

Integrating social sustainability into the engineering curriculum at the Royal Institute of Technology (KTH): A pilot study

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Abstract

In recent years, significant efforts have been made at the Royal Institute of Technology (KTH) in Stockholm to integrate sustainable development in the university's Bachelor and Master education. However, a self-evaluation study carried out in 2012 showed that many programme coordinators and teachers at KTH still struggle with how to integrate social sustainability in their programmes. Based on interviews with programme coordinators at four engineering programmes at KTH we analyse what are perceived to be the main challenges associated with integration of social sustainability in the university's engineering education. The paper reports on data acquired through the interviews, focusing on three questions: (1) How is the concept of social sustainability defined and operationalized in the selected engineering programmes? (2) How is social sustainability taught in the selected engineering programmes (learning objectives, teaching methods, pedagogical strategies/tools)? (3) What resources (training efforts, material/tools, etc.) are (according to the informants) required in order to support teachers and programming coordinators in their professional roles as (social) sustainability educators?

1 Introduction

The Swedish Higher Education Ordinance (SFS1993:100) requires that engineering education in Sweden meet a set of learning outcomes focused on sustainable development. Annex 2 of the Ordinance prescribes that for a Degree of Master of Science in Engineering the student shall, among other things, “demonstrate the ability to develop and design products, processes and systems while taking into account the circumstances and needs of individuals and the targets for economically, socially and ecologically sustainable development set by the community”. Similar requirements exist for a Degree of Bachelor of Science in Engineering. At the Royal Institute of Technology (KTH), Sweden's oldest and largest technical university, significant efforts have been made in recent years to integrate sustainable development in the university's Bachelor and Master education. However, a self-evaluation study carried out in 2012 showed that many faculty members still struggle with how to integrate sustainable development in the engineering programmes. While the self-evaluation revealed a relatively high degree of integration of ecological aspects of sustainable development, programme coordinators expressed considerable confusion in how to approach the issue of social (and economic) sustainability.

The present study is part of a research project that aims to increase our knowledge and understanding about how future engineering programs/education should be designed in order to secure the inclusion of social sustainability aspects as effectively as possible. In the paper, based on interviews with programme coordinators at four engineering programmes at KTH, we investigate the perceived challenges of integrating social sustainability in the university's engineering education. We report on data acquired through the interviews, focusing on three questions: (1) How is the concept of social sustainability defined and operationalized in the selected engineering programmes? (2) How is social sustainability taught in the selected engineering programmes (learning objectives, teaching methods, pedagogical strategies/tools)? (3) What resources (training efforts, material/tools, etc.) are (according to the informants) required in order to support teachers and programming coordinators in their professional roles as (social) sustainability educators?

Our main study will include statements from program coordinators, teachers and (at a later stage) engineering students at KTH. The aim of this pilot study is to, in a small scale, try-out tentative interview questions and methods/tools of analysis. Data collection and analysis is therefore limited to statements from programme coordinators.

2 Background

2.1 The concept of social sustainability

The model for social change proposed in the Brundtland report (WCED, 1987) requires that development meet ecological as well as economic and social demands. Today, there is broad consensus that in order to achieve ecological sustainability societies must develop in such a way that the regenerative capacity of biological systems is maintained over time. However, there is significantly less explicit agreement on what it means for development to be socially (and economically) sustainable (Vallance *et al.*, 2011). From the literature it is clear that at present there is no single agreed-on definition of social sustainability. At the same time, there is a more or less shared view among academics as to what the main aspects of social sustainability are (Murphy, 2012), although different aspects, or dimensions, tend to be emphasized in different academic disciplines/policy areas (Weingaertner and Moberg, 2011). Baines and Morgan (2004) argue that common ingredients in the concept of social sustainability are: “overcoming disadvantage due to disability, social responsibility, social capital, equitable distribution of opportunities in development, cultural and community diversity and participation” (p. 97). According to Colantonio (2011) the key social sustainability themes are: satisfaction of basic needs, education and skills, employment, equity, human rights and gender, poverty, social justice, social cohesion, identity, participation and access and health, safety and well-being. Among the key factors identified by Dempsey *et al.* (2011, p. 291) are: social justice, participation and local democracy, social inclusion, safety, fair distribution of income, social interaction and employment, decent housing and accessibility.

In summary, social sustainability can be said to be closely related to traditional social welfare goals. Thus, Weingaertner and Moberg (2011) conclude that “there seems to be a common underlying understanding that social sustainability has to do with improving or maintaining the quality of life of people” (p. 7). To this social sustainability adds a “futures focus”, which implies that key social welfare goals should not only be met in the present but in an intergenerational perspective (Partridge, 2005).

2.2 Social sustainability in engineering education

Although there is relatively abundant literature on sustainable development in higher education, there is less literature dealing with sustainable development in engineering education and still less literature dealing specifically with social sustainability in engineering education. In engineering education, economic sustainability, interpreted as economic efficiency and long-term profitability, has traditionally received the most attention (Valdes-Vasques and Klotz, 2011). Some authors note that in recent years ecological aspects of sustainable development have started to attract more attention (e.g., Woodruff, 2006). However, it is clear that a similar development has not taken place when it comes to social sustainability.

The few authors who explicitly deal with social sustainability in engineering education tend to emphasize similar aspects to those identified in the social sustainability literature (see section 2.1). Valdes-Vasquez and Klotz (2011) argue that social sustainability is about “improving social safety, health and well-being during a project’s life cycle” (p. 189). The teaching model they propose is based on four dimensions of social sustainability: community involvement, corporate social responsibility, worker safety, and social design (Valdes-Vasques and Klotz, 2011). Segalàs *et al.* (2012), in an article investigating how sustainability is conceptualized by experts on teaching sustainability in engineering education, identifies a number of social sustainability themes, including quality of life, health, ethics, respect for traditions and cultures, fair distribution of goods and fair use of resources. In chemical engineering, corporate social responsibility has been pointed out as a central aspect of social sustainability (Allen and Shonnard, 2012).

3 Methods

This pilot study is primarily a descriptive study; however, the question of how to explain and understand the findings is, to some extent, also addressed. The starting point of our study is the requirement that social aspects of sustainability should be included in all engineering education. In order to understand how different actors respond to this requirement, the intermediate process, i.e., the question of how education about sustainability dimensions is organized, planned and implemented, needs to be addressed. In this study, the Frame factor theory thinking model (*sv. ramfaktorteoretiskt tänkande*) is used as a tool for understanding the informants’ different ways of responding to the listed requirements. This conceptual model was introduced by Dahllöf (1967, 1999) in the 1960s and was initially referred to as Frame factor theory thinking (FFTT) by Gustafsson (1994).

Four engineering programmes at KTH participated in the pilot study. Taken together these programmes were deemed to constitute a reasonable representative sample of engineering education at KTH. The programmes belong to different schools and, hence, represent different engineering fields. Three of the programmes were master programmes (300 ECTS). The remaining programme was a bachelor programme (180 ECTS). Semi-structured interviews with programme coordinators at the selected programmes were conducted in Spring 2013. All interviews lasted between 20 and 30 minutes and followed the same interview template. The template consisted of questions sorted into five focus areas: the interviewee’s background, the concept of social sustainability, learning objectives, curriculum integration and opportunities/difficulties. At the time of the interviews, the informants (two women and two men) had worked as program coordinators for between 2.5-18 years. None of them were currently or had been involved in research directly related to sustainable development. Collected data was transcribed, systemized and analyzed through repeated readings of statements.

4 Results

All four programme coordinators have been actively involved in the integration of sustainable development in their programmes and most of them say that they feel fairly comfortable discussing sustainability issues in engineering education. Their thoughts and views are accounted for below.

4.1 The concept of social sustainability (Q1)

To define and pinpoint the term ‘social sustainability’ is perceived as being something of a challenge to the informants. Sustainability in general and social sustainability in particular is/are difficult concepts to elucidate.

... the concept of social [sustainability] is really a concern of mine. What is it? I've thought a lot about this.

All program directors at some point compare their perception of social sustainability with how they perceive the (to them) more familiar concept of ecological sustainability.

Ecological sustainable development has always been included in this program, ‘naturally’ so to speak. Environmental issues have close links to my field of expertise. So I have no problems with this.

Not surprisingly all program directors are well aware of the requirements stated in the Higher Education Ordinance and in the KTH policy documents (KTH-Sustainability, 2012) regarding the integration of sustainability dimensions into engineering education. However none is familiar with the details of the what, when and why's behind recent investments in sustainability at KTH.

When asked to define the term ‘sustainability’ the informants initially refer to personal feelings and experiences. Someone mentions an interest in sustainability issues awakened early in youth. Others initially associate sustainability with professional experiences made prior to and/or within their present employment at KTH (however prior to them being appointed program directors). Only one of the informants spontaneously refers to what might be called an ‘official’ definition namely the Brundtland report (WCED, 1987). There are some examples of statements in the data showing traces of anxiety among some of the informants regarding the balance act of being ‘politically correct’. Half in jest someone says

I have deliberately withheld myself from talking too much about sustainable development in order not to get into trouble.

When analysing the informants’ statements regarding the concept of social sustainability the informants’ strategy could be described as being cautious. Most program directors find it difficult to present a ‘complete’ definition. What makes social sustainability particularly difficult to grasp is, according to one informant, the dimension of valuation that this concept covers.

You might say that it is more of a general principle...there may be a consensus that we should have it [sustainability aspects covered] but we are not yet agreeing on the definition or the means to get there. So it's difficult.

Another informant points to the politicization of the concept of sustainability and its various meanings and the consequences this leads to.

... generally speaking a part of this [social sustainability] is actually political issues which we will have different views on depending on our different positions. ... Ecologically sustainable development is much more ... it is a scientific fact that ... it's natural science and therefore it is easier to see what is right or wrong.

4.2 *How is social sustainability taught in the selected engineering programmes? (Q2)*

Social sustainability (as understood by the informants) is integrated in the selected programs in various degrees. Social sustainability dimensions are however commonly not explicitly specified as a learning objective in most of the course syllabuses. The informants however do recognise social dimensions as being implied in many of their courses and therefor dealt with (to some degree) within their program.

No, but there is surely something about sustainable development in general, but not specifically social sustainability that I know of.

Several of the informants point out the problems inherent in the fact that the concept of sustainable development has been divided into three different dimensions. This is, by some of the informants, perceived as an aggravating circumstance.

According to the informants teaching about social sustainability in the context of engineering education should have a close link to technology.

Projects are a very good way of working with this. It is important to link it to technology issues. I do not believe in dealing with it separately and to, oh well ... say let's have a course on socially sustainable development, and then to say that we are done with it. That's not how it works. This would be just like theoretical swimming training on land without having any contact with the water where you are supposed to swim.

So it's not about integrating into a single course, but to identify all these things naturally present in a number of courses and to ensure that they fit together in a good way.

Statements expressing that sustainability issues (including the social dimension) have been addressed prior to the introduction of this concept are found in the data.

Yes, it is a bit like that. I think the whole concept of sustainability is dealt with before. We have not called it sustainability for very long, but the issues have been there.

The informants express a need for support in improving their education about social sustainability issues. The initiatives already made have been acknowledged however not always apprehended as being significantly effective and supportive to the needs of their own specific program.

A concrete teaching example is mentioned by one of the program directors. It suggests that education about social sustainability could benefit from being linked to social media activities.

Some students did an 'app' for blood donors, then you could see when you can give blood next time, where to find the blood bus and such things. This shows how we can contribute to social sustainable development

Linking education to areas of interest and relevance to the students could, according to this informant be a way of making social sustainable learning goals visible and important to the students while studying and to their future profession.

4.3 *What resources are required in order to support sustainability education? (Q3)*

The establishment of a specific organization within KTH with responsibility for sustainability issues internally at KTH (KTH-Sustainability) is perceived as an important initiative. What direct and tangible benefits the different programs have had from this initiative however varies. Informants generally express views regarding the potential for further initiatives (e.g., information and feedback on initiatives taken, peer discussion).

Peer discussion that might include both program managers and teachers about what social sustainability really means would be good. Or even more important - what it means for our programs.

Guidelines, good examples and most of all a precise definition to relate to are other requests mentioned. A situational analysis regarding how sustainability issues are dealt with at other universities is also seen as helpful.

The issue of economic governance in order to achieve the objectives of sustainability is highlighted by one of the informants

...then we are into this issue of economic instruments as something that is essential for achieving sustainable development. And I think the reality is such that you have to steer it in that way.

Findings show that there is a need for (further) support from the university regarding clarification and specification of content and teaching methods related to the dimension of social sustainability. Good examples that could be adapted to the various programs at KTH are requested, preferably through designated courses, seminars and lectures. The competence among concerned teachers is also mentioned as a key factor.

5 Discussion and conclusions

When defining the concept of social sustainability the program directors express uncertainty regarding their ability to fully pinpoint the concept. The concept is perceived to be vague and therefore difficult to operationalize into clear learning objectives and activities. At the same time, the informants give rather similar accounts of what they believe the concept of social sustainability includes. Among the aspects mentioned by the informants are: (1) juridical considerations/questions (legal regulation of relations between people), (2) relationship between people (the good society – including gender equality, democracy, human rights, ethics), (3) work environment (occupational safety and individuals being able to work with other people), and (4) education/education system (access to information). This is consistent with the literature on social sustainability, which, although it acknowledges that there is no single agreed-on definition of social sustainability, expresses a shared view on what the main aspects of social sustainability are. However, the data also supports the hypothesis, put forward by Weingaertner and Moberg (2011), that different aspects of social sustainability are emphasized in different (policy and academic) contexts. Occupational safety is, for example, emphasized by the informant representing chemical engineering education. The informant working in the field of information technology instead highlights aspects such as education and access to information.

All informants consider social sustainability to be an important dimension, although for somebody social sustainability is ranked lower compared to the other two dimensions of sustainability (ecologic and economic). The latter view is in line with the literature on sustainable development in engineering education, in which it is argued that economic and (more recently) ecological aspects of sustainable development have traditionally been perceived as most important in engineering education (e.g., Valdes-Vasques and Klotz, 2011). At the same time, it is clear from the interviews that social sustainability issues are slowly gaining more attention in KTH's engineering education. Some of the informants mention that they have included learning modules dealing with ethical issues in engineering in recent years, and that they consider those to fall within the scope of social sustainability.

Some of the informants express the view that social sustainability is a much more ideologically, or politically tinted, concept than the concept of ecological sustainability. This echoes Murphy (2012), who argues that the choice of key themes or indicators of social sustainability in policy contexts is sometimes politically rather than scientifically motivated. That social sustainability is considered to be a more value-laden concept than ecological sustainability is considered to be a challenge when designing learning activities at KTH, since by including the concept of social sustainability in one's teaching one risks imposing one's own political views on the students. This is an interesting area of further study. Arguably, the concept of ecological sustainability is also a value-laden concept. For example, questions about the substitutability of natural capital and how to best manage natural resources given the uncertainties involved cannot be addressed in an entirely value-neutral way. It would be interesting to explore in further detail what are perceived to be the crucial differences between teaching about "good environmental quality" (ecological sustainability) and "the good society/life" (social/economic sustainability).

Social sustainability is addressed in all selected programs but in various degrees and at various stages. Projects are seen as a good way of integrating social sustainability aspects into the context of engineering education. Several of the informants emphasize that effective learning situations are created when social sustainability issues are clearly linked to the students' main fields of study. Thus, there is an expressed call for contextual teaching methods that introduce (social) sustainability issues through examples that are rooted in the engineering discipline (cf. Hirst *et al.*, 2004).

Looking at the reported results from a Frame factor theory thinking perspective (FFTT) (Dahllöf, 1967, 1999), the findings are logical and understandable. Decisions and directives concerning sustainability education in general and social sustainability in particular within the context of engineering education has been taken at the organizational level with few opportunities for program managers to influence the pace of this process. A perceived lack of economic and educational support for this education has undoubtedly led to consequences for the management of the programs. The problem is not the task itself. All program managers fully share the visions and goals stated on the executive level. The experienced problems in the implementation process (e.g., need of pedagogical/didactic guidelines/support and financial control) lie rather in the organizational structure. Our suggested conclusion is that the planning, organization and implementation of future sustainability efforts must be coordinated carefully with all concerned parties in advance and be supported more substantially than this current effort.

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