

Embedding of ESD in Engineering Education - Experiences from Chalmers University of Technology

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Abstract

Purpose

This paper reports on methods developed, within a three-year ESD (Education for Sustainable Development) project at Chalmers University of Technology in Gothenburg, Sweden, to achieve a higher degree of embedding of ESD in engineering programmes. The major emphasis is on methods used, results achieved and lessons learned from the work.

Approach

The basic idea that methods and activities were built on was that the only way to achieve long-term changes is to increase the motivation and capacity of lecturers and program directors to perform the required changes.

Findings

Activities that were developed and tested focused on coaching discussions and on workshops for teachers, gathering teachers from one programme at a time. These activities aimed at starting learning processes in individuals. Special care was put on keeping the feeling of responsibility and initiative on the faculty members within the programmes. A special "resource group" of experienced ESD teachers was available as support for programme directors and lecturers.

Originality/value

The methods reported on are further developments of a method that has been used in Delft University of Technology (the Individual Interaction Method) in the Netherlands. The experiences from Chalmers are discussed in such a way that they provide useful insights for others aiming at similar changes at university.

Keywords: engineering education, education for sustainable development, ESD, individual interaction method, group interaction, embedding, integration

Type of paper: Case study

Introduction

Today, there are more and more efforts to include education for sustainable development (ESD) in engineering education. Many projects relate to the development of learning objectives or strategies for curriculum or course development for inclusion of ESD (Knutson Wedel et al. 2005; Svanström et al. 2008; Segalàs et al. 2009; Hargroves and Desha 2010). A frequently recurring challenge is to find an effective process of integration of sustainable development (SD) in the curriculum. Such a process often involves a change of attitudes. SD might for example have been perceived as something slightly off the core subject by tradition. New traditions and frameworks therefore need to be built and implemented.

At Chalmers University of Technology (Chalmers), a reform project was pursued in 2006-2009. It was called the ESD-project (Chalmers University of Technology 2010) and comprised many different aspects of ESD. Among those were, to:

- guarantee and enhance the quality of compulsory courses in SD
- guarantee and enhance the quality of SD content in other courses
- give effective support to those who order SD courses

One task in the ESD project was therefore to address the integration of ESD into educational programmes; to make it something that is taught not only in one compulsory course, but something that is embedded in the programme and appears in many different activities throughout the programme. In this way, courses that appear later in the programme can build on knowledge and competences that have been learnt earlier on. The vision is for SD to become the paradigm for the whole educational system so that different perspectives are constantly present in learning situations, and the direction towards SD is always safeguarded. Providing support to the program directors in achieving this change was mentioned specifically in the action plan, as can be seen in the third item in the list above.

This project relies on a firm belief that in order for this change to happen, the competences and attitudes of people in the system as well as characteristics of the system itself must be aligned to the new vision. For efficient and lasting change, it is not enough to carry out campaigns addressing student knowledge and awareness, but rather, activities should be directed towards a change of more permanent structures – of people that are in the system on a long-term basis, and of the system itself. In a comparison between Chalmers and two other technical universities (UPC in Barcelona, Spain and DUT in Delft, the Netherlands), it was concluded that there are five important factors for successful embedding of ESD within the curriculum (Holmberg et al. 2008):

- *Legitimacy*: It is beneficial if it is seen as legitimate for all involved to focus on SD in research and in education.
- *Commitment in university management*: It is of vital importance that university management is determined to integrate ESD in educational programmes.
- *Responsibility spread throughout organization*: The responsibility to work with ESD should be spread between different departments and levels – ideally a responsibility of all teachers and other levels in the educational system.
- *Skilled teachers*: It is an advantage if there are many lecturers in the organization that have a long experience of working with ESD.
- *Effective structure of organization*: The educational organization can be structured in such a way that it either constitutes a barrier or enables or even facilitates ESD integration efforts.

Within the project described in this paper, the embedding of ESD was mainly directed towards the knowledge and attitude of teachers and programme directors. The earlier experience at Chalmers was that it is only people that are already motivated to make changes that will respond to calls for action, unless they are directly approached and asked to contribute. Experiences from other universities of successful ESD integration efforts were searched for, and a method that had been used at Delft University of Technology (DUT) in the Netherlands (Peet et al. 2004) appeared to be both successful and in line with Chalmers' idea of a desirable approach. This method, the Individual Interaction Method (IIM), involved face-to-face discussions with individual lecturers, normally one-on-one. Instead of sending the whole staff group to a compulsory lecture on what sustainability is about, which is typically not much appreciated in academia, individuals were approached and asked about how their research topic or course contributes to SD. Not many people said that their research was not important for SD, but rather started explaining how they viewed sustainability and how their work could contribute. This created common ground for further discussion, and also pushed the approached lecturer to start thinking about this – it started a learning process and a growing interest. However, the method was claimed to be time consuming.

This paper reports on efforts to utilize and develop further the ideas from the IIM from DUT in order to design a process to achieve a higher degree of embedding of ESD in engineering programmes at Chalmers. The paper also reports on results from using the methods and lessons learned.

Method

Underlying principles

A group of teachers from many different departments, experienced in ESD, formed a so-called "resource group", and was given the task to approach teachers and programme directors at Chalmers with the aim of embedding ESD in educational programmes. The group first defined a strategy for embedding that was later used to create a new method for interaction with teachers and programme directors that built on some basic elements and ideas from the IIM that had been used at DUT. The modified method aimed at drawing upon the best of the IIM but also added some new elements.

Before the modified method was developed, the following strategy was formulated:

- Find out what motivates to integrate ESD in courses and programmes, e.g. opportunities for promotion within the academic system, available resources, demands from educational management, demands described in degree ordinances and the university law etc
- Hitch-hike with other processes of change, e.g. the adaptation to the Bologna system requiring teachers to redesign their course syllabus descriptions
- Respect and utilize the annual course and programme development cycle, e.g. suggest changes to courses in due time before the web system is locked for changes in February each year, and suggest teacher workshops to be held when the programme has its normal annual quality review
- Aim at establishing a sense of responsibility for integration of ESD among teachers and programme directors all over the organization – not in a special department or tied to a specific person. Especially, the resource group should be a resource in, but not responsible for, the implementation
- Aim at starting individual learning processes in as many individuals as possible, and at many levels
- Use ambassadors and already existing good examples of successful efforts to show that changes are possible and have a beneficial effect

Elements of the new method

The modified method builds on the experiences from DUT, but adds some new elements and allows for interaction also with groups and not only individuals. The new method primarily focuses on two major elements: individual coaching discussions and programme workshops for teachers.

Individual coaching discussions: Individual coaching discussions were offered to both teachers and programme directors. Since it was not compulsory to participate in these coaching discussions, only motivated individuals were expected to respond to this. This was therefore also combined with efforts to motivate the targeted persons. As an example, the first offer for these discussions was given at a workshop for programme directors and other educational management, in which the participants were informed about the intensified ESD embedding work at Chalmers, also making clear the strong drivers from both the university management and the Swedish National Agency for Higher Education (a new evaluation was pending). There were variations between programmes but typically up to a handful of teachers in each educational programme were asking for individual coaching over the slightly more than two years that the resource group was active. The majority of the teachers were reached through programme workshops where up to 20 teachers were present.

Programme workshops: Programme directors were also offered help in organizing faculty workshops for their respective programmes, according to a specific model that had been developed by the resource group, based on the formulated strategy and on the IIM method, to something that could be called a group interaction method. The purposes were to increase the quality and quantity of ESD embedding, to stimulate learning processes in both teachers and programme directors, and to give teachers and programme directors an overview of the programme in question and in specific its content of ESD. The planning and carrying out of the workshops was structured in the following way:

1. Programme director plans the day together with resource persons
2. Programme director invites teachers and asks them to prepare for the day
3. Faculty workshop:

- Program director explains the purpose of the day and gives an overview of the idea and content of the educational programme
 - Resource persons inform briefly on how embedding of ESD can be achieved and about available support at the university, e.g. the individual coaching discussions
 - Teachers present ESD in courses in the programme and ideas on how this can be further embedded and the quality improved
 - Group discussion on possibilities to increase the quality and the embedding of ESD in the programme
 - The faculty decides on an action plan together with the programme director
4. Resource persons contact the programme director to follow up on what has been achieved and to offer further assistance

Note that care was put on keeping the responsibility and initiative on programme directors and teachers. The goal was to make them feel that this was something they needed to do themselves, and if needed, the resource group could provide support in the work. During the slightly more than two years that this resource group was active, most educational programmes at Chalmers held a workshop like this, a few even held several workshops.

The two major elements described above were also backed up and strengthened with other efforts and initiatives, when chances appeared. Since the work of the resource group was part of a larger ESD project at the university, it was possible to find synergies with other efforts within the ESD project, e.g. the work to increase the quality in the compulsory courses on environment and SD in each programme. A working group of four people at the university, representing different subprojects in the larger ESD project, made sure that these synergies could be found. Therefore, other efforts also contributed to the work of the resource group and the embedding of ESD in programmes. Some examples are:

- Information on the work, the drivers and available support was spread to many different actors on many different levels in order to initiate and strengthen learning processes, responsibility and knowledge throughout the organization. Any information campaign made within the larger ESD project always informed about the different efforts that were made and the different types of support that was available
- Workshops for the educational management, programme directors, teachers in compulsory courses on SD and others were held. In these workshops, many different issues were presented and discussed, e.g.
 - drivers for embedding
 - what constitutes quality of ESD in educational programmes
 - different stakeholders' view on the current quality of ESD at the university
 - examples of successful efforts to embed ESD at the university
 - drafts to documents describing desired generic ESD learning outcomes at bachelor level in engineering programmes
- Motivating introductory lectures on SD for new students before starting the educational programmes, to show the sincerity of Chalmers' efforts, explain the basics of SD, and also to create expectations in students on courses and teachers as a driver for embedding. This activity started several years before the ESD project and is now standard procedure on both bachelor and PhD level

Results and lessons learned from embedding efforts

In this section, some specific examples of efforts carried out by the resource group and the effects that these had on the embedding of ESD in educational programmes are described. Lessons learned from the efforts aimed at improving the embedding of ESD in programmes include both experiences on how the work was managed and on the method itself.

Hitch-hiking with other reform processes or developments

All educational change processes, internally or externally initiated, can be utilised as windows of opportunities to also achieve better integration of ESD in courses and programmes. A few examples of such developments that were utilized in the ESD project are discussed below. Missing such windows of opportunity can result in stronger resistance to change due to change fatigue in the organization.

The CDIO (Conceive-Design-Implement-Operate) framework is a model for engineering education that aims at creating engineers that are better prepared for their professional life (Crawley et al. 2007). The Mechanical Engineering program at Chalmers had recently been reformed and organised according to this model. This greatly facilitated the subsequent ESD integration work (Knutson Wedel et al. 2008). When the faculty workshop on embedding of ESD was held for this programme, there was previous experience of discussing and including generic skills as programme learning objectives. The existing programme structure, described in a programme design matrix, made it possible to integrate objectives and learning modules related to sustainability in a similar way. Also, the embedding of generic skills, such as team work, is emphasized in the CDIO framework, and the faculty members therefore already had experience of integrating some generic skills that also relate to ESD. Furthermore, there were already many learning modules centred on product design, such as product development projects or assignments where the function of a product was to be discussed, in which sustainability issues were ideal to incorporate. Several integrated learning activities on SD were developed and successfully integrated into different courses, such as small calculation assignments, discussions on function and ethical considerations for a known product, and an interactive lecture on materials and sustainability in products. An important remark is, however, that some challenges were met in relation to the inclusion of a more holistic perspective. For instance, an environmental evaluation of a mobile phone is performed, but the questioning of the appropriateness of the mobile phone in fulfilling the function of personal communication, is far more difficult to embed. The Mechanical Engineering programme received, in 2008, an award from the Swedish National Agency for Higher Education for their successful efforts. This annual award, called Centre of Excellence in Higher Education, is an incentive for educational units that have already reached a high standard to improve even further. The award was given for the strong involvement in the CDIO Initiative and for the successful reform of the program, which is described like this: "The thoughtful manner in which teaching is approached is inspiring. Acquiring generic skills (team work, presentation, writing skills and communicative ability) is emphasised. Industrial experience is integrated through internships and project assignments assisted by a company-based supervisor." (Swedish National Agency for Higher Education 2010). Today, sustainability is highly prioritised on the programme agenda thanks to the combined effect of the CDIO reform and the ESD embedding work. An added benefit of the ESD work is that during the years of the ESD project, people involved in the CDIO project took part in discussions on ESD and, as a result, ESD is today better clarified in the syllabus recommended by CDIO, which will provide ESD benefits to other universities that are adopting or are being influenced by the CDIO concept as well.

The CDIO programme design matrix offers a very clear and transparent way to describe the structure and expected learning in a programme, which was advocated for use in all programmes at Chalmers by the educational management, at the same time as the resource group started its work. Together with an effort to rewrite all course descriptions so that they contained student-centred learning outcomes in the form: "After the course, the student should be able to demonstrate...", teachers were therefore already in a "change mode" when the resource group offered support to also include ESD in a better way. This is believed to have been an important success factor.

Consequently, there are opportunities to hitchhike with on-going processes, and even having been through a reform process recently may provide special opportunities. The CDIO framework is focused on providing structure and clarity to programmes and programme descriptions, and therefore, once this reform has been made, or when the reform is being made, it is much easier to implement other changes as well, as long as they are in line with the main ideas of the framework.

There are most often several initiatives and projects going on in an educational organization. The ESD project has in some cases been successful in finding the connections to such processes, e.g. the connection to the CDIO reform above, or the work with progression in learning throughout the programme on Architecture that is described below. However, in other cases, the project may have

missed such windows of opportunity. Somehow, a resource group of this kind needs to have connections to and support from educational project initiators in order to be able to find synergies and thereby lessen the workload for teachers, an important prerequisite for increased acceptance. It must also be remembered that after thorough changes to the educational system, the willingness to make considerable efforts to achieve changes can temporarily be exhausted. This makes it even more important not to miss out on the opportunity to hook on to other processes of change.

Examples of interventions by the resource group and effects on programmes and courses

In the programme on Architecture, three different workshops were conducted. The first two were meetings with teachers responsible for two overarching themes within the programme, i.e. “buildings” and “urban design”. The third workshop was carried out with the staff within a project on progression in learning throughout the programme in general, in which SD was used as a pilot theme. The workshops gave considerable input to the work with achieving a better progression in learning, and resulted in a proposal for a new structure of the programme which is being implemented in 2011. In the new structure, several different “lines of progression” have been identified, among them a new one on SD, which stretches from the compulsory course in the first year to the bachelor degree. The process has also resulted in two other important outcomes. The first is that many teachers have now become aware of the already existing SD related content in their courses, which they were not before. The second is that some aspects of SD will now be offered as in-depth studies on the master level. The work of the resource group has thus provided important input into and been one of the initiators of the restructuring work in the Architecture programme.

Another result from the work of the resource group is that within the three-year long bachelor programme on Product Design Engineering, some SD course elements were moved from the compulsory SD course to other courses in the programme. A basic course on materials now also has a course module on SD aspects, and in the thermodynamics course, SD aspects on energy are being discussed. As a result, a better progression in learning on SD has been achieved. Furthermore, a change has been made in the students' final thesis project. Students must now do a sustainability analysis within their project and e.g. make suggestions on how the SD performance can be increased if they are developing new products and service solutions. This makes it necessary not only for the students to increase their awareness of relevant sustainability issues but also for the supervisors, various teachers at the department, to have the relevant competences to be able to determine whether students are selecting relevant aspects to look into and are setting the system boundaries in an appropriate way. Some students initially found the sustainability analysis as something extra that did not add value to their specific project, but from a supervisor perspective, the addition of the sustainability analysis has resulted in that project results are much broader and has more credibility than before. A majority of students find that the sustainability analysis helps them in their development process and prevents them from getting stuck in details. Most of the students see this as something relevant for their future work as product developers. This has thus started learning processes both in students and in teachers in the organisation. This has also led to a demand for more teacher training courses within the Department of Design.

At the Department of Civil and Environmental Engineering, the ESD project was presented at a teacher seminar dedicated to the development of the five-year programme on Civil and Environmental Engineering, in which the future structure of the entire programme was discussed. In this way, the information about the resource group and ESD embedding efforts reached the teaching staff both at the bachelor level and in the five different Master's programmes at Civil and Environmental Engineering. This occasion led to continued contacts in three ways. Firstly, an individual coaching discussion was held with the teacher in the basic programming course for the first-year students, on “sustainability examples” to be included in the course. Secondly, a separate meeting with the five Master's programme coordinators was arranged, and thirdly, the resource person became engaged as a facilitator of an in-depth project with separate funding on embedding of SD in the Master's programme on Geo and Water Engineering (Palme et al. 2010). Towards the end of the resource group project, the person in the resource group who was responsible for the contacts with Civil and Environmental Engineering also became engaged in the programme council. One of the main issues presently handled in the council is that of how to restructure the entire educational programme, a

process which is coordinated with the programmes on Architecture respectively Architecture and Technology. It has been suggested that SD should be a theme that runs through the entire programme and integrates different parts of it as well as functions as a platform for meetings between students and teachers from the different programmes involved.

In both the Mechatronics programme and the Industrial Design programme, sustainability is today highly prioritised, partly because of the successful interaction by the resource group. The Mechatronics programme carried out a highly successful faculty workshop on ESD embedding, but the Industrial Design programme did not have a workshop at all. However, this is a small programme with engaged faculty, and the resource persons were instead involved in discussions with teachers and the programme director and therefore provided support in other ways.

Lessons related to the composition and task of the resource group

The so-called resource group got the responsibility for developing the method to be used and function as coaches in the embedding work. Care was then taken to achieve a broad representation from different departments within the group. It was thought to be more important to have this broad coverage of the subject areas than to keep the number of persons low. One result was that the dedicated time for the persons involved was sometimes apparently below a certain critical level. Unfortunately, many members of the group felt that a long-term task (almost three years) without sharp deadlines, and only a small fraction of the time devoted to the task (in general 5-10% of full time) made it difficult to prioritize this task above other more urgently time-restricted tasks. If similar activities were to be started again, care would be taken to create shorter projects with sharper deadlines.

The project served as training not only for the people approached by the resource group but also for the resource persons themselves. The members of the resource group now form an important network, spread over the university, of people knowledgeable in the embedding of ESD. Some of them were later assigned other tasks that involved coaching in relation to ESD.

The resource group as a whole contained a certain "mass" of competence and network contacts. An individual resource person acting as a representative of the group does not have the same overall competence, nor the power and the mandate, as the group as a whole. In some cases, it might have been more efficient if the entire group had taken the initial contacts with the programme directors and teachers in order to stress the importance of the project and introduce the network.

The original thought was that the major task of the resource group would be to coach individual faculty members, and after coaching those that were highly motivated and that even asked for help, approach others, using the IIM. Initially, the educational management, including the programme directors, was informed about the work at a first meeting, and several programme directors immediately asked for help in their programmes. Then, the model for faculty workshops was developed, and the first workshops proved so successful that this became the major type of activities of the resource group. The focus was therefore shifted towards approaching programme directors and offering help in planning faculty workshops. It was a clear benefit that some flexibility was allowed in the project so that the methods could be adapted and developed as the needs became clearer or shifted in the project. This could be done because the group itself had the responsibility for the development of the methods.

In some programmes, since the resource persons were selected from different areas and were contact persons for their own areas, the programmes also selected them to help out in programme and course ESD development in addition to their resource group tasks. The benefit of this was that this work was carried out by someone who was knowledgeable and that could get support from other members of the resource group. The drawback, however, is that this sometimes disincentivised other teachers and the programme director to take responsibility for ESD embedding in the areas that they were responsible for. This sometimes came in conflict with the overall strategy of the ESD work to keep the sense of responsibility and build competences in all persons involved.

The resource persons themselves have now ended the specific effort that related to the ESD project, but are of course effective ambassadors for ESD embedding at the university, now even more than before the ESD project. By letting people perform different ESD embedding work, their competences increase. This is an important reason to carry out different ESD projects at university and also to let

many different people participate, not only a few experts. Furthermore, as explained above, this has created an active network of teachers from different areas that now exchange experiences and help each other out in different ways. One drawback is that the resource persons still get requests and are expected to help out even after their mission ended, even if they no longer have extra time for this. Current requests for new ESD embedding efforts, especially help in organizing faculty workshops on ESD and individual coaching discussions, show that there is still a demand for more support in this area.

ESD embedding is a long-term effort

A more general result of the embedding work is that today, programme directors and many teachers are more aware of what ESD is and how it can be implemented. A greater level of awareness and knowledge has thus been achieved in the organisation. However, there are still many teachers at Chalmers that have not yet participated in any of these discussions on ESD.

With the current educational management system at Chalmers, programme directors and individual teachers are heavily affecting the quality, the quantity and the integration of ESD in the programmes. With knowledgeable and devoted teachers and programme directors, the result can therefore be very good. However, when these teachers and programme directors are replaced, much of the earlier hard work can be lost. Changes of this type may effectively slow down, stop or even reverse any successful changes that have already been made. ESD embedding must therefore be seen as a long-term effort that has to be patiently carried out over a long period of time. New co-workers need to be informed about the work. Furthermore, the structure around these roles and the annual quality development cycle of the programme does today not have control measures built into the system that safeguard ESD and make sure that history and knowledge is transferred to new staff. In the final report from the ESD project (Chalmers University of Technology 2010) it is suggested to the educational management that these structures should be changed or introduced in order to promote and safeguard ESD in the best possible way.

It is very important that the university and any person involved in embedding efforts recognises that long-term efforts are needed and that this requires patience and a positive attitude among those involved. If the sense of responsibility can be spread to many people at different levels, this will facilitate the work, both in terms of getting the changes done and in terms of lifting the knowledge level in the whole organisation.

Future outlook

The three-year ESD project at Chalmers aimed at developing a framework for a more permanent structure that can carry the responsibility for developing ideas and support related to ESD quality and embedding at the university. However, already during the ESD project, some recurring activities were started that will aid in ESD embedding. One example is a course on sustainable development for PhD students. The course was elective for a few years but is compulsory to all PhD students from 2012. A driver behind the course is that we need embedding also at the graduated level in order for PhD students to be able to consider SD in their research. The PhD students also function as teachers in the educational programmes and therefore this is an important group to approach for ESD embedding at bachelor and master level. However, this course is on SD and not on ESD and primarily aims at increasing the PhD students' ability to reflect on SD in relation to their own research topic. This course has been described in more detail elsewhere (Svanström et al. 2010).

Chalmers Learning Centre was initiated already before the ESD project ended in 2009, but was not formally instigated until 2010. The Learning Centre aims at being a platform for cooperation and resources in the area of learning at Chalmers, at which internal and external actors can meet, exchange experiences and develop their professional abilities, and provide input to the long-term quality development of learning activities at Chalmers. This platform will be a very important feature of any future activity in the ESD area at Chalmers. One idea is that a group similar to the resource group that was active in the ESD project could exist on this platform, but as a pool of resources rather than with a specific task. Short-term projects with a specific purpose related to ESD embedding that are started can then easily find persons that can perform or help out in these projects. The Learning Centre is

running the PhD course mentioned above. A professional development course on ESD for teachers as part of the Diploma of Higher Education that is required for teachers that receive tenure at the university was also suggested from the ESD project to the educational management. The Learning Centre is also pushing for the starting of this course. Furthermore, it has been suggested from the ESD project to the educational management that there should be a function, carried by one person in the educational management at Chalmers, that safeguards the development of the ESD area and makes sure that a) resources needed in terms of professional development courses and good teaching examples are available for teachers and others, and b) that the document describing desired learning outcomes for ESD is developed according to state-of-the-art. A project is now being run, using the Learning Centre as its operational platform, which starts up this work and elaborates on how the responsibilities should be carried on in the organization after the project ends.

Suggestions have also been made to the quality assurance system for education at Chalmers. Some years ago, a template for how to write program curriculum descriptions was made at Chalmers, but this template does not require a certain section on describing how the compulsory ESD course load is fulfilled and on how ESD is embedded in the program. A suggestion has been forwarded to the educational management that this should be changed. Furthermore, a specific learning outcome on reflections on SD has already been included in the goals of master theses at Chalmers, after suggestions from the ESD project. Other structures, like course evaluation templates and templates for the annual dialogue between heads of departments and the university management are now also reviewed in order to find out where ESD embedding could and should be included in order to make this something that cannot be forgot or disregarded. General experiences from the ESD project at Chalmers have been described elsewhere (Holmberg et al. 2010).

Conclusions

The method used to achieve a higher degree of embedding of ESD at Chalmers involved the formation of a “resource group” of teachers from many different departments, experienced in ESD. This group was given the task to approach teachers and programme directors at Chalmers with the aim of embedding ESD in educational programmes. Important conclusions are:

- Embedding of ESD relies on the persons and the structures that exist more permanently in the organization. Embedding efforts therefore have to address both of these.
- Therefore, efforts should be directed towards starting learning processes and building competences within ESD in as many people in the educational organization as possible, in as many groups and at as many levels as possible.
- Furthermore, quality improvement structures relating to e.g. course evaluation, programme development and competence building, should be improved in order to safeguard ESD in the best possible way.
- The resource group has successfully carried out work that has led to a higher degree of embedding of ESD at the university. The major elements in their approach are a group interaction method carried out through faculty workshops centred on the educational programmes, and individual coaching discussions.
- When other change processes are initiated in the organization, e.g. in educational programmes and in courses, there is an opportunity for hitch-hiking with these efforts in order to achieve also a higher degree of embedding of ESD. There is also a risk that earlier embedding efforts are lost if they are not safeguarded by permanent structures in the organization.

Chalmers Learning Centre has now been instigated at Chalmers with one of its tasks to carry on the work on ESD embedding at Chalmers. Among other things, the Learning Centre hosts a PhD course on SD, and will push for the starting of a professional development course on ESD for teachers at Chalmers. The Centre hosts a project that provides support to compulsory courses on ESD and explores how this should be handled more permanently in the organization. Any further ESD embedding efforts at Chalmers will utilise the Learning Centre as a platform, but will approach the whole educational system all over the university in order to build competences and commitment for ESD.

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