Brief Report

Sustainable Development in Higher Education—What Sustainability Skills Do Industry Need?

Göran Finnveden [1,*] and André Schneider [2,†]

1   KTH Royal Institute of Technology, Department of Sustainable Development,
    Environmental Sciences and Engineering, 10044 Stockholm, Sweden
2   EPFL (École Polytechnique fédérale de Lausanne), 1015 Lausanne, Switzerland
*   Correspondence: goranfi@kth.se
†   Current address: Geneva Airport, 1215 Geneva, Switzerland.

Abstract: Higher education must provide students with tools for a broad and holistic understanding of the complex situations they will meet in their careers after they graduate. This also includes issues related to sustainable development. Few studies have however been conducted where industry representatives specify what sustainability skills they require. The aim of the present study is to achieve a better understanding of the needs of industry related to a student's sustainability skills and knowledge. Industry opinions on sustainability skills were gathered in two ways: interviews were conducted with executives in different positions at companies and a workshop with sustainability directors from different sectors was organized. Companies expressed primarily two needs regarding sustainability skills: (1) sustainability professionals/specialists are needed and, (2) there is an equal need for all managers and leaders to have a general and basic competence regarding sustainable development within a number of different areas. While sustainability specialists are well represented in industry, the latter skills are rarer. Higher education institutions must therefore make sure that sustainable development is integrated into all educational programs.

Keywords: education for sustainable development; higher education institutes; learning outcomes; competencies

1. Introduction

Higher education institutions (HEIs) have a unique role and responsibility for the future and for driving the development of a sustainable society [1]. The establishment of Agenda 2030 and the Sustainable Development Goals is an opportunity that many universities have not yet realized [2]. Higher education institutions need to prepare students with tools and knowledge for a broad and holistic understanding of the complex situations they will meet once they graduate. Sustainable development skills are part of what they need to learn. This is relevant for technical universities such as EPFL (École polytechnique fédérale de Lausanne) and KTH (Kungliga Tekniska Högskolan), but also for other higher education institutions. The importance of sustainability skills is illustrated in the results from a survey of KTH alumni with a few years of experience after graduation. The results for 2021 show that 77% of KTH alumni in their early careers have jobs where sustainability issues need to be addressed [3]. This number has increased since previous surveys in 2011, 2014, and 2018 [3]. Furthermore, the interest among students in sustainability education can be significant [4]. An important issue is then what kind of knowledge and skills the students need to learn.

The question of what students should learn about sustainable development remains a challenge that needs to be discussed [5]. It is important to discuss competencies [6–13] but also learning outcomes including taxonomy [14–17]. Much of these discussions have, however, started from discussions within the universities, describing what is included in curricula or what faculty thinks should be included. There does, however, seem to be a

gap between obtained competencies and industry needs [18] and there are few studies that actually look at the competencies that are used [12,13,19,20]. There is also a lack of studies where industry representatives specify what sustainability skills they require. Many studies have also focused on sustainability professionals [11–13]. There is, however, also a need to discuss what sustainability skills and competencies that non-sustainability professionals need. The aim of the present study is to achieve a better understanding of the needs of industry related to a student's sustainability skills and knowledge also with a focus on non-sustainability professionals.

2. Materials and Methods

For this study, we used two complementary approaches: interviews and a workshop. Opinions on what sustainability skills that are needed can vary both between different types of companies, but also between different functions within the same company. An aim of this study was, therefore, to obtain input both from different companies as well as from different types of functions. We choose interviews for getting input from different functions within the company in order to allow the interviewees to speak more freely. This can be relevant since representatives from a company sometimes can have a tendency to want to speak with "one voice" which could imply that we would not be able to obtain different opinions. We choose a workshop for connecting with a larger number of companies, because we think that different sustainability directors would be inspired by hearing what others in a similar position would say. The combination of interviews and a workshop allowed us to obtain information from both different functions within companies and from a larger number of companies and organizations.

Altogether thirteen interviews were conducted with executives in different parts of two major international companies: Ericsson and Nestlé. From Ericsson, five people were interviewed coming from the human resources, supply chain management, sustainability and environmental departments. From Nestlé, eight people were interviewed coming from corporate strategy and finance, research and development, business units, human resources, public affairs, and sustainability and corporate responsibility. In this part of the study, care was thus taken to talk to people from different parts of the companies. Interviews were open around three topics: corporate sustainability context, sustainability skills needed, and current education and training. An interview guideline was developed and used. The interview guideline was developed together with a working group within the International Sustainable Campus Network (ISCN). When interviewing people at Nestlé, the interviewees were asked how essential different sustainability skills (presented below) were to them for future managers. When interviewing people at KTH, the interview guideline was used as a starting point, but the interviews were allowed to develop more freely. Interviews were mostly individual, but occasionally two people were interviewed at the same time.

The workshop was conducted with sustainability directors (or similar positions) from KTH's strategic partners. All strategic partners at the time (ten) were invited and eight of them came to the workshop with one or two representatives. KTH's strategic partners are typically larger organizations that have and want to have a strategic collaboration with KTH in relation to both education and research. Altogether eleven people participated coming from Ericsson, Saab, Sandvik, Scania, Skanska, Stockholm City, Stockholm County and Vattenfall, thus representing local government in addition to some major international companies based in Sweden coming from different sectors (telecommunications, defense industry, materials, vehicles, construction and energy). Furthermore, participating were six persons (faculty and staff) from KTH as facilitators and for taking notes. The questions asked at the workshop were as follows: What skills and knowledge related to sustainability do you think graduated engineers should have? Do they have that at present? If not, what is missing? Discussions were first made in smaller groups. Results were then summarized in a large group where there was also space for some final reflections. The workshop was

part of a longer meeting and lasted for approximately one hour. All interviews and the workshop took place in 2016.

3. Results

The results from the different datasets were fairly similar, but there were also some differences. For both Ericsson and Nestlé, sustainability is an important aspect. Nestlé has identified a number of sustainability issues that are of major concern to their stakeholders and at the same time have a significant or major impact on the business of Nestlé. These include climate change, water use, improved nutrition, human rights and food security. Ericsson wants to use ICT (Information and Communication Technology) for contributing to Agenda 2030 and the Sustainable Development Goals (SDGs). They describe how ICT can contribute to both environmental sustainability and socioeconomic development.

One aspect that was consistent in both interviews and the workshop was the need for both sustainability specialists and a common understanding of sustainability in basically all people they hire. Hence there is an important wish to see the education for these skills largely spread throughout universities.

Based on the interviews with Nestlé, a priority list of sustainability skills could be set up. This list was based on their views on how essential these skills were for future managers.

1. **Critical thinking on complex issues (including system dynamics)**: understanding sustainability as a complex issue in interlinked systems (different supply chain elements, differing interests by partner, multiple time horizons, business opportunities and threats related to sustainability, opportunities for innovation related to sustainability).
2. **Articulating sustainability issues**: communicating in an effective and engaging manner with partners inside and outside of the company about options to solve complex issues linked to sustainability
3. **Understanding megatrends and global drivers**: impacts of demographic shifts, climate change, food availability, and other global change issues on the company's value chain and operations
4. **Literacy on key qualitative and quantitative sustainability issues**: including energy and greenhouse gas management, ecosystem services, community and stakeholder engagement, social infrastructure development, life-cycle management, sustainable supply chains, resource/capital flows etc.
5. **Personal engagement on sustainability issues**: including own beliefs about the importance of sustainability.

Based on the interviews with Ericsson and the results from the workshop, it was not possible to make a priority list. The results were more spread out and evenly distributed. The issues identified could be sorted into the same general categories as the priority list above, but the same ranking was not identified. For example, literacy on key sustainability issues was stressed more by the Swedish stakeholders. The importance of personal engagement was, however, seen as less important also in these cases.

One specific aspect identified during the workshop was the ability to understand when a sustainability expert needs to be involved. This requires knowledge in order to identify the situation, which may be an opportunity or a threat, and an understanding of what a specialist can bring.

An interesting result from the interviews with Ericsson was also the need for being able to handle the combination of deep technological knowledge with sustainability skills. This would for example imply that sustainability needs to be integrated also in doctoral studies.

The answers and prioritization clearly show the importance of critical and systemic thinking that needs to be fostered and developed in students and also their capability to articulate and present these issues in an effective and engaging manner. This stresses the importance of being able to combine different types of skills e.g., combining communication skills and or sustainability knowledge. Finally, the importance of personal engagement in sustainability issues seems less valued as an important element for future employees.

When asked how satisfied the interviewees are with the sustainability skills available in candidates on the job market, the general answer was that the level of experts in this field is good and satisfactory but there is still a need for an evolution towards more generally present knowledge around sustainability issues. Hence, there is an important wish to see the education for these skills largely spread throughout all classes taught at universities.

Concerning what kind of skills that need to be further developed some examples of answers are listed below:

- Learn how to learn and process new data efficiently;
- Sustainability in all topics (sustainability needs to be broadly integrated);
- Extend technical knowledge with abilities to interact and collaborate with different people in a fast-changing business environment;
- Cultural openness including languages and open mindedness;
- Understanding of the links/impacts of sustainability issues on business (risks and opportunities, financial implications);
- Learn how to translate frameworks into actions;
- Skills in how to apply protocols;
- Understanding and managing relationships with stakeholders;
- Understanding of different organizations and initiatives in the sustainability field;
- Discussing real world examples and creating comprehensive business cases;
- Being able to reflect on the subject taught in relation to sustainable development;
- Being able to model impacts and do calculations;
- Having terminology and basic knowledge of sustainability;
- Being able to connect technological development to social and environmental sustainability.

Related to the question of how these topics should be taught, there was a strong emphasis on enhancing the integration of such topics in the existing curricula at the universities. Another point was to co-develop classes between universities, companies and NGOs and to use such co-developed programs to concentrate on real-world problems, and to assure that these classes transmit not only academic points of view on these topics but also the points of view of companies and NGOs. This is also in line with suggested practices [21,22]. In the workshop it was also stressed that there is a need for progression in the curriculum. Having just one class on sustainability in a longer program is probably not the right way. Having an early introduction to sustainability basics and then later coming back to the subject in several classes is probably more relevant. This is also in line with the suggested CDIO (Conceive, Design, Implement, Operate) standard on sustainable development [23]. This approach will however put higher demands on universities for monitoring and evaluating the curricula [17]. The importance of having interdisciplinary courses was also stressed. This is also in line with recent discussion on the need for transformations in learning and education for sustainable development including more collaborative approaches [24].

The results from this study can be compared with lists of learning outcomes [15] for sustainable development that has been suggested in the literature. Although there are similarities, for example in the emphasis on systems thinking, there seems to be a stronger emphasis skills in articulating sustainability issues as well as on literacy on key sustainability issues and an understanding of megatrends and drivers in this study. Compared to the list of recommended learning outcomes at KTH [16,25], there is a stronger emphasis on systems thinking and communication competencies in the present study.

The results here can also be compared with the suggested framework for sustainability competencies by Brundiers et al. [11], which is an update of the framework by Wiek et al. [6] which probably is the most cited paper on sustainability competencies. Brundiers et al. suggest the following key competencies: systems-thinking, strategic-thinking, values-thinking, futures-thinking, implementation, interpersonal, intrapersonal and integrated problem-solving. Although there is some overlap (e.g., concerning systems thinking and interpersonal competencies) there are several of these competencies that are not included in the results presented here. One reason for this may however be that the framework

presented by Brundiers et al. is for educational sustainability programs that are for students who are expected to work as sustainability experts. The present study on the other hand is focused on sustainability skills that industries expect from all their managers and leaders. It can be expected that sustainability specialists need different sustainability competencies than non-sustainability specialists.

In the framework of sustainability competencies suggested by Brundiers et al. [11], topical knowledge has a limited role. In contrast, the results presented here suggest that students should have a literacy on key sustainability issues as well as an understanding of megatrends and global drivers. This is also in line with the results of the empirical study by Venn et al. [13] that stresses the role of topical knowledge and how sustainability professionals constantly need to further develop their knowledge.This study is based on information from Swedish and Swiss companies and two local Swedish authorities. All companies are large international corporations and most of them have activities all around the world. The participating companies should therefore not be seen as typical only for Sweden and Switzerland. However, only a limited number of companies were involved and it would, therefore, be of interest to see similar studies made in other parts of the world as well.

It can be noted that the study focused on large companies and organizations. For small and medium sized companies the situation can be different. Smaller companies may not have the possibility to employ sustainability specialists. Therefore it may be even more important for non-sustainability specialists to be able to handle sustainability issues. If so, this could be an increased argument for the broad integration of sustainability in university education.

This study can be seen as a pilot study since there is a lack of studies that have looked into what kind of sustainability competencies companies need and who should have these competencies. An important aspect of the study was to not only ask sustainability directors (or equivalent) but also people from other parts of the companies. As a pilot study it points out three areas where more research is needed on sustainability competencies:

* More discussions are needed not only on what competencies sustainability specialists need, but what competencies do all future managers and specialists need and what needs to be integrated broadly in university curricula.
* As pointed out by other (e.g., [12,13] more empirical studies are needed on what sustainability competencies are actually used and needed by sustainability professionals but also by non-sustainability professionals that need to handle sustainability issues.
* More research on the needs from industries on sustainability skills would be useful.

4. Conclusions

Although there were some differences in the answers given by different stakeholders in this study, a consistent general picture emerged. There is a need for sustainability professionals. There is, however, also a need for sustainability skills amongst managers and leaders in different positions in companies. Furthermore, specialists working for example in research departments need sustainability skills. There is, therefore, a need for universities to provide students with a comprehensive set of sustainability skills also among those that are not going to work as sustainability professionals.

Four major groups of necessary sustainability skills emerged: critical thinking on complex issues, articulating sustainability issues, understanding megatrends and global drivers, and literacy on key sustainability issues. The relative importance of these four skill sets differed among different stakeholders. Personal engagement on sustainability issues was however typically ranked low.

When asked about how these topics should be taught, there was an emphasis on enhancing the integration of such topics into the existing curricula at the universities, but also working together with companies and NGOs concentrating on real-world problems.

The results from this study are important when universities develop their curricula. It points to the importance of integrating sustainability into a broad range of topics taught

at universities. Recent evaluations [23,26–28] indicate that there is a need for further development in this area.

The results from this pilot study also indicate the need for further empirical research on what sustainability skills are needed among non-sustainability specialists also in industries.

References

1. Finnveden, G.; Newman, J.; Verhoef, L.A. Sustainable Development and Higher Education: Acting with a Purpose. *Sustainability* **2019**, *11*, 3831. [CrossRef]
2. Leal Filho, W.; Shield, C.; Paco, A.; Mifsud, M.; Ávila, L.V.; Brandli, L.L.; Molthan-Hill, P.; Pace, P.; Azeiteiro, U.M.; Vargas, V.R.; et al. Sustainable Development Goals and sustainability teaching at universities: Falling behind or getting ahead of the pack? *J. Clean. Prod.* **2019**, *232*, 285–294. [CrossRef]
3. Eklund, A.; Stenvall, A.C. *Karriäruppföljning 2021*; KTH: Stockholm, Sweden, 2021.
4. Aginako, Z.; Guraya, T. Student's perception about sustainability in the engineering school of Bilbao (University of the Basque Country): Insertion level and Importance. *Sustainability* **2021**, *13*, 8637. [CrossRef]
5. Mulder, K.F.; Segalàs, J.; Ferrer-Balas, D. How to Educate Engineers in/for Sustainable Development. Ten Years of Discussion, Remaining Challenges. *Int. J. Sustain. High. Educ.* **2012**, *13*, 211–218. [CrossRef]
6. Wiek, A.; Withycombe, L.; Redman, C.H. Key competencies in sustainability: A reference framework for academic program development. *Sustain. Sci.* **2011**, *6*, 203–218. [CrossRef]
7. Lozano, R.; Merrill, M.Y.; Sammalisto, K.; Ceulemans, K.; Lozano, F.J. Connecting Competencies and Pedagogical Approaches for Sustainable Development in Higher Education: A Literature Review and Framework Proposal. *Sustainability* **2017**, *9*, 1889. [CrossRef]
8. Lozano, R.; Barreiro-Gen, M.; Lozano, F.J.; Sammalisto, K. Teaching Sustainability in European Higher Education Institutions: Assessing the Connections between Competencies and Pedagogical Approaches. *Sustainability* **2019**, *11*, 1602. [CrossRef]
9. Giangrande, N.; White, R.M.; East, M.; Jackson, R.; Clarke, T.; Coste, M.S.; Penha-Lopes, G. A competency framework to assess and activate education for sustainable development: Addressing the UN sustainable development goals 4.7 challenge. *Sustainability* **2019**, *11*, 2832. [CrossRef]
10. Galleli, B.; Horneaux, F., Jr.; Munck, L. Sustainability and human competencies: A systematic literature review. *Benchmarking Int. J.* **2020**, *27*, 1981–2004. [CrossRef]
11. Brundiers, K.; Barth, M.; Cebrián, G.; Chen, M.; Diaz, L.; Doucette-Remington, S.; Dripps, W.; Habron, G.; Harré, N.; Jarchow, M.; et al. Key competencies in sustainability in higher education—Toward an agreed-upon reference framework. *Sustain. Sci.* **2021**, *16*, 13–29. [CrossRef]
12. Perez Salgado, F.; Abbott, D.; Wilson, G. Dimensions of professional competences for interventions towards sustainability. *Sustain. Sci.* **2018**, *13*, 163–177. [CrossRef]
13. Venn, R.; Perez, P.; Vandenbussche, V. Competencies of sustainability professionals: An empirical study on key competencies for sustainability. *Sustainability* **2022**, *14*, 4916. [CrossRef]
14. Segalàs, J.; Ferrer-Balas, D.; Svanström, M.; Lindqvist, U.; Mulder, K.F. What Has To Be Learnt for Sustainability? A Comparison of Bachelor Engineering Education Competencies at Three European Universities. *Sustain. Sci.* **2009**, *4*, 17–27. [CrossRef]
15. Svanström, M.; Lozano-García, F.J.; Rowe, D. Learning Outcomes for Sustainable Development in Higher Education. *Int. J. Sustain. High. Educ.* **2008**, *9*, 339–351. [CrossRef]

16. Finnveden, G.; Strömberg, E. Developing sustainability learning outcomes for engineering. In *Proceedings of Engineering Education for Sustainable Development*; Cambridge University: Cambridge, UK, 2013.

17. Guiterrez-Bucheli, L.; Gillian, K.; Reid, A. Sustainability in engineering education: A review of learning outcomes. *J. Clean. Prod.* **2022**, *330*, 129734. [CrossRef]

18. Hanning, A.; Priem Abelsson, A.; Lundqvist, U.; Svanström, M. Are we educating engineers for sustainability? Comparison between obtained competencies and Swedish industry's needs. *Int. J. Sustain. High. Educ.* **2012**, *13*, 305–320. [CrossRef]

19. Thomas, I.; Despasquale, J. Connecting curriculum, capabilities and careers. *Int. J. Sustain. High. Educ.* **2016**, *17*, 738–755. [CrossRef]

20. Lambrechts, W.; Gelderman, C.J.; Semeijn, J.; Verhoeven, E. The role of individual sustainability competencies in eco-design building projects. *J. Clean. Prod.* **2019**, *208*, 1631–1641. [CrossRef]

21. Pacheco, L.; Ningsu, L.; Pujol, T.; Gonzalez, R.J.; Ferrer, I. Impactful engineering education through sustainable energy collaborations with public and private entities. *Int. J. Sustain. High. Educ.* **2019**, *20*, 393–407. [CrossRef]

22. Moksi, E.; Leal Filho, W.; Sehnem, S.; Andrade Guerra, J.B.S.O. Education for sustainable development in higher education institutions: An approach for effective interdisciplinarity. *Int. J. Sustain. High. Educ.* **2023**, *24*, 96–117. [CrossRef]

23. Rosén, A.; Hermansson-Järvenpää, H.; Finnveden, G.; Edström, K. Experiences from Applying the CDIO Standard for Sustainable Development in Institution-Wide Program Evaluations. In Proceedings of the 17th International CDIO Conference, Bangkok, Thailand, 21–23 June 2021.

24. Leal Filho, W.; Raath, S.; Lazzarini, B.; Vargas, V.R.; de Souza, L.; Anholon, R.; Quelhas, O.L.G.; Haddad, R.; Klavins, M.; Orlovic, V.L. The role of transformation in learning and education for sustainable development. *J. Clean. Prod.* **2018**, *199*, 286–295. [CrossRef]

25. KTH. Clarification of Overall Learning Outcomes. 2015. Available online: https://www.kth.se/en/om/miljo-hallbar-utveckling/utbildning-miljo-hallbar-utveckling/verktygslada/larande-for-hallbar/outcomes/precisering-av-overgripande-larandemal-1.432077 (accessed on 11 January 2023).

26. Finnveden, G.; Friman, E.; Mogren, A.; Palmer, H.; Sund, P.; Carstedt, G.; Lundberg, S.; Robertsson, B.; Rodhe, H.; Svärd, L. Evaluation of integration of sustainable development in higher education in Sweden. *Int. J. Sustain. High. Educ.* **2020**, *21*, 685–698. [CrossRef]

27. Robinson, J.; Ariga, A.; Cameron, S.; Wang, R. Reaching the rest: Embedding sustainability in undergraduate student learning. *J. Integr. Environ. Sci.* **2022**, *19*, 171–197. [CrossRef]

28. Åhag, P.; Hed, L.; Lundow, P.H.; Olsson, L. Are we ready for the Agenda 2030 for Sustainable Development? In Proceedings of the IEEE International Conference on Industrial Engineering and Engineering Management, Macao, China, 15–18 December 2019.

29. Finnveden, G.; Schneider, A. Corporate-university dialogue on sustainable development in education. In *Educating for sustainability*; International Sustainable Campus Network: Lausanne, Switzerland, 2017.