP requirements and the diary is kept individually and graded (no lab reports).

4. What are the main results?
Positive. First of all the course evaluations show that they like it, and the response is reflected in their engagement. I have to tell them to go home in the evenings, and to arrange so that they could do work over the weekends. Scientifically every course has contributed substantially to research. This year i.e. one crucial mutation was identified and the properties of the enzyme were further revealed, which lead to another important modification.

5. Advice for others wishing to do something similar.
I believe that many teachers are already doing similar things. This is not unique, already Carl von Linneaus supervised students. Important is, however, communicating the ideas and results.

6. Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar
Torsten.unge@gmail.com; Department of Cell and Molecular Biology (ICM)

The KrUUt/CrED Follow-up 2012

Report 2. Research-teaching linkages

Disciplinary domain:Physics and astronomy, as well as other related domains

Faculty:Science and technology

Department:Physics and astronomy

Example 4:

Physics Education Research and strengthened scholarly practice

1. What are you doing to maintain or develop strong research-teaching linkages?

The division of Physics Education Research conducts research on higher education teaching and learning of physics. The primary focus of this effort is on the disciplinary discourse of physics. Although the aim is primarily basic research, the discoveries and competencies of the group can greatly inform educational practice in physics as well as other related subjects. This is done both through regular publishing of research results and other activities, such as workshops, talks and courses. Some members of the division also participate actively in teacher competence building and pedagogical development projects. An overview of division activities can be found at http://www.physics.uu.se/en/page/didaktik.

2. Why are you doing it this way?

This is one of the formal research divisions at the department of physics and astronomy and it follows the standard working procedures for these. The closeness to educational practice is both a condition for the successful research and an asset for our colleagues. This closeness has greatly contributed to an increased scholarly practice, particularly regarding teaching and learning.

3. How are you going about doing this in concrete terms?

A number of research projects are ongoing at the division at any given time. These are funded both internally and externally. Some applied projects also attract funding for pedagogical development. Our web pages provide examples of our research and further details on how we do it in concrete terms can be found in our publications.

The information of practice is done in a number of ways. Close collaboration with pedagogical leaders, individual teachers and other interested parties allow us to answer relevant questions. We also provide support for projects, studies and different initiatives. This support stretches from advisory functions to full project leadership.

4. What are the main results?

The research results are numerous and relate to issues such as how one develops disciplinary literacy, how experiences affect educational results and student persistence, how language use affects learning and how students relate to their educational programmes.

The application of these results and other research-based knowledge into scholarly practice has also yielded a number of results. Some examples of these are:

• design and investigation of interactive learning activities.

• improved curriculum design.

• initiatives to improve student persistence.

Other examples can be found on our web pages.

5. Advice for others wishing to do something similar.

Established research divisions with an education focus can greatly improve and inform educational practice. The aim of such divisions should however be clearly stated and well understood. The research at the division for Physics Education Research was recently evaluated as being of internationally high standard, with potential of becoming world leading. This requires high quality research that continues to attract funding. At the same time, requests for help, support and services on educational development must be handled in a good way. This balance is often quite delicate.

The most important advice from our experiences is that the chances for successful education development and strengthened scholarly practice are greatly improved by drawing on research based sources.

6. Name/s (department and e-mail) of person/s to contact in case there are questions from colleagues wishing to do something similar

Staffan Andersson, division of physics education research, department of physics and astronomy
staffan.andersson@physics.uu.se