

Virtual Exchange in Education for Sustainable Development

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Abstract— In this work-in-progress research paper we aim to explore further the concept of Virtual Exchange (VE) in engineering Education for Sustainable Development (ESD). VE is understood as an ICT enabled practice where education programmes and/or education-related activities take place between students or groups of students who are separated geographically. VE allows for international and intercultural interactions among students without the need to move abroad, which substantially lowers the barriers for participating in such exchange. As VE enables interaction between students with different cultural backgrounds without the need for physical travel, it is clear that VE has potential to contribute to sustainability. However, there are also other sustainability-related effects that need to be emphasized. First, to promote international collaborations among students with different worldviews (internationalization) is often emphasized within ESD in order to be able to acquire a global mindset and develop the ability to collaboratively contribute to the alleviation of global sustainability issues, such as climate change. Second, VE requires students to adopt digital competences not directly related to the course content such as virtual meeting software (e.g. Zoom, Skype), “cloud collaboration software” (e.g. Google Drive, Microsoft Teams) and more. These competences are useful in order to later in the professional life of such students to exploit the dematerialization potential of sustainable ICT. Furthermore, we discuss our experiences with VE in the course *Managing Sustainability in Global Industrial Companies* which is a course co-taught between Uppsala University and University of Tokyo.

Keywords— *Virtual Exchange, VE, Education for Sustainable Development, ESD, Engineering*

I. INTRODUCTION

In recent years education institutions worldwide have become much more aware of the importance of internationalization. According to Knight [1] internationalization is defined as the process of “integrating an international, intercultural, or global dimension into the purpose, functions or delivery” of higher education. The “global education market” [2] is driven by among other things the need of intercultural competences in an increasingly globalized labour market, increased employability in such a market, and an overall interest among students to experience new cultural contexts. Clearly, internationalization has many benefits for individual students, the labour market, and for society at large, and therefore policymakers and researchers are generally optimistic towards increasing internationalization in higher education (HE).

A common strategy to achieve internationalization is to promote international student exchange programmes. A student exchange program is a program in which university students can choose to study at another university or

institution for a limited period of time. Although there are examples of national exchange programmes, most exchange programmes are international and involve travelling to another country to study.

In this paper, we review previous literature and discuss recent phenomena that suggest that the assumption of exchange programmes as the silver bullet to internationalization of higher education institutions (HEIs) needs to be further problematized. First of all, there are many well-documented negative side effects related to exchange programmes that indicate that internationalization could be more effectively achieved and facilitated by other means. The side effects that have been identified are for example unequal opportunities to participate in exchange programmes depending on wealth, family situation, disabilities, and so on [3]. Also, it has been suggested that although exchange programs can promote increased internationalization, many exchange students that stay for shorter periods of time rarely mix with natives [4]. Two of the recent phenomena are *Flygskam* (“flight shame”) and the recent Corona outbreak. Such phenomena suggest that we are in fact experiencing a paradigm shift when it comes to students’ attitudes towards flying, which is often more or less required to participate in conventional student exchange programs.

However, we believe that these obstacles for achieving higher levels of internationalization should not hinder students to meet and collaborate with fellow students from other countries and cultural contexts, and thus experience new perspectives and ways of studying, and develop intercultural competences. Instead, we argue that while conventional exchange programs have much to offer, VE should be more actively promoted as a way to increase internationalization in HEIs while at the same time avoid many of the (sustainability-related) side effects with physical exchange programs.

Virtual exchange is often understood as an umbrella term for Information and Communication Technology (ICT) enabled and mediated exchange-related practices. It is seen as alternatives or complements to conventional exchange activities, but that interaction takes place through the internet. As such, VE includes practices ranging from short projects or activities that students carry out in collaboration with other students or student groups virtually in for a limited period of time, to full programmes or courses. According to Helm [5], the focus is often on connecting classrooms and students across the world so that students can engage in “deep, interactive, social learning”. Furthermore, it has the potential to provide intercultural literacy and competences to students who cannot or do not want to engage in conventional exchange programs. Another benefit of virtual exchange over conventional exchange programs include an increased need for students to learn and use digital

tools that increase their digital literacy. Digital literacy is important for all students in an increasingly digital and globalized labour market and work life. More on this later.

Recently, Higher Education Institutions (HEIs) including universities, have been criticized for not being able to decrease travelling despite increased awareness of its implications on the global climate. In the appropriation directions from the government to Swedish universities in 2020, universities are commissioned to strengthen their work for sustainable development, and to report how this work is carried out now and in the future. This work should be linked to the global goals for sustainable development (the SDGs), where one of the more emphasized goals is SDG 13, Climate action. One of the most important sustainability-related challenges for HEIs to solve concerning this goal is related to travelling. Research projects in Sweden (e.g. FLIGHT) and globally have started to look into how to reduce travelling in flight-intensive organizations such as HEIs. While there are examples where students need to engage physically in activities in other countries, it is safe to say that many trips are also unnecessary and can be avoided. Of course, it is still crucial to keep working for increased internationalization, not least since many of today's sustainability-related problems (such as climate change) are global and thus require global collaboration.

Despite the potential of VE to promote different vital competences among students as well as increased environmental sustainability of HIEs, such activities are seldom implemented in courses by educators. It can be assumed that this is related to a common misunderstanding that VE requires high levels of technological competences including knowledge about each and every digital tool needed. This is, according to our experiences with VE, not the case. Furthermore, some activities require coordination between educators, courses and their curricula in different parts of the world, and this might be another (avoidable) obstacle.

The discussion in this paper draws on our experiences with VE between Uppsala university engineering students and students from University of Tokyo in the course Managing Sustainability in Global Industrial Companies, run by the authors from 2016 until today. The course is case-based and builds on a (light) problem-based learning (PBL) philosophy. The students meet weekly in video-linked seminars simultaneously run in Uppsala and Tokyo with one teacher in each of the two classrooms. Also, the PBL approach requires students to collaborate in international teams in order to solve cases. Throughout the years, we have experimented with different strategies to promote the out-of-class collaboration, since we believe that much of the important sharing of worldviews take place in the meetings between students outside class, and these will also be reported in the paper.

This paper aims to contribute both to practice and research. For practice, this paper aims to contribute with practical examples of how VE can be implemented in ESD, especially in engineering education. It also aims to debunk some common misconceptions about VE (e.g. that it is technologically complicated) but also discuss some of the barriers to successful implementation of VE in ESD. While many researchers and teachers might have been hesitant towards changing behaviours and practices before the Corona crisis in 2020, when essentially all teaching activities

were carried out virtually, this should no longer be a problem. Instead, we see this as a unique opportunity for HE and for ESD in particular.

II. INTERNATIONAL EXCHANGE PROGRAMS

As emphasized by Verzella [4], Student exchange programmes are popular for students in all disciplines and can be utilized for projects within and between a plethora of disciplines. An exchange programme is either long or short term, where short-term programs usually last for a few weeks or a month, and long-term exchange programmes can last for up to a full master or bachelor program. There are many potential benefits of exchange programmes. For example, students of marketing in the U.S. can benefit from collaborating with students of marketing in other cultural contexts to understand how to adjust rhetoric strategies for diverse audiences. According to Verzella [4], marketing teachers often ask students to assess their audience before presenting for example a proposal, but "all too often the implied readers for these assignments are tacitly identified in members of the local community ... who share values and cultural background with the writers". Engineering students who might end up in international engineering companies will greatly benefit from experiencing and learning about how projects are managed in other contexts, and so on. Not only can exchange programs contribute to intercultural awareness and competence within disciplines, but also among disciplines. Engineers who work in international projects can benefit from working together with law students in other countries, for example. Also, education in Western countries tend to be quite Western-centric [6], and all students benefit from being educated about and from within other cultural contexts. In summary, the most important thing about international exchange programs is that they allow for the development of cross-cultural (or intercultural) competences, which refer to the skills or knowledge that help students adapt to an inter-cultural environment.

Furthermore, Hansel and Grove [7] argue that international student exchange programmes are very beneficial for personal development and growth of students. They argue that compared with students who did not choose to study abroad, exchange students develop certain personal traits and characteristics better, such as communication, critical thinking and open-mindedness. Exchange students get the opportunity to learn about other cultures often show a greater awareness and appreciation of their own culture(s). They gain skills, competences and personality traits and characteristics that many students that never study abroad may miss out on. Overall, many proponents of exchange study programs show that there are great benefits of travelling abroad and that such programs should be promoted by HEIs.

Intercultural competences are also highly emphasized within ESD. Often, HE is seen as a vehicle to work towards a sustainable development [8]. First of all, HE has a responsibility to promote students to contribute to social progress and process. According to UNESCO, the goal of HE is to make students "wiser, more knowledgeable, better informed, ethical, responsible, critical and ... education ... is humanity's best hope and most effective means in the quest to achieve sustainable development" [9]. Many issues related to sustainability, such as poverty, are labelled "wicked problems", as they consist of incomplete, contradictory and changing requirements and lack the required information to solve. It is commonly implied that wicked problems, i.e. most

sustainability-related problems, cannot be fully “solved”, but require interdisciplinary and intercultural competences to solve. Thus, internationalization is often seen as a prerequisite to mitigate many of the great challenges related to sustainable development. Quite obviously, global problems require global collaboration and solutions.

A. Drawbacks to International Exchange Programs and the Potential of Virtual Exchange

According to Verzella [4], there are mainly two problems with international exchange programmes. The first one is that only a small percentage of students world-wide can afford to study abroad, and that many more are not mobile enough to do so for an extended period of time due to for example their family situation. Messer and Wolter [3] see that the socio-economic background of the students has a significant impact on their participation in student exchange programs. The second problem mentioned by Verzella [4] is that the programs themselves rarely contribute to the achievement of various pedagogical goals. Furthermore, the development of intercultural competences promised by such programs rarely materialize, as students who travel abroad for shorter periods of time rarely mix with local people, or engage deeply with students from that geographical or cultural context. Also, while many exchange programs certainly increase the “employability” of students (Messer and Wolter [3] see that participation in student exchange programs is associated with higher starting salaries among students), many exchange programs fail to make “students ... open and sensitive global citizens” [4]. Especially students from the US, according to Verzella [4], keep using the English language without attempting to socialize in any meaningful way with local people using their language. Doerry et al. [10] also emphasize that not as many students go abroad to get international experience due to various obstacles: among them language barriers, inflexible curricula, incompatible semester planning, and that students do not fully grasp that the world is becoming more globalized [10].

Apart from these obvious problems with exchange programs, there are other recent phenomena that suggest that exchange programs are not the only or best way of promoting internationalization of HE. First of all, we have the paradigm shift when it comes to attitudes towards flying among (mainly young) students. *Flygskam* (which translates into “flight shame” from Swedish) has spread around the world, and refers to the feeling of shame and guilt for flying as it contributes to negative environmental effects such as climate change. The authors of the book *Grounded – Beyond flygskam* [11] show that while young people generally feel guilty for flying, the guilt itself is not what leads them to choosing other means of transportation. Instead, they choose other means of transportation because they are aware of the negative environmental consequences of flying and do not want to contribute to them. In a sense, it is a very rational response to a problem and not directly related to what is socially acceptable. Although we have not yet found any studies showing that flight shame or environmental consciousness per se is correlated to increased reluctance to participate in exchange programmes, it is reasonable to assume that it does or at least will do in the future. Also, while we have established that intercultural competencies and internationalization are beneficial for ESD, it is clear that increased air travelling is not. Another recent phenomenon that will most likely have a long-lasting impact on the way we

travel is the spread of the Coronavirus. Many states are closing their borders and discouraging travelling to other countries. While this will hopefully change once the epidemic is over, it is reasonable to believe that this will have lasting effects on people’s travelling habits.

Although there are negative aspects related to exchange programs, it is important to note that the positive effects can be tremendous and that conventional exchange programmes should be promoted also onwards. However, there are alternatives to conventional exchange programs that avoid many of the negative effects related to conventional exchange programmes, while maintaining some or all of the positive effects. One of these alternatives is VE. VE is an umbrella term for different ways in which HIEs and individual educators are internationalizing their courses and programmes. While VE is ICT enabled, the focus is not on the digital content but on the intercultural and interaction that digitally connected classrooms across the world can provide. VE can be used throughout courses or programmes and connect students and teachers in each and every activity, or in isolated activities or projects in a single course. The main argument is that VE can offer intercultural exchange to the majority of students who cannot or do not want to participate in physical exchange programmes, completely free or at a fraction of the cost of an exchange program. While VE cannot promote the same in-depth exchange that conventional exchange programs can (potentially) offer, many of the abovementioned positive effects can still be achieved with VE. Furthermore, VE projects help students to develop their digital literacy [5]. Kellner [12] sees that in an evolving and turbulent global culture, it is necessary to be able to understand and work in heterogeneous cultural groups and forms, and acquire literacy and competence in media and ICT. VE projects require the students to fully utilize the potential of ICT for communication and collaboration purposes. Tools and software like Zoom, Google Drive, Microsoft Teams, Skype for Business and more are necessary for VE. These are also tools that are commonly used in both regional and international projects. This can thus be seen as a major positive side-effect of virtual exchange. However, such competence is also needed in order to unleash the potential of sustainable ICT, where one important aspect is presence dematerialization, i.e. virtual conferences, meetings and so on.

In the following chapter, the course in which VE activities have been implemented will be described in depth. Following the introduction to the course is a discussion based on our experiences with VE in engineering ESD, and previous literature on VE.

III. MANAGING SUSTAINABILITY IN GLOBAL INDUSTRIAL COMPANIES

The course in which VE has been implemented as one aspect is called Managing Sustainability in Global Industrial Companies. The course aims to facilitate the development of strategies to address and approach sustainability-related challenges that accommodate a range of interrelated perspectives, including economic, social and environmental. By targeting sustainability, the course is thus unavoidably and inherently multidisciplinary and interdisciplinary, encourages holistic, “fuzzy-problem solving” skills, and requires students to engage in critical thinking and self-reflection to make progress. Interdisciplinarity feeds into the program in three fundamentally different ways, i.e. not just through the nature

of the problems to be solved, but also through the background of both the educators and the students.

An important feature of the course is its cross-continental structure. It is given both in Sweden at Uppsala university and in Japan at University of Tokyo. While some lectures and seminars are given at only one of the two campuses, some seminars and lectures are co-taught and many of the group assignments are carried out by cross-national groups consisting of a diverse group of students located at two different universities. The UU side involves graduate students primarily from MILI (Master Programme in Industrial Management and Innovation, which adds knowledge about management to students with a bachelor's degree in engineering), which consisted of Swedish home students in 2016, but which opened up for international students from the autumn of 2016. The UT side involves undergraduate students, primarily from the PEAK Environmental Sciences programme (these students study two years of liberal arts before specializing in environmental sciences in years 3 and 4) but also some from the PEAK Japan in East Asia programme. These students are all international and come from a wide range of worldwide locations. They are also joined by some home Japanese students from a variety of different departments and also by students visiting UT on student exchange programs. Thus, the participants differ in terms of their location, background, expertise, study level and nationality. Rather than giving rise to problems, these extensive differences become an important part of the ability of the class as a whole to explore the roles of different perspectives and stakeholders, and bring a wide variety of different views to the discussions.

The course revolves around a series of case studies of different global industrial companies such as Nike, Intel, Royal Caribbean, Pfizer and Ikea. Until 2020, when the Corona outbreak forced all HEIs to provide students with virtual courses, the introductory lecture, the introduction to all case assignments and some various other lectures were physical lectures. However, these are now pre-recorded and followed up by a Q&A session using video conference software. Each week, the students are provided with a range of voluntary articles and online video materials that forms the starting point for their research and teamworking. The students work on each case for a full week and are required to produce a written report that addresses the questions posed. Each week one team is responsible for producing an oral presentation on the case (involving members from both UT and UU) and one team is assigned to be the primary responders to the presentation. Until 2020, when all physical seminars were made virtual, some seminars were delivered both at UU and UT simultaneously, using a mobile Polycom system. The presenting team delivered their report using live online slide sharing, with speakers from the two institutions speaking in turn. As of 2020, all students and teachers participate virtually through the video conference software Zoom.

For some cases, real world experts from either the companies being discussed or from relevant associated institutions are invited to attend this live networked session. They participate in the debate, comment on the students' presented solution, ask questions to the students, and answer specific questions asked by the students. They also share their views with the instructors on how well the students have addressed the sustainability challenges. The course is

supplemented with individual assignments to students to allow them to elaborate on theoretical and empirical aspects of the cases, as well as a reflective piece where each student concludes what were the main take-aways from the course. From 2020, optional seminars have been implemented where students can ventilate their ideas and get feedback from fellow students. These sessions make use of the breakout groups function and require little to no teacher involvement.

Before 2020, the key to the success of the course was careful timetable matching between Sweden and Tokyo, which meant organizing classes well in advance to secure video-conferencing capable rooms at appropriate times in both institutions. In addition, there were some problems related to sharing content of the "offline" activities between the two campuses. While the Corona outbreak has certainly made the course more difficult to organize in many ways, these two challenges have been solved by the use of more digital content and presence.

IV. CONCLUDING DISCUSSION

This paper has discussed the phenomenon Virtual Exchange (VE) in engineering Education for Sustainable Development (ESD). The paper is based on our experiences with the course Managing Sustainability in Global Industrial Companies (which is co-taught at Uppsala University and University of Tokyo) and previous research on VE and conventional exchange programmes. The conclusions thus far can be divided into two categories, for practice and for research. We will start off with the practical contributions of the study.

Cross-cultural competences can result from conventional exchange programs, but we believe that they can do so also from VE. While we have not made any empirical inquiries as of yet, we assume that such competences materialize from the collaboration/interaction that can be facilitated by the educator and not from the form of exchange (virtual or physical). That being said, however, it is clear that conventional exchange programs have the upper hand, as students then have an opportunity to develop these competences 24/7 for a limited period of time, while VE usually only promote intercultural interaction in seminars, lectures and student projects. However, as previous studies on exchange programs have shown, short-term physical exchange oftentimes does not promote meaningful intercultural interaction [4].

Out of necessity, due to the Corona virus, most teachers in HE have prepared courses and materials for online teaching, which is necessary for VE. However, this does not mean they have yet acquired the necessary skills and competencies to effectively facilitate VE, but it is an important first step. However, for the course presented in this paper, the teachers had no prior experience with VE or knew about the concept of VE before initiating the initiative. Without us teachers giving the students any examples of digital tools to use in their collaboration, they managed to autonomously explore a plethora of different useful tools and software, and develop the basic skills necessary to use them to facilitate international virtual collaboration. This means that VE is also promoting digitalization and dematerialization [13].

Thus, despite the obvious sustainability-related benefits of VE, namely that it can substitute physical travelling with virtual meetings and lectures, VE also has the potential to facilitate internationalization of HE, and help students to develop skills to promote digitalization and dematerialization

in their future professional life, without putting too much pressure on the educator. However, there are some obstacles that need to be overcome in order to start promoting VE in HE courses. For example, there are time zone differences that we have not experienced as limiting for the students in their collaboration, but somewhat problematic when scheduling joint-seminars and lectures, and when communicating with students through email. There is also potentially difficult to find good counterparts to collaborate with. VE can certainly help to promote interdisciplinarity in different assignment, but this hinges on if the groups that are collaborating virtually are both sufficiently different and sufficiently similar to each other. Similar so that all students can understand the course content and the assignments, and different so they can see the problems from different perspectives, or frame it differently by drawing on theories and ideas from different academic fields.

As this is a work-in-progress paper, we have not yet engaged very much in any academic debate on VE for ESD. Neither have we started our empirical enquiries. Instead, we have focused on presenting some preliminary findings from our own experiences with VE in the course so far. Our main motivation with this study moving forward is to explore the value of VE for ESD, especially within engineering education, and discuss how VE can be tailored to fit such education. This discussion will be anchored both theoretically and empirically. Theoretically, our ambition is to engage more in the academic discussions related to VE – and digitalization in general – and ESD. While this has been done to some extent, it is clear that more theoretical grounding is necessary. Empirically, the idea is to – through online surveys and interviews – more closely examine the students' perception of and experiences with VE for ESD.

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