Introduction

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ABSTRACT*: The aim of the SustainComp project was to bridge the gap between sector-divided, discipline-embedded national curricula in education and to address the current need for competence-based, interdisciplinary, transformative, and internationalized Higher Education (HE) that is in congruence with the European Council Erasmus+ program and the 21st Century learning goals. Four HE partners – UCL University College in Denmark, University of Agder in Norway, University of Ljubljana, Slovenia, and Masaryk University, Czech Republic - set out to develop a 10 ECTS SustainComp Curriculum, each partner contributing to the aims with a 2,5 ECTS submodule as part of the SustainComp curriculum. The development of the 10 ECTS SustainComp curriculum was guided by Design Based Research (DBR) approach, enabling the four HEs to test in practice and adjust the curriculum in the pre-pilot phase in April 2023 and the full-scale pilot in October-December 2023. See fig 1.*

KEYWORDS: *Sustainability Education; Higher Education; ESD; Teacher Education; Design-based Research; DBR*

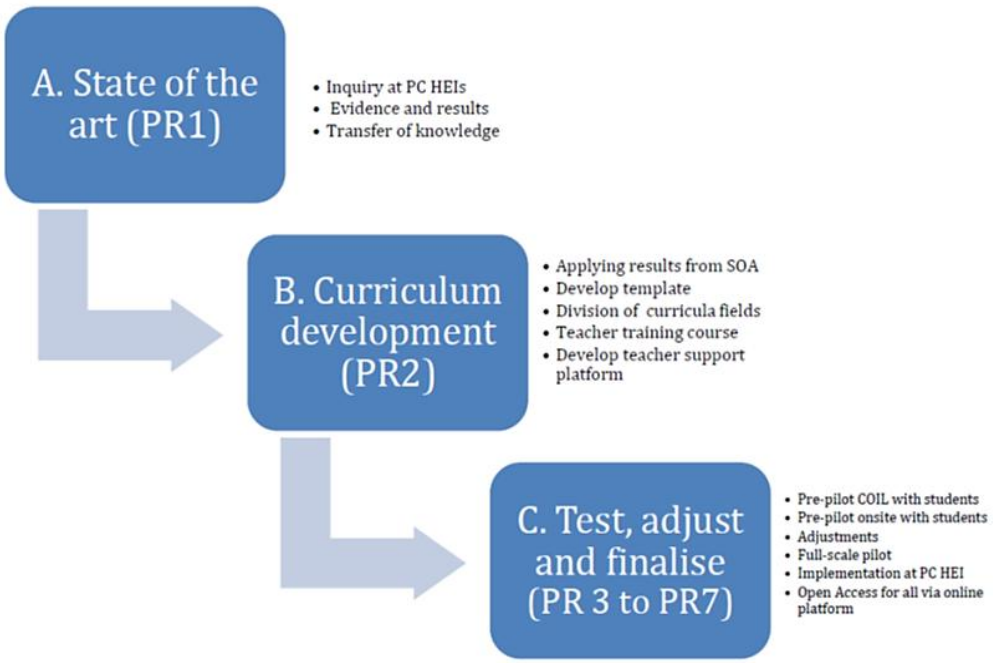
The aim of the SustainComp project was to bridge the gap between sector-divided, discipline-embedded national curricula in education and to address the current need for competence-based, interdisciplinary, transformative, and internationalized Higher Education (HE) that is in congruence with the European New Green Deal[i]Council Erasmus+ program and the 21st Century learning goals.

Background

Four HE partners – UCL University College in Denmark, University of Agder in Norway, University of Ljubljana, Slovenia, and Masaryk University, Czech Republic – agreed to develop a 10 ECTS SustainComp Curriculum, each partner contributing to the aims with a 2,5 ECTS submodule as part of the SustainComp curriculum. The development of the 10 ECTS SustainComp curriculum was guided by Design Based Research (DBR) approach, enabling the four HEs to

test in practice and adjust the curriculum in the pre-pilot phase in April 2023 and the full-scale pilot in October-December 2023. See fig 1.

Figure 1. SustainComp Program for the design-based research process (Authors).



The project further encouraged and facilitated HEI teachers' participation in the SustainComp online learning, teaching, training activities, as a supplement and added value to their respective academic educational backgrounds. The study materials, courses, modules, and reports are available to all interested via Open Access on the SustainComp e-learning platform[i] in an aim to encourage and support international and intercultural online collaboration among students and teachers.

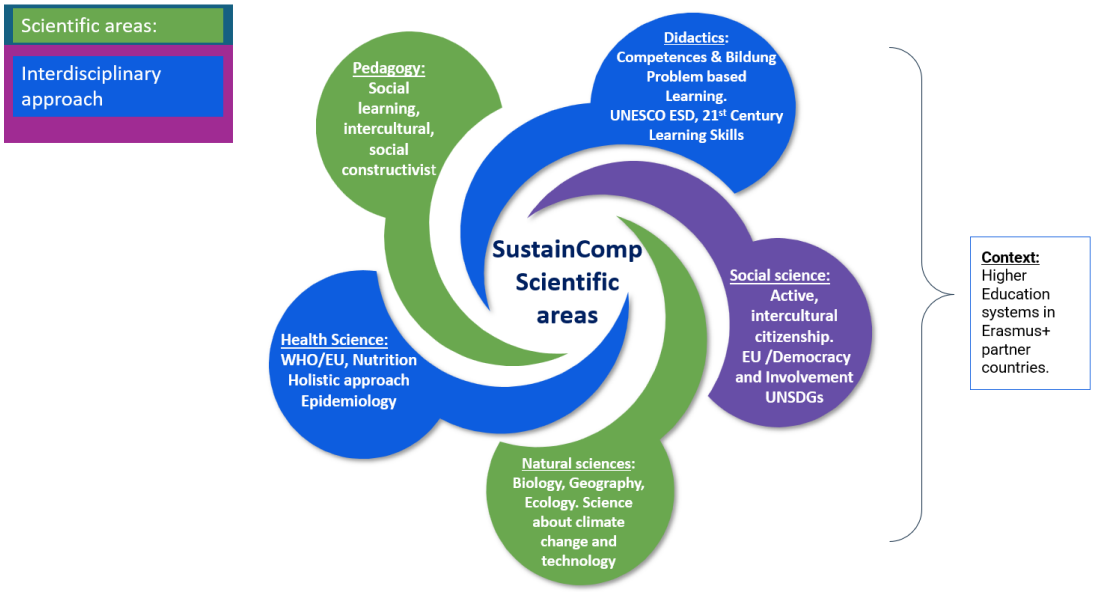
In both Europe and globally, we are confronted with significant obstacles related to health, environment, and climate change (Romanello et al., 2023). They constitute major challenges for the health, well-being and prosperity of citizens. The solutions to these obstacles are complex and emphasize the demand for cross-border, educational- and intercultural collaboration. The educational sector at Higher Education Institutions (HEIs) play an important part in these challenges as students are citizens and stakeholders of both today and the future.
The significant obstacles related to health, environment and climate change we face globally (Romanello et al., 2023) constitute major challenges for health, well-being and prosperity of us all. Solutions to these obstacles raise demand for the cross-border, intercultural collaboration of Higher Education Institutions (HEIs) whose graduates will be empowered to tackle the

challenges. The Sustainable Competences in Higher Education (SustainComp) project was awarded a grant in the Erasmus+ 2021 call: KA220-HED - Cooperation partnerships in higher education (EU, 2021) and brought together four experienced HEIs - UCL University College in Denmark, University of Agder in Norway. University of Ljubljana in Slovenia, and Masaryk University, Czech Republic - to develop a future-oriented, interdisciplinary, and internationalized curriculum. The four HEIs entered into a joint partnership to develop a common curriculum for HEIs in and outside the EU.

SustainComp Curriculum

The resulting SustainComp curriculum bridges the gap between sector-divided, discipline-embedded national curricula in education and addresses the current need for competence-based, integrated, interdisciplinary, and transformative higher education.
The SustainComp curriculum is based on the UNESCO framework for Education for Sustainable Development (ESD) and draws on the cognitive, socio-emotional, and behavioral domains of learning (UNESCO, 2017). The multimodal educational resources in the curriculum include the UN Sustainable Development Goals (SDGs) with the aim to develop students' competences pertaining to sustainability (United Nations, 2015). In addition to sustainable competences, the curriculum builds sustainable students' transversal skills for 21st century (Joynes et al., 2019). These are critical thinking, creative problem-solving, empathy and communication skills that enhance students' capability to apply ethical judgments to personal and professional actions informed by global perspective (UNESCO, 2017).

The curriculum bears 10 ECTS credits (European Credit Transfer and Accumulation System) and enhances digitalization readiness, transversal skills and intercultural competences of students in bachelor's degree study programs. The prerequisite for students to study in the curriculum is English language proficiency B2 (according to CEFR). While the curriculum aims primarily at bachelor students at HEIs, it is not part of obligatory bachelor education, and it is open to all students and teachers across the world.



Development of the four modules in SustainComp

The SustainComp curriculum was collaboratively developed by scholars and teachers at the four partner HEIs and consists of four modules, each bearing 2,5 ECTS (1) Sustainable Diets, (2) Resources, Inequality and Sustainability, (3) Sustainable Consumer Behavior and (4) Health and Sustainability.

Each module engages students in collaborative tasks and activities and has a teacher guideline to assist instructors and lecturers in the curriculum delivery. Additionally, an online-based and self-paced teacher training course was developed to assist instructors in developing intercultural competences and teaching skills for effective curriculum delivery and students' interdisciplinary and intercultural learning. The modules rely on innovative, project-oriented teaching and assessment methods, including Collaborative Online International Learning (COIL), to enhance students' digital and intercultural competences while engaging students in both online and onsite inter-active learning environments.

The aim of the modules is to foster sustainable competences that encompass students' cultural awareness and critical thinking, while participating in discussions, to improve students' creativity and build their capacity to promote values congruent with sustainability, consumption habits and lifestyles. The partners developed the 10 ECTS curriculum by several joint online meetings, project meetings for all partners in person, and extensive work in partner groups over the 2,5 years of the project.

State-of-the-art report and implications

The State of the Art (SOA) report constituted the first Project Result (PR1) in the SustainComp project (Ruge et al., 2022). The aim of the SOA report was to gather and present research findings with regard to Education for Sustainable Development (ESD) in 2021-2022 in the four project-partner HEIs' countries: The Czech Republic, Slovenia, Norway and Denmark. Case study research methods (Yin, 2011) were applied in the form of a joint inquiry in own didactical

practices conducted by researchers and lecturers from the partner institutions. Results were based on analysis of self-reported data from survey distributed to employees and semi-structured interviews. The research questions that guided the inquiry have provided the following results:

Question 1) To which extent is Education for Sustainable Development (ESD) included in bachelor education at the four partner institutions? ESD was taught at all partner HEIs. However, not all the lecturers, who were invited to take part in the survey, taught ESD.
Question 2) Is Education for Sustainable Development (ESD) included as a separate course or as a part of another topic? Results indicated that most ESD teaching was conducted as a part of another topic. Following this, courses with ESD integrated as a subtheme prevailed in number over individual courses dedicated to ESD. At the same time, the individual courses offered more lessons and hours. Individual courses tended to be less prevalent. Individual courses seemed to have more lessons per week and a longer duration.

Question 3) Which kind of educational resources do teachers apply? ESD teaching as 'part of another topic' seemed to be more varied and multimodal in the application of educational resources. The didactical design of ESD was mainly textbook based. Additionally, inquiry-based and project-oriented approaches were sometimes included. Excursions and field visits were the least used. ESD aimed mostly on the cognitive and then on the socio-emotional capacities of learners. The capacity to enact an action at campus or in society was the least addressed. In general, the lecturers covered all 17 UN Sustainable Development Goals, UNSDGs (United Nations, 2022). In some cases, the UNSDGs were addressed in more detail. The disciplinary background of the lecturers varied and included a wide range of subjects: language, intercultural studies, food science, natural science, health science, mathematics, arts and more.

Question 4) Which methods or educational resources are missing regarding development of a new Education for Sustainable Development (ESD) curriculum? The majority of the lecturers indicated that they missed a supportive didactical framework for teaching ESD that could contribute to the following:

- Text-based materials or books
- Methods to understand and assess students' previous knowledge to start at the same point of departure at the beginning of a course
- Collaboration with other ESD teachers e.g. in the form of co-teaching
- Evaluation or assessment methods for ESD
- Insight into what employers think is important of the future graduates with regard to ESD (in schools, hospitals, others)

The answers to the research questions had a direct implication for the subsequent development of curriculum and educational resources in 2022-2023 in the SustainComp project.

Presentation of modules
Sustainable Diets (UiA, University in Agder, Norway)

Chapter 4 describes the development of the submodule Sustainable Diets, and an assessment of the full-scale pilot carried out in October 2023 with students from UCL University College

(UCL) in Denmark is included. The research question was: How did students perceive the content, the competence acquired, and delivery of the submodule Sustainable Diets? Data from a student survey conducted immediately after the end of the submodule was analyzed and presented in this chapter.

Health and Sustainability (MUNI, Masaryk University Czech Republic)

Chapter 5 provides an overview of the submodule Health and Sustainability and examines its development in the phase of the full-scale pilot. During the pilot, 17 students from Masaryk University, Czech Republic collaborated online with 25 students from UCL University College in Denmark engaging in tasks and activities related to gender equality and sustainable health. The article evaluates the impact of the online collaboration structured around the method of Collaborative Online International Learning (COIL), on students' development of intercultural and sustainable competences.

Resources, Inequality and Sustainability (UCL University College, Denmark)

Chapter 6 'Resources, Inequality and Sustainability – integrating language (English as Second Language) and science teaching in ESD' is based on a case study that deals with the dynamics between inequality and sustainability, especially in relation to sand extraction in vulnerable, marine and coastal areas in Asia and Africa. The research question for the chapter is: 'How can a course on resources, inequality and sustainability, that is focused on the impact of sandmining, contribute to student teachers' development of sustainable competences?'. Via qualitative methods and a problem-based approach the authors shed light on the inequalities caused by transnational sand extraction activities and the destruction of native people's livelihood, futures, cultures and the surrounding nature. Students' main subject during the full-scale-pilot was English and interculturality. English as a Second Language was taught in a problem based, interdisciplinary way, integrated with natural science and focused on the theme of sand extraction. In conclusion, results indicated that students to a high degree acquired knowledge about socio-scientific, interdisciplinary and cross-curricular approaches to teaching ESD.

Sustainable Consumption (UL, Ljubljana University, Slovenia)

Chapter 7 presents the content of the Sustainable Consumer Behaviour module, which aims to promote sustainable consumer behaviour by encouraging conscious and informed consumer choices. The content of the module was used in an online programme for students at UCL University College (UCL) in Denmark as part of the full-scale pilot. The chapter presents the results of the data collection, using a case study focusing on the sustainability perspective and didactic materials related to sustainable consumer behaviour identified as relevant by the students during the project work. The study also aimed to test the potential of digital technology in teaching education for sustainable development. The second part of the article presents the implementation and analysis of a multiplier event based on Erasmus students' project work.

Interdisciplinarity and the fostering of sustainable competences – implications and limitations

Chapter 8 This article presents findings from case study research of an interdisciplinary approach to Education for Sustainable Development (ESD) at Higher Education (HE) bachelor level. The interdisciplinary approach was applied in the 'Sustainable Competences in Higher Education' (SustainComp) project (2022-2024). The research question for this chapter is: To

what extent did the interdisciplinary approach to teaching ESD foster sustainable competences – and what were the implications and limitations? The Community of Practice (COP) developed an interdisciplinary 10 ECTS curriculum that was tested during fall semester 2023 in a full-scale pilot for 25 students, integrated in an English as a Second Language course (ESL) in the Teacher Education department, at UCL University College, Odense in Denmark. The findings suggest that the interdisciplinary, ESD1, ESD2, ESD3 approaches to some extent fostered sustainable competences among students regarding cognition (new knowledge), socio-emotions (engaging in problems), behavior (act for solutions). Finally in the article, a conceptualized SustainComp model is suggested for ESD in Higher Education. The model suggests that interdisciplinarity can foster sustainable competences in a way that integrates the complementary ESD1, ESD2 and ESD3 dimensions.

Modes of delivery of curriculum

The SustainComp curriculum is in English and has been developed as a 10 ECTS module, however each of the four 2,5 ECTS modules can be delivered separately. As a result, we suggest that there are several modes of delivery which can be employed:

As an elective course – The 10 ECTS SustainComp module was conceived as a "stand alone" course for bachelor students in a regular semester, and as such, can be delivered as an onsite course with COIL elements throughout.

- The elective can be for a single homogeneous population of students, e.g. Bachelor of Education students, though it is well-suited for inter- or intra-faculty cohorts of students.
- As the module is in English, it can serve as an 'Internationalisation at Home' (I@H) activity.
- Own lecturers across disciplines, as well as 'visiting professors' with expertise related to one of the topics, can facilitate the module.

As a Summer School for own and/or exchange students – As the curriculum is interdisciplinary in nature, the SustainComp module is well suited as an intensive course over a period of several weeks, e.g. in the summer.

- A summer school often includes COIL activities before, during or after the physical course.
- As there are project-oriented elements in the modules, field visits and field work can easily be included in a schedule stretching over several weeks.
- The intercultural aspect of the SustainComp curriculum is conducive to increasing the social connectiveness of the participants.

As Individual modules – Each of the four separate 2,5 ECTS modules can be used separately.

- The modules can form the basis for an 'Internationalisation at Home' (IaH) activity, theme- or project week(s) in a bachelor course or programme.
- They can be used during 'international weeks', where students work with exchange students and faculty, who are visiting their campus.
- They can form the basis of a COIL project with international partners.
- They can be used for short-term blended mobility exchanges, and Blended Intensive Programmes (BIPs).

Modes of delivery Teacher Training Course

Parallel to developing curriculum for bachelor students in the SustainComp project, a Teacher Training Course was developed. The Teacher Training Course is intended for lecturers at HEI in Europe and beyond, who have teaching experience with bachelor students, and who are interested in approaching complex topics, such as those related to ESD, in an innovative and international way.

The Teacher Training Course covers six topics:

- Teaching 21st Century Skills
- Teaching Inquiry Based approaches
- Teaching Interculturally
- Teaching Interdisciplinarity
- Teaching Sustainability
- COIL methodology.
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The course, originally thought of as a connected physical course, has subsequently been developed in topics or sections, allowing the mode of delivery to vary, depending on the population and the circumstances:

As an onsite training course for lecturers over three to five days – The Teacher Training Course can be arranged at a HEI as an onsite course for a group of own and partner teachers and lecturers as part of the HEI's competence development efforts. If the course is offered to lecturers from outside one's own HEI, these colleagues can be from HEIs in one's own region or country, or from abroad, perhaps as a "training mobility" in the Erasmus+ Programme. The advantage of the onsite course is that it allows participants to move coherently from one topic to another in a group format, which allows participants to network across disciplines and institutions, as well as giving the flexibility of adjusting the time intervals for each section according to the dynamics in the learning group. An onsite course can provide the framework for trial field visits, which can lay the foundations for similar field visits when using the SustainComp curriculum with one's own bachelor students.

As blended learning workshops over a period of time – Should a concentrated course delivered over consecutive days not be feasible, the course can be offered in a blended format over an extended period, such as an academic year. This mode of delivery can be structured in such a way that lecturers work with the Teacher Training course materials one topic at a time online in groups, with regularly scheduled onsite workshops to train elements of the course together. As such, this mode of delivery can be ideal for new lecturers at HEI, or to interdisciplinary teaching, who can gain valuable experience from the interchange between practical teaching with bachelor students and competence development offered in the regular training sessions online and onsite.

Self-paced learning – The Teacher Training course can be used with HEI lectures who are highly skilled and experienced in more classical educational and research traditions, but who are at the same time interested in developing broader didactical competences in order to facilitate higher educational learning sessions in non-traditional settings, such as study trips, off-campus summer schools, or in professional learning communities where bachelor students and practitioners learn new skills together.

Targeted competence development - While the Teacher Training Course has been developed as a cohesive training material, it contains six distinct components or topics which can be used for 'targeted' or competence-specific skill acquisition. Ideally this could be for a group of lecturers, who wish to co-teach or who will be engaging in interdisciplinary teaching.

Concluding remarks and perspectives

The authors hope that readers will be interested in reading the chapters and to apply insights and perspectives in own teaching and research within ESD. Thanks to the Erasmus Plus program and Editor-in-Chief, FECUN Journal, Jesper Garsdal, we are able offer our findings in SustainComp research as Open Access and in this way contribute to the ongoing development and research within ESD. Further, the SustainComp e-learning platform[ii] provides Open Access educational resources available for teachers and students. In a wider perspective, efforts will be made to support ESD network activities student exchange and collaboration with reference to the international UNESCO guidelines.

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