

R&D-Report

Teaching sustainable entrepreneurship: Learning approaches, pedagogical methods and teaching tools

Ida Matilde Fauske
Harrshinny Vallipuram
Benedicte-Elise Foldnes
Elli Verhulst
Karin Wigger
Sølvi Solvoll

Nord University
R&D-Report no. 82
Bodø 2022


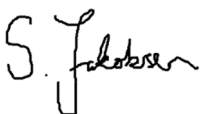
Teaching sustainable entrepreneurship: Learning approaches, pedagogical methods and teaching tools

Ida Matilde Fauske
Harrshinny Vallipuram
Benedicte-Elise Foldnes
Elli Verhulst
Karin Wigger
Sølvi Solvoll

Nord University
R&D-Report no. 82
ISBN 978-82-7456-850-1
ISSN 2535-2733
Bodø 2022

[Creative Commons Attribution Licence](#) (CC BY)

Dekangodkjenning

Tittel Teaching sustainable entrepreneurship: Learning approaches, pedagogical methods and teaching tools	Offentlig tilgjengelig Ja	Publikasjonsnr. 82
	ISBN 978-82-7456-850-1	ISSN 2535-2733
	Antall sider og bilag: 52 sider og 2 bilag	
Forfatter(e) / prosjektmedarbeider(e) Ida Matilde Fauske, Harrshinny Vallipuram, Benedicte-Elise Foldnes, Elli Verhulst, Karin Wigger and Sølvi Solvoll	Prosjektansvarlig (navn/sign.) Karin Wigger 	
Prosjekt Entrepreneurship meets Sustainability	Oppdragsgiver(e) Engage SFU – Centre for Engaged Education through Entrepreneurship	
	Oppdragsgivers referanse	
<ul style="list-style-type: none"> Publikasjonen er vurdert etter gjeldende vitenskapelige standarder, nasjonale forskningsetiske retningslinjer, samt retningslinjer for forvaltning av forskningsdata ved Nord universitet. Det foreligger ikke egeninteresser/ situasjoner som er egnet til å påvirke vurderingen av innholdet i denne publikasjonen, for eksempel økonomiske interesser i publikasjonens tema. 	Intern kvalitetssikrer utpekt av dekan (navn/sign.) Siri Jakobsen 	
Sammendrag Hvilke læringstilnærminger, pedagogiske metoder og undervisningsverktøy er aktuelle å bruke for undervisere innen høyere utdanning i undervisning knyttet til bærekraft og entreprenørskap? Undervisning på bærekraftig entreprenørskap (UBE) kombinerer aspekter fra entreprenørskap og bærekraft gjennom å utvikle ferdigheter og kompetanser som skal bidra til et mer bærekraftig samfunn gjennom å opptre entreprenørielt og nytenkende. Selv om det er enighet om at dette er ferdigheter som er viktige å utvikle, er likevel spørsmålet om hvordan man bør utvikle disse ferdighetene debattert. Ved hjelp av intervjuer og gjennomgang av eksisterende litteratur gir vi i denne rapporten en oversikt over 13 læringstilnærminger, 15 pedagogiske metoder og 24 ulike læringsverktøy som vi mener er nyttige i UBE. Metodene og verktøyene er videre delt inn kategorier basert på deres bruk i arbeidslivet og i høyere utdanning. Dette gjør denne rapporten til en praktisk veileder og inspirasjonskilde for	Emneord Entreprenørskapsutdanning, bærekraft, undervisning på bærekraftig entreprenørskap, læringstilnærminger, pedagogiske metoder, undervisningsverktøy	

<p>undervisere som ønsker å øke studentenes kunnskap, ferdigheter og kompetanse knyttet til bærekraftig entreprenørskap.</p>							
<p style="text-align: center;">Summary</p> <p>Which learning approaches, pedagogical methods and teaching tools can educators at higher education institutions use to teach sustainable entrepreneurship? Sustainable entrepreneurship education combines those aspects from entrepreneurship and sustainability education to teach students the skills and competences needed to contribute to a sustainable society by acting entrepreneurially. Although there is consensus that these skills and competences are crucial to have, how they are taught is still debated. Using a review of the literature and interviews with practitioners and educators, this report offers an overview and discussion of 13 learning approaches, 15 pedagogical methods and 24 teaching tools for sustainable entrepreneurship education. The identified methods and tools are further divided into categories regarding their usage in business and higher education, making this report an inspirational hands-on toolkit for educators.</p>	<p style="text-align: center;">Keywords</p> <p>Entrepreneurship Education, Sustainability, Sustainable Entrepreneurship Education, Learning Approaches, Pedagogical methods, Teaching tools</p>						
<p>Kryss av for valgt lisens</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">x</td> <td>Navngivelse/ CC BY</td> </tr> <tr> <td></td> <td>Navngivelse-Del på samme vilkår/ CC BY-SA</td> </tr> <tr> <td></td> <td>Navngivelse-Ingen bearbeidelse/ CC BY-ND</td> </tr> </table>		x	Navngivelse/ CC BY		Navngivelse-Del på samme vilkår/ CC BY-SA		Navngivelse-Ingen bearbeidelse/ CC BY-ND
x	Navngivelse/ CC BY						
	Navngivelse-Del på samme vilkår/ CC BY-SA						
	Navngivelse-Ingen bearbeidelse/ CC BY-ND						
<p>Dato 25.4.22</p>	<p>Dekan (navn/sign.) <i>Gry AAlsos</i></p>						

Teaching sustainable entrepreneurship: Learning approaches, pedagogical methods and teaching tools

Ida Matilde Fauske¹, Harrshinny Vallipuram², Benedicte-Elise Foldnes², Elli Verhulst^{3*},
Karin Wigger⁴ and Sølvi Solvoll⁴

¹ Research assistant at Nord University Business School, Bodø, Norway.

² Student at the NTNU School of Entrepreneurship, Trondheim, Norway.

³ Associate Professor, Academic Section Experts in Teamwork, Department of Industrial Economics and Technology Management at NTNU, Trondheim, Norway.

⁴ Associate Professor, Nord University Business School, Bodø, Norway.

*Corresponding author: Elli Verhulst, NTNU Gløshaugen, Oppredningen/gruvedrift, 351, elli.verhulst@ntnu.no



Picture: Ingrid Berg Sivertsen

Abstract

Which learning approaches, pedagogical methods and teaching tools can educators at higher education institutions use to teach sustainable entrepreneurship? Sustainable entrepreneurship education combines those aspects from entrepreneurship and sustainability education to teach students the skills and competences needed to contribute to a sustainable society by acting entrepreneurially. Although there is consensus that these skills and competences are crucial to have, how they are taught is still debated. Using a review of the literature and interviews with practitioners and educators, this report offers an overview and discussion of 13 learning approaches, 15 pedagogical methods and 24 teaching tools for sustainable entrepreneurship education. The identified methods and tools are further divided into categories regarding their usage in business and higher education, making this report an inspirational hands-on toolkit for educators.

Acknowledgement

This report was made at the request of Engage, the Centre for Engaged Education through Entrepreneurship, a Centre of Excellence in Education in Norway. The goal of Engage is to increase the number of students in Norway and around the world with entrepreneurial skills and the mindset to become change agents for the better. Engaging students is a priority in how the centre functions. Another priority is supporting educators by providing them with relevant pedagogical resources.

We are grateful and acknowledge the contributions and dedication of our former and current students, Ida Matilde Fauske, Harrshinny Vallipuram and Benedicte-Elise Foldnes. Without them, this report would not have been possible. Furthermore, we are grateful to those who support Engage, including the Norwegian Directorate for Higher Education and Skills and the two host universities: Nord University and the Norwegian University of Science and Technology.

Sammendrag

Hvilke læringstilnæringer, pedagogiske metoder og undervisningsverktøy er aktuelle å bruke for undervisere innen høyere utdanning i undervisning knyttet til bærekraft og entreprenørskap? Undervisning på bærekraftig entreprenørskap (UBE) kombinerer aspekter fra entreprenørskap og bærekraft gjennom å utvikle ferdigheter og kompetanser som skal bidra til et mer bærekraftig samfunn gjennom å opptre entreprenørielt og nytenkende. Selv om det er enighet om at dette er ferdigheter som er viktige å utvikle, er likevel spørsmålet om hvordan man bør utvikle disse ferdighetene debattert. Ved hjelp av intervjuer og gjennomgang av eksisterende litteratur gir vi i denne rapporten en oversikt over 13 læringstilnæringer, 15 pedagogiske metoder og 24 ulike læringsverktøy som vi mener er nyttige i UBE. Metodene og verktøyene er videre delt inn i kategorier basert på deres bruk i arbeidslivet og i høyere utdanning. Dette gjør denne rapporten til en praktisk veileder og inspirasjonskilde for undervisere som ønsker å øke studentenes kunnskap, ferdigheter og kompetanse knyttet til bærekraftig entreprenørskap.

Table of contents

- Abstract 4
- Acknowledgement 4
- Sammendrag 5
- Introduction 7
- Sustainable entrepreneurship education and pedagogical interventions—background** 8
- Project methodology**..... 10
 - Preparation 10
 - Data gathering 11
 - Analysis 12
- Results** 12
 - Results from the literature review 13
 - Results from the interviews 18
 - Results from the clustering 20
- Application of learning approaches, methods and tools** 22
 - The use of methods and tools for sustainability 22
 - Lack of resources and knowledge of tools for sustainability 26
 - Scope of sustainability and entrepreneurship in education 27
- Conclusion**..... 29
- References** 31
- Appendix 1: Overview of identified methods and tools** 38
- Appendix 2: Summaries of interviews**..... 53

Introduction

Sustainable entrepreneurship education (SEE) focuses on increasing students' skills and competencies within sustainable entrepreneurship (SE) and is a form of entrepreneurship education (EE) (Lourenço et al., 2013; Ploum et al., 2018). Educating students to become change agents for sustainability has become a focus at higher education institutions because teaching students the necessary skills and mindset to contribute to sustainable development is seen as an important part of moving towards sustainability (Brundiens et al., 2021; Hesselbarth & Schaltegger, 2014; Rieckmann, 2012; Wals & Jickling, 2002). Here, SE aims to create sustainable development through entrepreneurial activities (Shaltegger & Wagner, 2011), and it has gained attention for its potential to solve complex societal and environmental challenges (Muñoz & Cohen, 2017; Stubbs, 2017; Hall et al., 2010). However, how students learn to become change agents for sustainability through pedagogical interventions is still highly debated (Strachan, 2018; Sharma et al., 2020).

The current report contributes to this debate by discussing how SE can be taught. Prior research debates have focused on the underlying principles for teaching sustainability and whether entrepreneurship is compatible and effective in teaching SE (Lans et al., 2014). We argue that sustainability and entrepreneurship principles can be combined by applying distinctive learning approaches that support both entrepreneurship and sustainability education, such as place-based learning (e.g., Smith & Sobel, 2010) or experiential learning (Kolb, 1984). In addition, effective teaching—that is, teaching that leads to the defined learning outcomes—asks for learning approaches that facilitate students' learnings (Dunlosky et al., 2013; Halberstadt et al., 2019). Therefore, we create a list of learning approaches for teaching SE in an effective and efficient way.

In addition, we argue that educators also need to be equipped with the necessary pedagogical methods and teaching tools for SE that can help facilitate effective learning approaches. Prior research and scholarly discussions have shown that the toolkit used for SE can entail methods and tools borrowed and adjusted from related fields, such as entrepreneurship, sustainability or management and business; the toolkit can also use methods and tools that come from different fields of applications, including business and work life or higher education. Moreover, the toolkit can entail methods and tools that are designed to teach SE. This report expands this topic by offering an overview of the selected methods and tools, clustering them into different aspects of SE and discussing what they can offer to SEE.

We have conducted a literature review, here searching for research on sustainable entrepreneurship, SEE and education for sustainable development (ESD). Further, we conducted interviews with both educators and practitioners. In this way, we have collected learning approaches, methods and tools that combine sustainability and entrepreneurship as used in business and higher education. Hence, the present report contributes to our knowledge of teaching SE by offering an overview of the state of the art regarding learning approaches, pedagogical methods and teaching tools. It is an important guide for educators who want to gain inspiration and knowledge on how to teach SE. The report offers an overview with a short description of each identified approach, method and tool, along with references to learn more about each one. The lists included are of an inspirational nature and do not claim to be complete.

We start by presenting the theoretical background and describing the methodology used for data collection: a literature search and interviews. Then, we present the results of the

interviews, providing information on how the various methods and tools are used by businesses and organisations. After the results, we present a clustering of the methods and tools, which is followed by a discussion of the results within the context of SEE. In the conclusion, we include the main results and suggestions for further development.

Sustainable entrepreneurship education and pedagogical interventions—background

SEE is a combination of two fields of research: SE and EE (Sharma et al., 2020). SE refers to the discovery, creation and exploitation of entrepreneurial opportunities that contribute to sustainability, specifically by generating social and environmental gains for others in society (Hockerts & Wüstenhagen, 2010; Pacheco et al., 2010; Shepherd & Patzelt, 2011). In the current report, we use the following definition: ‘SE is a way of generating competitive advantage by identifying sustainability as new business opportunities, resulting in new and sustainable products, methods of production or ways of organising business processes in a sustainable way’ (Lans et al., 2014 p. 37). According to Schaltegger and Wagner (2011), SE aims to create sustainable development through entrepreneurial activities. SE has attracted a lot of scholarly attention because of its increasing practical significance for sustainable development (Halberstadt et al., 2019). According to Thomassen and Stentoft (2020), education is important for developing a sustainable future, and it is emphasised in the United Nations’ Sustainable Development Goal (SDG) number 4: ‘Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all’ (United Nations, 2015; Thomassen and Stentoft, 2020, p. 2).

EE focuses on the development of entrepreneurial knowledge, skills and/or attitudes (Kakouris & Liargovas, 2021). The pedagogy behind different EE efforts is quite diverse, but it is possible to make a distinction between a narrow view of EE that mainly focuses on educating students on how to start a business and a wide definition of EE for stimulating an entrepreneurial mindset and developing entrepreneurial skills among students (Lackèus, 2015; Baggen et al., 2021). For this report, we use the wide definition of EE. By this, we follow Sarasvathy and Venkataraman (2011) and Lackèus (2015) in stating that EE is a generic method for human action, one consisting of principles and techniques that anyone can learn through education.

SEE must provide future change agents with the knowledge, skills and mindset they need to make decisions that consider the environmental, social and economic ramifications of their actions. However, there is a shortage of studies on how to teach SE (Halberstadt et al., 2019). Existing frameworks that could be implemented into education programmes to empower entrepreneurs to take into account sustainability aspects are, among others, *the Natural Step* and *the Five Capitals* (Strachan, 2018). A lack of overview on available educational interventions emphasises the need for a collection of approaches, methods and tools for SEE.

One important topic in research for SEE is how to educate students to become change agents for sustainability (Hesselbarth & Schaltegger, 2014). Hesselbarth and Schaltegger define a change agent for sustainability as ‘an actor who deliberately tackles social and ecological problems with entrepreneurial means to put sustainability management into organisational practice and to contribute to a sustainable development of the economy and society’ (2014, p.

26). According to Hesselbarth & Schaltegger (2014), a change agent for sustainability is an active initiator of sustainable development in an organisation; they also discuss which competencies are needed to become a change agent for sustainability, which is also a well-researched topic within the field of ESD and SEE (Dobson & Tomkinson, 2012).

The most recent contribution in this field comes from Ploum et al. (2018). Their validated competency framework is based on the framework by Lans et al. (2014), which is the only framework focusing specifically on the competencies required for SE and how they can be measured. Their competency framework for '*Sustainable Entrepreneurs as Change Agents*' includes seven competencies in total: systems thinking competency, embracing diversity and interdisciplinary competency, foresighted thinking competency, normative competency, action competency, strategic management competency and interpersonal competency (Ploum et al., 2018). Their competency framework can assist higher education institutions in planning or adjusting education programmes (Ploum et al., 2018).

Pedagogical interventions facilitate students' development of competences for SE; these interventions combine the 'what' to teach with 'how' to teach (Mindt & Rieckmann, 2017). Sustainability competences require a combination of learning approaches, pedagogical methods and teaching tools, hence allowing the students to benefit from different learning processes (UNESCO, 2012). Learning—or pedagogical—approaches describe the didactical principles being used to facilitate learning. Pedagogical methods and teaching tools support learning approaches by concretising these principles, whereby the methods provide a pedagogical procedure covering several stages. Tools can be considered teaching instruments that have a particular task and goal, facilitating learning within a specific stage of a method or learning approach. The choice of pedagogical approaches, methods and tools depends on the learning goals and context. Ligouri et al. (2018) state that there is no common understanding in EE on what to teach, how to teach it and how entrepreneurial learning is best measured. Because SEE is a new field building on EE and ESD, the search for consensus is still ongoing (Strachan, 2018; Sharma et al., 2020). By systematising different learning approaches, pedagogical methods and teaching tools in SEE, the current report provides educators with more specific insights into how these approaches, methods and tools can be combined.

There is a difference between the methods and tools developed for businesses and work life and those developed for education. The methods and tools used by businesses aim mostly at developing sustainable strategies, processes, products and business models. Businesses are interested in analysing sustainability and measuring their environmental impact, and various tools have been developed for this purpose, such as the Five Capitals model (Strachan, 2018). Other tools used by businesses are used for product development, such as Sustainability Quality Function Deployment (Baumgartner, 2003). Several tools are used for creating or improving sustainable business models. Some examples are the Flourishing Business Model Canvas (Flourishing Business, 2021) and Re-Start tool (Jørgensen & Pedersen, 2017), which can be used to innovate sustainable business models.

In education, methods and tools are developed for educational purposes, and they are developed with educators and students in mind. The methods developed for education can, for example, be game based, such as the Sustainable Business Innovation Game, where students can learn about the Sustainable Business Model Canvas (Threebility, 2021). Other methods have been developed for educators to aid them in enhancing their sustainable development classroom activities, such as the EPOSEA tool (Uhrqvist et al., 2021). Either way, having an overview of the different methods and tools and their usages is an advantage, both in education and for businesses.

Project methodology

For this part of the report, we give an explanation of how preparation and data gathering has led to our analysis of the project. The first step was the research and preparation phase, where we reviewed literature on SE and conducted initial web searches. Thereafter, we conducted a qualitative study using interviews. The last step was the analysis stage, in which we analysed the results from the literature review and interviews separately. Combining these findings allowed us to connect the dots and categorise the learning approaches, pedagogical methods and teaching tools based on how they are employed and what they are used for. We also include the time phase in which the methods and tools can be implemented by businesses and start-ups.

Preparation

Before searching for specific learning approaches, methods and tools in the literature and online, we wanted to gain knowledge about SE and other topics within this field. First, we carried out a preliminary literature search, where we focused on the topics of sustainable entrepreneurship, SEE and ESD. By familiarising ourselves with the relevant topics within research, we developed an understanding of what is important in the field of SEE, such as competencies, methods and tools, along with what teaching and learning approaches are generally used. Although the current report focuses on pedagogical methods and teaching tools, when looking at the literature, we collected methods and tools for use in both work life and education. This offers a broader view of the state of the art of how one can work in practice and learn about SE. Hence, we included methods and tools for business that have a learning aspect and the potential to be used in education. The literature we found for this report was added to a spreadsheet to obtain an overview of different topics. We also planned to organise the methods and tools we collected in another spreadsheet for us to get an overview and experiment with alternative ways of structuring the methods and tools for clustering.

Two interview templates were created in preparation for the interviews: one for educators at higher education institutions and the other for businesses. We have targeted both educators and businesses to obtain a more holistic view of what methods and tools are used and how they are used in businesses and academia. The main focus was on the use of methods and tools in business practice. Because one of the key goals in education is to provide students with skills and competences relevant for their work life, it is crucial to include this perspective and get input from business. We chose to use a semi structured interview guide because it provides the opportunity to ask other relevant questions outside of the guide while also giving us a clear idea of the themes we wanted to discuss during the interviews. In this way, we could ask questions related to the respective companies about topics that came up during the interviews and obtain information that we would not necessarily find during a literature review. This provides a more detailed picture of the methods and tools for SE and their usage in practice.

Our interview guide focuses on gathering insights into the need, use and experiences of the methods and tools used for SE. The first section of the interview guide is the introduction, which consists of questions regarding the informant's company or organisation and the participant's knowledge about sustainability and entrepreneurship and its role in their organisation. The second part covers their knowledge of the methods and tools used for SE, while the third part focuses on the need, application and experience of the methods and tools.

Data gathering

Before the interviews, we looked more in depth into the literature and conducted a structured literature review using Scopus, Google Scholar and pertinent journals. During the data gathering phase, 52 articles were collected in addition to web searches. An overview of the literature was made, which, among other things, included methods and tools, abstracts and general findings. The most significant aspect of the literature review and web search was mapping existing methods and tools found in the literature. These were placed in a spreadsheet, followed by the clustering process in analysis.

Our selection criteria for participants were people who worked with sustainability or sustainable development. It was also important that they had knowledge of the methods and tools that combined sustainability and entrepreneurship.

When we started the interview process, we sought out relevant participants for the interviews from both start-ups and established companies in different industries; furthermore, we used the snowball method to gather more participants, which is suitable when it is difficult to determine who belongs to a certain population (Easterby-Smith et al., 2015). During the interviews, we asked if the participants knew of others who would fit the selection criteria, which led us to find more participants.

The participants in the interviews were from different industries, and the company ages and sizes at which the participants worked varied. Along with those participants from businesses, one interview was performed with an academic within the field of SEE. A full list of participants for the interviews is shown in Table 1. We conducted seven interviews between August and October 2021. The interviews lasted between 25 and 45 minutes, and we gathered insights into the needs, uses and experiences of these methods and tools. During the interviews, we aimed to ask all participants the same questions to make sure we obtained the needed information. By utilising company ages and sizes, we could analyse the difference between the companies in how they used the various methods and tools for SE.

Table 1: Participants and companies

Participants	Industry	Company age	Company size	Date	Length
1	Consulting for business development and innovation	Developed	Medium	26.08.21	39 min
2	Centre for sustainable development	Newly established	Small	25.08.21	24 min
3	Construction	Start-up	Small	07.08.21	19 min
4	Facilitator for innovation, knowledge and business development	Developed	Small	21.09.21	24 min
5	Consulting for entrepreneurs	Developed	Small/Medium, many customers	21.09.21	46 min
6	Consulting	Developed	Large	30.09.21	28 min
7	Academia	/	/	23.08.21	

The interviews were transcribed. Summaries from the interviews are shown in Appendix 1.

Analysis

Literature and web search analysis

We analysed the literature thematically with the goal of exploring the main topics of the literature on SE and education for SE. We wanted to understand the existing research and what is important to know regarding the methods and tools for SE. This analysis led us to find existing clusters of methods and tools in the literature, such as research on sustainable business models. Our analysis also revealed differences in the methods and tools developed by businesses and education, along with examples of how they can be applied in education.

Interview analysis

The interviews were recorded so that we could transcribe them afterwards. We then made a table with the main discoveries, which can be found in Appendix 1. The methods and tools from the interviews were added to the Excel sheet, which also contained the methods and tools discovered from the literature and web search. Because it was not the same person who conducted all the interviews, the similarities and differences between them were examined in a meeting with the project team.

Analysis of the interviews was conducted thematically, and it was based on the topic of the project description and interview guides. We analysed which methods and tools were used; the interviewees' knowledge, needs, usage and experience of using these methods and tools; and the scope of sustainability and entrepreneurship of the methods. We further analysed how the different organisations used their methods and tools and how the results varied depending on company size and age.

Clustering analysis

One task of this report was to cluster the gathered methods and tools. In cluster analysis, the goal is to gather objects in groups based on their similarity; hence, we conducted cluster analysis based on the results from the literature review and interviews. We wanted to perform cluster analysis in a way that made it easy for educators to find and apply the most relevant and fitting methods and tools. We found it appropriate to cluster the methods and tools based on their purpose, meaning when they can be used and what they can be used for. By clustering the methods and tools in this way, it is easier for educators and businesses to find the most suitable methods and tools for the purpose they need. In the results, we present a detailed description of the five categories we have decided to cluster the methods and tools within.

Results

The report is divided into two main data collection methods: the collection of learning approaches, methods and tools through a literature and web search and through interviews. Combined, these ways of collecting data have formed the foundation for our clustering analysis of the methods and tools.

We have chosen to divide the results from this project into three categories: 1) results from literature and web search, 2) results from interviews and 3) clustering: results from the literature review and interview combined.

Results from the literature review

This section builds on our literature search on SE and education for SE. We first provide an overview of the identified learning approaches before offering a list containing the selected methods and tools.

Learning approaches for sustainable entrepreneurship

Because ESD is a new field of research, there is a limited number of new pedagogical methods and teaching tools that have been developed for SE. This is evident when looking at the publication dates of the new methods and tools because much of the research has been published in the last five years. However, some research on SEE has reviewed suitable teaching and learning approaches for SEE (Mindt & Rieckmann, 2017).

Mindt and Rieckmann (2017) present a literature review on teaching–learning approaches and methods for SE. They collect articles from higher ESD (HESD) and higher education for entrepreneurship (HEE), finding the most used and recommended teaching and learning approaches for SE (Mindt & Rieckmann, 2017). With a focus on SEE, the CASE project highlights Mindt and Rieckmann’s study as a suggestion for relevant teaching and learning approaches in HESD and HEE (CASE, 2021a). The authors include descriptions and suggestions for further reading about the teaching and learning approaches. Some of the most popular teaching–learning approaches are collaborative learning, experiential learning and problem-based learning. Table 2 describes more relevant teaching and learning approaches, which can be paired with pedagogical methods and teaching tools for SE.

Table 2: Collection of learning approaches for sustainable entrepreneurship education

Learning approaches	Description	References
Active learning	Actively engage students through the course material so that students acquire learning actively by using methods like case studies and discussions.	Bonwell, C. C., & Eison, J. A. (1991). <i>Active learning: Creating excitement in the classroom</i> . 1991 ASHE-ERIC higher education reports. ERIC Clearinghouse on Higher Education, The George Washington University, One Dupont Circle, Suite 630, Washington. MacVaugh, J., & Norton, M. (2012). Introducing sustainability into business education contexts using active learning. <i>International Journal of Sustainability in Higher Education</i> .
Learner-centred learning	This method emphasises the independence of students, where they learn to solve problems independently.	Brooke G. C., & Andrade H. L. (2012). Learner-Centered Teaching In N. M. Seel (Ed.), <i>Encyclopedia of the sciences of learning</i> . Springer.
Reflective learning	Students increase their competencies through reflection on their learning experiences.	Seel, N. M. (Ed.). (2011). <i>Encyclopedia of the sciences of learning</i> . Springer Science & Business Media.
Collaborative learning	Students learn and work together in groups, and the aim is to learn together.	Slavich, G. M., & Zimbardo, P. G. (2012). Transformational teaching: Theoretical underpinnings, basic principles, and core methods. <i>Educational psychology review</i> , 24(4), 569-608.

Experiential learning	Learning through experiencing a situation. Includes reflection about experiences from activities done in the course. This is mainly done in projects.	Kolb, D. A. (2014). <i>Experiential learning: Experience as the source of learning and development</i> . FT press.
Problem-based learning (PBL)	Students learn through understanding and solving problems.	Barrows, H. S., & Tamblyn, R. M. (1980). <i>Problem-based learning: An approach to medical education</i> . Springer. Wiek, A., Xiong, A., Brundiars, K., & Van Der Leeuw, S. (2014). Integrating problem-and project-based learning into sustainability programs: A case study on the School of Sustainability at Arizona State University. <i>International Journal of Sustainability in Higher Education</i> .
Interdisciplinary learning	Used in collaborative projects or subjects where perspectives of multiple disciplines are included.	Feng, L. (2012). Teacher and student responses to interdisciplinary aspects of sustainability education: What do we really know?. <i>Environmental Education Research</i> , 18(1), 31-43.
Transdisciplinary learning	Can be done through collaboration with external partners for real-world problem solving, or it can be the integration of different disciplines for learning.	Van Wynsberghe, R., & Moore, J. L. (2015). UN decade on education for sustainable development (UNDESD): enabling sustainability in higher education. <i>Environment, development and sustainability</i> , 17(2), 315-330. Hynes, B., & Richardson, I. (2007). Entrepreneurship education: A mechanism for engaging and exchanging with the small business sector. <i>Education+ Training</i> .
Transformative learning	Learn new ways of thinking and creating different perspectives of the social world.	Mezirow, J. (2000). <i>Learning as Transformation: Critical Perspectives on a Theory in Progress. The Jossey-Bass Higher and Adult Education Series</i> . Jossey-Bass Publishers, 350 Sansome Way, San Francisco.
(Agile) social learning	Learning takes place in social interactions, where the students learn from interactions, situated actions and theory. Students can learn about environmental, social and economic spheres of sustainable development through this approach.	Bolmsten, J., & Kitada, M. (2020). Agile social learning—Capacity-building for sustainable development in higher education. <i>International Journal of Sustainability in Higher Education</i> .
Service learning	Link the classroom with the outside world. The goal is for students to gain academic knowledge while they engage in community service (Halberstadt et al., 2019).	Halberstadt, J., Timm, J. M., Kraus, S., & Gundolf, K. (2019). Skills and knowledge management in higher education: how service learning can contribute to social entrepreneurial competence development. <i>Journal of Knowledge Management</i> . Biberhofer, P., & Rammel, C. (2017). Transdisciplinary learning and teaching as answers to urban sustainability challenges. <i>International Journal of Sustainability in Higher Education</i> . Brundiars, K., Wiek, A., & Redman, C. L. (2010). Real-world learning opportunities in sustainability: from classroom into the real world. <i>International Journal of Sustainability in Higher Education</i> .

Place-based learning	Students learn about a local place, or a local heritage, and it is used in the curriculum. It connects communities with learning communities.	Smith, G. A., & Sobel, D. (2010). <i>Place- and community-based education in schools</i> . Routledge, New York.
Problem analysis	Integrated into problem-based learning. It can shift the focus from problem solving to analysing problems.	Thomassen, A. O., & Stentoft, D. (2020). Educating students for a complex future—why integrating a problem analysis in problem-based learning has something to offer. <i>The Interdisciplinary Journal of Problem-Based Learning</i> , 14(2).

Service learning is found to be an effective learning approach for students to develop sustainability entrepreneurship competencies such as normative competence, strategic management and action competence (Halberstadt et al., 2019). This learning approach links the classroom with the outside world, and the goal is for students to gain academic knowledge while engaging in community service (Halberstadt et al., 2019). The educators in Halberstadt et al.'s study (2019) state that it is important to carefully choose the right learning format and to focus on a few competencies for students to develop when using service learning. It is difficult to get the students' attention if they try to cover everything, and other educators report service learning being successful when focusing on a few competencies instead of many (Halberstadt et al., 2019).

Learning approaches can be used in various ways. One example is a case study using a practice-based pedagogy in which systems thinking is merged with entrepreneurship (Lynch et al., 2021). According to Lynch et al. (2021), their study is not a best practice example because their aim is to show how it is possible for students to shift their mindset towards sustainability early in their education. Still, it is a good example of how a case study approach can make students shift their mindsets towards systems thinking while identifying sustainable opportunities for local businesses (Lynch et al., 2021). It is also an example of how students can develop an important competency for SE: systems thinking (Ploum et al., 2018).

Another study shows how problem analysis can be integrated into problem-based learning for students to be educated for a complex future, such as working towards the SDGs (Thomassen & Stentoft, 2020). Thomassen and Stentoft (2020) argue that problem analysis as the first step in problem-based learning can help students gain the needed competencies for understanding and solving complex and uncertain problems in today's society; they mention Schön (1987), who states that 'it is not enough that students can apply theories in solving a predetermined problem; they must also be able to define the problem and apply the relevant theories and methods in the problem-solving process' (Thomassen & Stentoft, 2020, p. 4). For example, students can use problem analysis to find the relevant theories, methods and tools in SE for solving a problem in PBL.

Pedagogical methods and teaching tools for sustainable entrepreneurship

Searching for existing methods and tools and structuring them in clusters was the aim of the literature review. We explain the difference between the methods and tools developed for businesses and education and include examples of them, along with how they can be used. All the methods and tools mentioned in the literature review can be found in Table 3.

Table 3. Pedagogical methods and teaching tools for sustainable entrepreneurship

Pedagogical methods and teaching tools	M ^(Method) T ^(Tool)	Goal
1. Measuring, assessment, and analysis		
The Sustainability SWOT Analysis	M	It can assess environmental risk, but also to engage employees, make it easier to work across departments, and then create long-term sustainable value for the company.
The Sustainability Performance Tool	T	It is a qualitative tool for assessing and improving sustainability in businesses and nonprofits.
The Sustainability Innovation Cube	M	It helps determine position regarding sustainable development.
The Sustainability Balanced Scorecard	T	The aim is to measure sustainability performance and implement strategies for sustainable development.
The Five Capitals Model	T	It can help analyse and assess sustainability in five different forms of capital. Then, strategies are considered for how to maximise the value of each type of capital.
The Natural Step	M	The purpose is to assess sustainability through four different principles. Students can gain competencies that enable them to take into account ecological and social impacts in entrepreneurship.
The Sustainable Entrepreneurial Process Flow Model	T	It explains the sustainable entrepreneurial process flow and increases people's understanding of the sustainable entrepreneurial process.
Project Canvas	T	This tool identifies research and development projects.
The Impact Canvas	T	It can be used to systematically identify the critical positive and negative externalities of one's business or product.
The Cambridge Value Mapping Tool	T	It can help analyse various types of value in the business and network in a methodical way, as well as to encourage innovation in sustainable value generation.
Root Cause Analysis	M	It helps identify and understand businesses' biggest sustainability pain points.
SDG Impact assessment tool	T	It is an assessment of SDGs.
Systematic Entrepreneurship Activity Method (SEAM)	M	This method aims to help entrepreneurs develop their ideas and businesses.
2. Sustainable process development		
PDCA (Plan, Do, Check and Act) cycle	T	This is a tool for successfully implementing sustainability improvements.
Gap Analysis	T	It is a tool for examining the current sustainability status in a business and developing an action plan.
Force Field Analysis	T	It is a tool for engaging in every part of the team, despite individuals' varying commitment to sustainability.

Lean Six Sigma	M	It is a structured approach to scrutinise operations, here looking at data and processes to uncover and remove waste.
Hoshin Kanri	M	The purpose is to ensure that a whole organisation works towards the same goals.
Just in Time (JIT)	M	It can help the control of production processes. It is about producing what the customer wants, when they want it, in the quantities requested, where they want it, and without delay. It keeps stock levels to a minimum to reduce waste and natural resource use.

3. Sustainable product development

Sustainability Quality Function Deployment	T	It can help transfer customer requirements into product features. Sustainability can be added in each step of the matrix, leading to eco-efficiency.
The Digital Product Ethics Canvas	T	The purpose of this tool is to identify the risk of digital products to individuals and society.
Design Thinking as a Sustainability Approach	M	This sustainability approach is merged with design thinking to develop socially responsible and environmentally sustainable products.
Life Cycle Assessment as an Entrepreneurial Tool for Business Management and Green Innovations	T	This can help in measuring the environmental impact of a product's life cycle in all stages, from production to disposal or recycling.
Sustainable Value Analysis Tool (SVAT)	T	It can assist manufacturing firms in identifying possibilities to build sustainable value by analysing captured and uncaptured value across the product life cycle.
Design Kit: The Human-Centred Design Toolkit	T	Creative approach to problem solving: starts with people and ends with innovative solutions.

4. Sustainable business model development

Re-Start	M	It can show businesses how they can innovate their business model by finding new ways of creating, delivering and capturing value.
The Triple-layered Business Model Canvas	T	It can help develop new sustainable business models or visualise existing ones while raising awareness about the current one.
Green Business Modelling Editor	T	A software(prototype)/tool that supports sustainability-oriented reflection in the process of (re)developing a business model.
Green Business Model Innovation	T	A tool that encourages businesses to be greener.
Business Transformation Tool	T	It can assist a business in developing a new business model from a new value opportunity.
Entrepreneurial Lean Thinking for Sustainable Business Modelling	M	It can guide innovation processes in complex environments. Through constant feedback loops of creating, testing and improving innovative solutions, uncertainty can be reduced, leading to flexible and faster implementation of innovations.
Flourishing Business Model Canvas	T	This can help create a visual framework through collaboration where it is possible to prototype, sketch, improve, communicate, understand, measure, diagnose and tell stories about any business model.

5. Development of entrepreneurial skills for sustainability

Re-Solve	T	This is a reflective and iterative process tool that aims to scale education for sustainable development (ESD).
The Burns Model of Sustainability Pedagogy	M	This uses an ecological course design process and creates transformative learning experiences.
EPOSEA Tool	T	This can aid teachers in enhancing their ESD classroom activities and is used for coproducing sustainability stories.
ASU-SOS Model	M	This can help in learning sustainability through real-world learning. The model explains how students can learn sustainability through four years of education.
Utopia Realising	M	It can help in gaining knowledge about sustainability and entrepreneurship through the use of multiple methods used in SEE, such as utopia as a method. Students can increase competences such as decision making and opportunity development.
The Sustainability Competencies Tool	T	This can help make individual sustainable development competencies evident and provide support for further development. It can help encourage people to reflect on and talk about their own abilities, as well as urge them to pursue their potential.
The Sustainable Business Innovation Game	M	It can ease the adaptation of the Sustainability Impact Canvas and Sustainable Business Model Canvas.

Appendix 1 provides a table of the above mentioned methods and tools, including more detailed information such as user group, degree of entrepreneurship and sustainability, further reading and references.

Results from the interviews

We conducted seven interviews, speaking with consultants, start-ups and a representative from academia. The interviews resulted in information about the companies' and organisation's need for—and experience with—methods and tools that combine sustainability and entrepreneurship. We conducted thematic analysis based on the interview guide and project description, and we noticed three themes: *the need for methods and tools*, *experience with methods and tools* and *the scope of sustainability and entrepreneurship*.

In Appendix 2, we include summaries of the interviews in a table to show which methods and tools are utilised, how they are used and when they are needed. The candidates from the interviews are shown in Table 2, including information about their industry, the age and size of the companies, the date of the interview and its length.

Methods and tools used by companies

The main goal of the interviews was to gather the methods and tools for SE used by companies today. These are as follows:

- *Project Canvas*
- *Flourishing Business Model Canvas*
- *SEAM*
- *SDG Assessment Tool*, or at least like this existing tool
- *Design Thinking for Sustainability* (Garcia & Dacko, 2015)

- *The Triple-layered Business Model Canvas* (Joyce & Paquin, 2016)
- *Re-Solve* (Mickelsson, 2020) and *Restart* (Jørgensen & Pederesen, 2017).

Needs and purpose of the methods and tools

Based on the interviews, we identified some distinguishing characteristics, here depending on the age of the company and its size. Newly established businesses, such as Candidate 3, were interested in measuring and mapping their sustainability status to develop strategies for where they should focus their efforts next. Other, more established companies, such as Candidate 1, had a better understanding of the methods and tools they use in their daily work, such as the *Flourishing Business Model Canvas* and the Research Council's *Project Canvas*. Smaller businesses, such as Candidate 4, lacked the resources, both in terms of time and employees, to find and develop methods in their organisation.

Whereas smaller businesses might not have the resources to learn about and integrate methods and tools into their business, larger companies had different prerequisites for finding suitable methods and tools. Candidate 1, an employee at a developed company, revealed that their consultants had extensive knowledge about the methods and tools they used on a daily basis. Some of the methods they used are the *Flourishing Business Model Canvas* and the *Project Canvas* developed by the Norwegian Research Council. Their consultants knew these methods by heart and, hence, were able to use these methods when consulting businesses for sustainable development. According to Candidate 1, this creates a more realistic approach for the consultants to figure out the state of the client businesses and their needs.

Experience with the methods and tools

The businesses we interviewed employed the methods and tools in a variety of ways. During the interviews, we learned that there were differences between start-ups and larger companies in how they used the different methods. For companies to use the various tools, it was necessary to adapt the methods to their needs or their customer's needs. In one of the interviews we had with a large consulting company, we learned that they used tools such as *Business Model Canvas* or *Value Proposition Canvas*, which is a tool they did not regularly use, but they used it based on what the customers needed, e.g. when a client aims to renew its business model due to changes in the market and the distribution channels. These are methods that are easily adaptable to the situation, making them more convenient to utilise. The *SEAM method* used by other consulting firms is also easy to adapt to the customer's needs, and this was found to be a method used for all of their customers to work with business plan development.

For the large companies, we have gained an understanding that the experiences they have had with the various methods and tools have helped them gain knowledge about how they can utilise existing tools. For the smaller companies, it was the lack of resources to build this knowledge that was the key to not utilising the methods and tools. We discovered that although SE was essential to several of our interviewees, there was little focus on this specific area because of a lack of resources and awareness about existing methods and tools. This was a prevalent theme throughout the interviews.

The scope of sustainability and entrepreneurship

During the interviews, we noticed that the scope of sustainability and entrepreneurship varied among the methods and tools. Some businesses used methods focusing more on sustainability than others, for example, the *Flourishing Business Model Canvas*. In this model, sustainability is more important than, for example, the *SEAM method*, which was used by a consulting firm we interviewed. Both methods still bring attention to sustainability in entrepreneurial work, though their main focus is on entrepreneurship. As for the *Flourishing Business Model Canvas*, the UN's SDGs are the main focus (Flourishing Business, 2021).

We also noticed that the scope of sustainability and entrepreneurship varied among the businesses' missions. The methods and tools the companies used on a daily basis aligned with the company's mission of either sustainability or entrepreneurship. The company that was using the *Flourishing Business Model Canvas* aimed at increasing sustainability; thus, they used methods more targeted towards sustainability. The consulting firm for entrepreneurs aimed to help entrepreneurs succeed, and their method was mostly targeted towards entrepreneurship. Appendix 1 provides summaries of the various interviews we conducted and what the most important findings are.

Results from the clustering

In this section, we address how we have chosen to cluster the methods and tools collected through the interviews and literature search. During the clustering process, we divided the methods into five categories based on how the methods were used and their purpose: 1) measuring and developing sustainable strategies; 2) sustainable process development; 3) sustainable product development; 4) sustainable business model development; and 5) development of entrepreneurial skills for sustainability.

In this way, clustering makes it easier for us to map which methods can be used for the different time phases and needs of the companies and start-ups. The results are presented in Appendix 2. Furthermore, we have looked at how these methods and tools can be relevant to teaching. These methods work towards enhancing the knowledge within entrepreneurship, sustainability and environmentally conscious development of companies, and they invite and inspire students to develop a sustainable mindset.

Measuring and developing sustainable strategies

This category includes those strategic methods and tools used for measuring, assessing and analysing sustainability and environmental impact. As we discovered during the interviews and literature search, businesses use these methods and tools in the starting phases of product, project or business development. They are mainly used to assess and measure the environmental impact of a product or process or to analyse where a business can improve its environmental impact. Thereafter, they can use these assessment methods to develop strategies to improve their environmental impact.

Some examples of the methods in this category are *Sustainable SWOT Analysis* and *Root Cause Analysis*. *Sustainable SWOT Analysis* can be used by companies to identify and assess environmental risk and then to take action to solve environmental challenges. *Root Cause Analysis* can be used for businesses to identify and understand their biggest sustainability pain points that are preventing them from reaching their best potential state (Courtneil, 2021). These methods both aid companies in analysing and identifying problems related to sustainability, which is why they are included in Category 1. A complete list of methods and tools in this category can be found in Appendix 2.1.

Sustainable process development

This category is based on sustainable business process development tools. These methods and tools are used for developing sustainable business processes, and they have been developed in fields such as business process management. A business process can be explained as the steps a business takes to produce a desired output, such as a product or service. The methods and tools in this category aim to create more sustainable business processes, and they are presented in Appendix 2.2.

Examples of the methods and tools in this category are *Lean Six Sigma* and *Just in Time*. *Lean Six Sigma* is used for analysing processes to remove waste; it can be applied in many contexts, from the delivery of goods to removing waste in production processes. *Just in Time* is used to control production processes, aiming to keep stock levels to a minimum to reduce waste and natural resource use. Because these tools are concerned with reducing waste and creating more sustainable business processes, they are included in the category of sustainable business process development.

Sustainable product development

The methods and tools in this category are used for sustainable product development, and they range from environmental analysis to innovation and development. Some examples of the tools in this category include the *Life Cycle Assessment tool*, which can be used for measuring the environmental impact of a product's life cycle in all stages, from production to disposal. By considering the environmental impact of all the stages of a product's life cycle, it is possible to create more sustainable products. Other tools like *Sustainability Quality Function Deployment* aim to transfer customers' requirements for sustainability into product features. A more detailed explanation of each tool and method can be found in Appendix 2.3.

Sustainable business model development

Early in the collection process, we noticed that there were many methods and tools for sustainable business models. Some of these methods, such as the *Triple-layered Business Model Canvas*, are based on the traditional *Business Model Canvas* by Osterwalder and Pigneur (2010) but with added sustainability building blocks. This model can be used by businesses to develop new sustainable business models. It can also be used to visualise an existing sustainable business model. The goal is for businesses to think more about sustainability in their business model development processes.

Other methods and tools in this category can be used for developing or innovating business models to be more sustainable, such as the *Green Business Modelling Editor* and *Re-Start*. We also discovered an example, *Entrepreneurial Lean Thinking*, in which entrepreneurial lean thinking is used for sustainable business modelling in a workshop (Schwarz et al., 2021). This is a good example of how one method within entrepreneurship can be used for sustainability while also showing how the two methods can be used together in a workshop setting.

Development of entrepreneurial skills for sustainability

The methods and tools in this category have been developed for education, and they can be used to increase entrepreneurial skills for sustainability. Some of the tools have been developed to be used in lectures, such as the *Sustainable Business Innovation Game*. This game was created to ease the adaptation of the *Sustainability Impact Canvas* and the *Sustainable Business Model Canvas*, and it can be a good way for students to learn about these methods. Tools such as the *Sustainable Competencies Tool* can be used for students to make individual

evaluations about their competencies for sustainable development; these tools can also be used for further developing their competencies. The common purpose of the methods and tools in this category is for students to increase their skills in SE.

Other methods in this category are intended for educators and can be used for developing courses, such as the Burns Model of Sustainability Pedagogy and the Re-Solve tool. The goal of the Burns *Model of Sustainability Pedagogy* is to create opportunities for transformative learning using an ecological course design, in which students are motivated and inspired to shift their values to make sustainable and authentic changes (Burns, 2009). The *Re-Solve tool* is also meant for educators, and it is a reflective and iterative process tool with the purpose of scaling ESD. The method consists of a series of workshops that allow stakeholders to reflect on and self-evaluate existing ESD initiatives or projects and then establish visions, strategies and actions to achieve their desired goals based on this self-assessment (Mickelsson et al., 2019).

Application of learning approaches, methods and tools

For this section, we want to look at how we sorted out the results from the literature search and interviews. The most prevalent findings are 1) the clustering of methods and tools and how they can be used in education. We also want to discuss findings from our interviews related to 2) the lack of knowledge and resources for SE in businesses and what this means for education. We also present and discuss 3) the development of a visualisation showing the degree to which the different methods and tools focus on sustainability and entrepreneurship. We conclude with 4) connecting the learning in this project to relevant learning approaches for SE.

The use of methods and tools for sustainability

The use of methods and tools in business and academia forms an essential part of the findings in the current report, which are valuable for the development of education for SE. In this section, we discuss which purposes the methods and tools are used for, how they can be used and what this means for education, all while taking the differences between methods and tools into consideration. The differences we discovered impacted our choices of clustering the methods and tools into similar categories based on the purpose they covered.

We have previously explained the difference between the use of methods and tools in business and those in education. Although the methods and tools in companies aim to improve and develop sustainable development and entrepreneurship, the methods and tools in education focus on students, trying to help them increase their competencies and skills in sustainable development and entrepreneurship. The methods and tools used in companies are included in Categories 1–4 of the clustering, while the methods and tools that are used to develop skills within sustainability and entrepreneurship in education are in Category 5. In this section, we highlight how the methods and tools can be used in education based on the different categories we discovered. One important consideration when using the methods and tools developed for companies in education is that some of them need to be adapted before being used in education.

Use of methods and tools in education according to clusters

During the literature and web search, we found methods and tools covering a variety of needs and purposes, which inspired us to cluster the methods and tools into categories of similarity. The categories we discovered can help educators find suitable methods and tools for their fields. Like the interviews, we discovered that some of the methods and tools were used for measuring sustainability and developing strategies. The methods and tools used for this purpose were set in *Category 1: Strategic tools for measuring and developing sustainable strategies*.

In education, the methods and tools in Category 1 can be applied in student projects to assess sustainability and develop ideas for sustainable strategies in projects. These methods and tools are also suitable to include in lectures, where students can learn about them before they use them. Examples of the methods that can be used in projects or in lectures to increase knowledge about SE are *Sustainability SWOT Analysis* and the *Sustainability Balanced Scorecard*. These methods are useful for measuring sustainability in companies, but they also aid in increasing students' knowledge of and develop competencies within SE while they learn how companies apply tools for sustainable development.

Another model in Category 1 that is suitable for education is *the Sustainable Entrepreneurial Process Flow Model*. This model explains the entrepreneurial process from idea generation to exploiting sustainable opportunities, and it is a good way to increase people's understanding of SE (Matzembacher et al., 2019). According to Matzembacher et al. (2019), this model can help educators identify which triggers for SE to use to better help students generate ideas. For example, this can be done by including sustainable problems for local businesses in education, integrating business cases related to sustainability in other contexts and more collaboration between universities and businesses.

Strachan (2018) suggests *the Natural Step* and *the Five Capitals* model be implemented in education for students to gain competencies for making decisions that account for ecological, social and economic consequences. These models are included in Category 1 because they have been developed to be used in businesses, but they are also suitable for students to learn about sustainability in lectures and projects. Both models take into account the different categories for sustainability, and they can be used for measuring sustainability in any company or entrepreneurial activity (Strachan, 2018).

Other methods and tools can be used for sustainable process development and are relevant in fields such as business process management. These methods and tools are included in *Category 2: Sustainable process development*. In education, many of the methods and tools in this category can be used in lectures and student projects. Examples of the methods that are suitable for such purposes are *Gap Analysis*, which is an examination of current sustainability status in a business to develop an action plan (Courtnell, 2021). *Lean six sigma* is also a relevant method for students to learn about and apply in their projects (Courtnell, 2021). Process tools that are less suitable for most student projects are the *Just in Time* tool, which is used for controlling production processes (Courtnell, 2021). However, the *Just in Time* tool could be a relevant tool to use in lectures in fields such as supply chain management and operations management.

In addition to sustainable process development, a group of methods and tools are used for sustainable product development. Therefore, we created *Category 3: Methods for sustainable product development*. The methods and tools in this category are used by businesses to

measure the environmental impact of products (*Sustainable Value Analysis Tool*) and their life cycles (*Life Cycle Assessment*). They can also be used for sustainable product innovation and for integrating sustainable ideas into product development (*Sustainability Quality Function Deployment*). The methods and tools in this category can be used in education for students to gain insights into what exactly makes a product sustainable and how they can develop products that are sustainable. Two tools that are suitable for students to gain knowledge about sustainable product development are the *Sustainable Value Analysis Tool* and *Sustainability Quality Function Deployment* (Baumgartner, 2003).

Methods such as *Life Cycle Assessment (LCA)* can be used for many purposes, such as strategic planning, marketing, green innovations, research and development and production (Moro Piekarski et al., 2013). Because it can be used for different purposes, the method is suitable for use in many educational fields. The goal of the *LCA* method is for businesses to quantify their use of resources, emissions and the environmental impact of products and processes (Welz et al., 2011; Moro Piekarski et al., 2013). In education, this method can be used in student projects to learn how to assess the environmental impact of products or processes, as well as for students to develop sustainable innovations.

The methods and tools in *Category 4: Methods for developing sustainable business models* can be used for creating, developing, innovating or improving sustainable business models. Learning about sustainable business models can help students increase their understanding of what makes a business sustainable and how it is possible to transform a business into a sustainable one. The most popular sustainable business model canvases we suggest for use in education are the *Flourishing Business Model Canvas* (Flourishing Business, 2020) or the *Triple-layered Business Model Canvas* (Joyce & Paquin, 2016); both are based on the original *Business Model Canvas* developed by Osterwalder and Pigneur (2010).

Sustainable business model transformation tools can be useful in education for students to increase their competencies in sustainable business model transformation. However, these methods and tools could require students to be familiar with the concept of business models. The *Re-Start* method and *Business Transformation Tool* are examples of methods and tools used by businesses to innovate or develop new sustainable business models. The *Re-Start* method was developed by Jørgensen and Pedersen (2018); the authors explain how businesses can innovate sustainable business models that are both sustainable and profitable, and they include case studies about sustainable business model innovation (Jørgensen & Pedersen, 2018). The *Business Transformation Tool* might need to be adapted for use in education because there are not as many resources online as with the *Re-Start* method, making the *Re-Start* method easier for use in education.

The last category of clustering is *Category 5: Methods and tools to increase entrepreneurial skills for sustainability*. This category consists of those methods and tools developed for education and that can be used for students to develop and increase their skills within SE; they can also be used by educators for developing courses about SE. The methods and tools educators can use for developing sustainable education are *Re-Solve*, *EPOSEA* and *the Burns Model*. *Re-Solve* can be used as a process tool for scaling ESD, and it can be adapted to multiple contexts (Mickelsson & Kronlid, 2019). Other tools such as the *EPOSEA* tool can be used for developing sustainability stories in education, which can increase competencies such as action competence, systems perspectives and critical reflection (Uhrqvist et al., 2021); the tool includes six dimensions of sustainability to help in focusing on only one dimension of issues (Lehtonen et al., 2018; Uhrqvist et al., 2021).

The Sustainability Competencies Tool can be used by students to reflect on their sustainability competencies and develop them further, and it has been created to be used in courses about sustainability (CASE, 2021b). The tool is flexible and can be applied in many ways (CASE, 2021b); for instance, it can be used in a single lecture. This makes the tool easy for educators to integrate into their courses, and it also comes with resources on the CASE website. *The Sustainable Business Innovation Game* is another tool that can easily be applied in lectures for students to learn about sustainable business models (Threebility, 2021). The game can be downloaded and is ready to be used in education. It can be a good way for students to be introduced to sustainable business models.

Utopia Realising is a novel case-based methodology that combines the methods and tools from entrepreneurship and sustainability education (Wigger et al., forthcoming). Students start by identifying a sustainable utopia before they are given an authentic case for them to work on and create sustainable opportunities. Realising sustainability is the last part of the methodology, and it consists of mobilising resources for their project and assessing a sustainable impact (Wigger et al., forthcoming). This is a well-developed methodology and can be used in courses for SE or other courses where students learn about sustainable development. However, educators need to consider the time aspect of this methodology because it has been made with larger projects in mind.

During our literature and web search, we did not find similar methodologies to the *Utopia Realising* methodology, which focuses on student case projects developed specifically for SE. The reason could be that SEE is a new field of research, so methodologies for SEE have not yet been published or developed. There is also a lack of research on which the methods and tools can be used to develop competencies for SE. As the field of SEE continues to grow, as well as the research on the different interventions, we emphasise the need to be consistent and clear on which learning approaches, teaching methods and tools are used in the different interventions. Our hope is that this report will contribute to clarify the different possible options in this matter.

Methods and tools used by companies and what this means for education

To know what to include in education, it is important for educators to know which methods and tools can provide which learning outcomes, but it is also an advantage to know what is used in the industry and how they use methods and tools. From the interviews, we gathered detailed information about which methods and tools are used by companies and how they are used. Therefore, we want to include these results in our discussion—along with the purpose and application of the methods and tools—and explore what it means for education.

The methods and tools for SE cover a range of purposes for companies. The most prevalent use of the methods and tools by the companies we interviewed were tools used for planning and mapping sustainable projects in their start phase, such as *the Project Canvas*. Methods and tools were also used by companies to measure and analyse sustainability based on the UN's measurement principles and key performance indicators (KPIs), and they were used for developing entrepreneurial ideas with the *SEAM Method*. By knowing the different purposes that these methods and tools cover, educators can use this information for planning courses and for students to learn how these methods and tools are used by companies for sustainable development.

The methods and tools used by companies in the current report were adapted according to the customers' and project's needs. Examples of methods and tools that are easy to adapt for different purposes are the *SEAM Method* and *Flourishing Business Model Canvas*. Informant 7 explained the importance of students learning how to use methods and tools and that there should be more attention to how students can learn to use methods and tools in education. Because they are applied by companies according to project and customer needs, students should learn that methods and tools are adaptable and not set to be used in one specific way. For example, this can be accomplished by learning how to apply methods and tools for different projects or business needs.

Lack of resources and knowledge of tools for sustainability

The findings have revealed a lack of resources and knowledge of methods and tools for sustainability as a barrier to take sustainable action. In this context, resources refer to employees and time. Company 4, a small and developed company, did not have enough employees or time to learn about and implement methods and tools for SE. Other companies, such as Company 2, did have the resources in the form of knowledge and employees, but because they were in the start-up phase, they did not yet have the opportunity to familiarise themselves with the methods and tools for SE. The lack of knowledge among employees of smaller companies that we interviewed on the methods and tools for SE impacted how they used resources in their companies. They also had fewer resources available than larger companies.

What these findings mean for education

These findings highlight the importance of education for SE and its role in making students become change agents for sustainability. Sustainable entrepreneurs are change agents because they see sustainability as a success factor in their organisation, and they use entrepreneurial means to integrate sustainability into the organisation (Hesselbarth & Schaltegger, 2014). This gives them the potential to tackle challenges, such as a lack of knowledge and resources in an organisation. However, some specific competencies are needed for being a change agent for sustainability (Hesselbarth & Schaltegger, 2014).

Providing students with the right competencies for SE can enable them to take action for sustainable development in their future work lives. However, which competencies are needed for becoming a change agent for sustainability and overcoming such obstacles? Some key competencies for sustainability change agents that are mentioned by Hesselbarth and Schaltegger (2014) are interpersonal competence (Ploum et al., 2018; Lans et al., 2014; Wiek et al., 2011), action competence (Ploum et al., 2018; Lans et al., 2014; Wiek et al., 2011; Roorda, 2010) and knowledge about sustainable development (Sterling & Thomas, 2006). Knowledge about sustainable development, paired with interpersonal and action competencies, can be important for making students become change agents for SE. According to Hesselbarth and Schaltegger (2014), among all the competencies found in their study, they all focus on the same educational objective: for students to partake in the processes for sustainable development.

How can students develop the needed competencies?

Currently, there are few publications or research projects that pair the methods and tools for SE with competencies or suitable teaching and learning approaches. According to Del Vecchio et al. (2021), there is a lack of university offerings for educating students in SE competencies (Vuorio et al., 2018; Pittaway et al., 2020). One reason for this is that the few competency frameworks that have been developed for SE are not applied to specific working contexts (Del Vecchio et al., 2021). However, research has shown how teaching and learning

approaches can develop competencies for SE, such as service learning. An effective learning approach for students to develop competencies like normative competence, strategic management and action competence needs to be developed and applied (Halberstadt et al., 2019).

We also noticed a lack of research pairing methods and tools with suitable teaching and learning approaches and research on how methods and tools can develop specific competencies for SE. This can make it difficult and time-consuming for educators to develop suitable education for students to gain the needed competencies for SE. However, other teaching and learning approaches are also found to be suitable for developing sustainability competencies. These include problem-based learning, project learning, service learning and case studies (Tejedor et al., 2018; Torres & Parini, 2019; Hägg & Gabrielsson, 2020; Del Vecchio et al., 2021). Still, it could be the lack of research on specific working contexts and research on how to use the methods and tools to develop specific competencies that is the problem.

Filling the knowledge gap among companies

One idea for companies to overcome a lack of resources and knowledge about methods and tools for SE is increased collaboration with universities. Increased collaboration with universities and the sharing of knowledge of methods and tools for SE could help smaller companies become more sustainable. These companies especially lack resources in the form of employees and time for finding suitable methods and tools for SE.

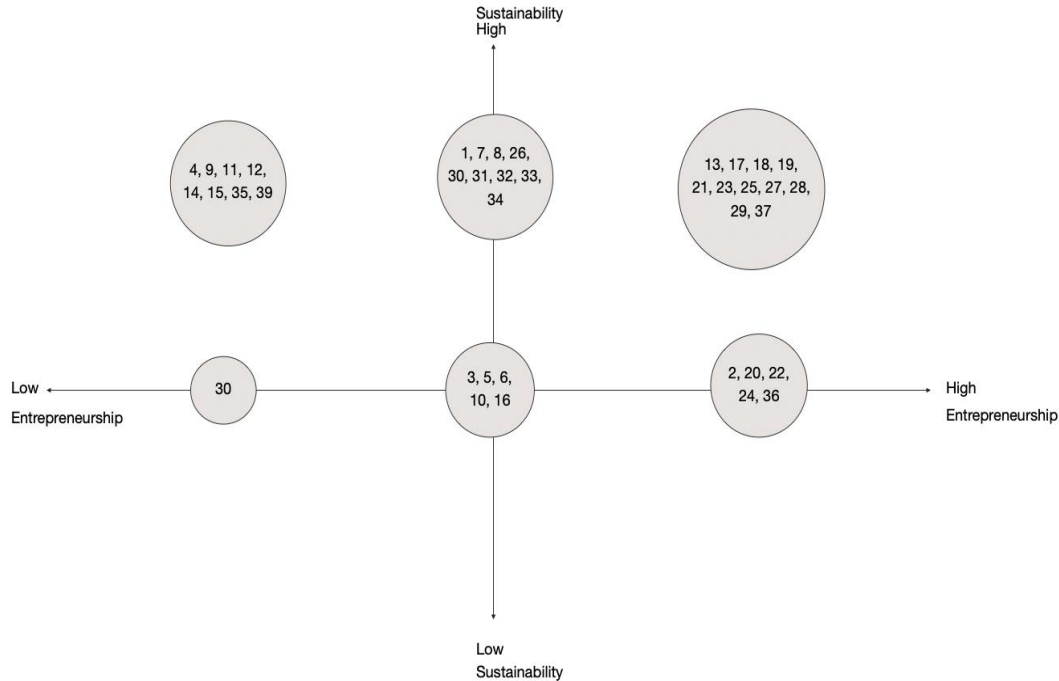
As the interviewee from Company 2 mentioned, they use tools for measuring sustainable impact to know where to take action and implement strategies for sustainable development. However, they have knowledge about sustainability but do not know about the methods and tools that could be used for further implementing sustainable development in their company after their start-up phase. The collection and accessibility of methods and tools for sustainability can be important for companies that lack resources and knowledge.

Some teaching and learning approaches found in Table 1 are suitable for collaboration with local companies, such as problem-based learning, transdisciplinary learning, service learning and place-based learning. For Company 2, collaboration with universities could, for example, be done in courses where the learning approach requires collaboration with local companies. Company 2 can be a case owner for projects, and students can be given the task of finding suitable methods and tools for SE that local companies can use. In this way, students can learn about SE while also learning how to use the methods and tools, which Interviewee 7 mentioned as an important learning outcome for students.

Scope of sustainability and entrepreneurship in education

We made a visualisation (Figure 1) illustrating the scope of sustainability and entrepreneurship among the methods and tools because we noticed that some methods were focusing more on sustainability in nature and others on entrepreneurship. We rated the methods and tools based on their scope of sustainability and entrepreneurship, here using a scale from 1 to 3, where 1 is the lowest value and 3 is the highest. A high score means the method or tool is developed for sustainability or entrepreneurship, while a lower score means the tool or method is not suitable or less concerned with topics of either sustainability or entrepreneurship. *Sustainability is shown on the y-axis, and entrepreneurship is shown on the x-axis.*

Explanation and discussion of the ratings in Figure 1



- | | |
|---|---|
| 1 THE IMPACT CANVAS | 20 FLOURISHING BUSINESS MODEL CANVAS |
| 2 THE TRIPLE LAYERED BUSINESS MODEL CANVAS | 21 PROJECT CANVAS |
| 3 THE SUSTAINABLE BUSINESS INNOVATION GAME | 22 GREEN BUSINESS MODEL INNOVATION |
| 4 THE DIGITAL PRODUCT ETHICS CANVAS | 23 ASU-SOS (SCHOOL OF SUSTAINABILITY) MODEL |
| 5 THE SUSTAINABILITY SWOT ANALYSIS | 24 ENTREPRENEURIAL LEAN THINKING |
| 6 THE SUSTAINABILITY BALANCED SCORECARD | 25 LIFE CYCLE ASSESSMENT |
| 7 THE SUSTAINABILITY PERFORMANCE TOOL | 26 SDG IMPACT ASSESSMENT TOOL |
| 8 THE SUSTAINABILITY COMPETENCIES TOOL | 27 GREEN BUSINESS MODELING EDITOR |
| 9 THE SUSTAINABLE CUBE | 28 BUSINESS TRANSFORMATION TOOL |
| 10 SUSTAINABILITY QUALITY FUNCTION DEPLOYMENT | 29 THE CAMBRIDGE VALUE MAPPING TOOL |
| 11 EPOSEA TOOL | 30 SUSTAINABLE VALUE ANALYSIS TOOL (SVAT) |
| 12 THE BURNS MODEL OF SUSTAINABILITY PEDAGOGY | 31 GAP ANALYSIS |
| 13 SUSTAINABLE ENTREPRENEUR PROCESS FLOW MODEL | 32 ROOT CAUSE ANALYSIS |
| 14 THE FIVE CAPITALS MODEL | 33 HOSHIN KANRI |
| 15 THE NATURAL STEP | 34 PDCA CYCLE |
| 16 DESIGN THINKING AS A SUSTAINABILITY APPROACH | 35 FORCE FIELD ANALYSIS |
| 17 RE-SOLVE | 36 SEAM |
| 18 RESTART | 37 THE HUMAN-CENTERED DESIGN TOOLKIT |
| 19 UTOPIA REALIZING | 38 JUST IN TIME |
| | 39 LEAN SIX SIGMA |

Figure 1: Scope of sustainability and entrepreneurship. Source: own illustration.

We rated the methods and tools based on how much they focus on sustainability and entrepreneurship. For example, if a tool has been made specifically to address sustainability, we rated it as 3, which is the highest score. We also rated the methods and tools after their novelty; if a method has changed and sustainability added, we would rate it as a 2. Sustainable SWOT analysis (5) is an example of a method where sustainability has been added to SWOT analysis; therefore, it was rated 2 on sustainability. Methods and tools for sustainable business models are often based on the Business Model Canvas by Osterwalder and Pigneur (2010),

such as the Triple-layered Business Model Canvas (2) or the Flourishing Business Model Canvas (20). These were also rated 2, as shown in Figure 1.

The methods and tools for entrepreneurship were rated after their entrepreneurial nature, and a high rating means that they were developed for entrepreneurship and within that field. One method that scored high on this scale is the SEAM method (36), which systematically addresses entrepreneurship because it was made for helping entrepreneurs develop their ideas. This method, however, scored lower on sustainability because this is not the main purpose of the method, even if it does focus on sustainability. It was difficult to decide which methods and tools were less entrepreneurial in nature because many of the methods and tools we collected can be used by entrepreneurs, even if not developed specifically for entrepreneurship. For instance, the tools for process development, such as JIT (38) or Lean Six Sigma (39), scored 1 on the entrepreneurship scale.

A ‘perfect’ tool or method on this scale is a novel method or tool that uses entrepreneurial means for sustainable development and that has a score of 3 on both entrepreneurship and sustainability. Twelve methods and tools achieved this score. Some methods and tools with the highest scores on both scales have been developed for education, such as Re-Solve (17), Utopia Realising (19) and ASU-SOS (23). Other methods and tools in this category can be used to develop and innovate sustainable business models, such as the Green Business Innovation Tool (22), Green Business Modelling Editor (27) and Business Transformation Tool (28).

More methods and tools score higher on sustainability than entrepreneurship, where many methods and tools score 1 on the entrepreneurship scale and no methods and tools score 1 on sustainability. The reason for this could be that when we searched for methods and tools for SE, we somehow found more methods and tools for sustainability instead of entrepreneurship. Another reason could be that our definition of entrepreneurship for these methods and tools is that they are developed within the entrepreneurship field. Other methods and tools we collected can be used by entrepreneurs, but we did not rate them high on this scale because they were not developed for entrepreneurship. For example, the Five Capitals model (14) can be used by entrepreneurs to assess sustainability in their business and further develop strategies for sustainability; however, this model is not entrepreneurial in nature and does not provide any knowledge of how to use entrepreneurship as a means for developing sustainability.

Conclusion

The current report concludes that there are multiple learning approaches that allow for the combination of entrepreneurship and sustainability elements in education (see Table 2). In particular, our study shows that these approaches often draw on the active involvement of students and self-directed learning. We argue that student-active learning forms are especially suitable for SEE. The overview of learning approaches provides educators with several options and inputs on how to facilitate and design sustainable entrepreneurial learning in higher education.

Further, the report presents a collection and clustering of the methods and tools that combine sustainability and entrepreneurship and how these are and can be applied in an educational context. We identified five clusters of methods and tools: 1. measuring and developing sustainable strategies; 2. sustainable process development; 3. sustainable product development; 4.

sustainable business model development; and 5. the development of entrepreneurial skills for sustainability. The methods and tools in these clusters all play a different role in education, here depending on their categories of clustering, and they can be used by educators when planning and developing courses, preparing classes or developing student assignments. The different categories can be used as a guide to find relevant methods and tools according to the different fields of education and desired learning outcomes. This collection is a first valuable step into how these methods and tools can be applied within relevant learning approaches that support SE, a topic that needs further exploration.

Although the current report presents how SEE can be taught, we call for more research on which competencies students can develop from the methods and tools we have collected. We also noticed a lack of research on how these methods and tools can be paired with suitable teaching and learning approaches, such as the *Utopia Realising* methodology. Therefore, we suggest that future research explore how these methods and tools can be paired with suitable teaching and learning approaches and explain which competencies can be developed from these pairings. The current report is a starting point for further research on the collection of methods and tools for sustainable entrepreneurship because more methods and tools for SE are appearing in new research.

References

- Baggen, Y., Lans, T., & Gulikers, J. (2021). Making entrepreneurship education available to all: Design principles for educational programs stimulating an entrepreneurial mindset. *Entrepreneurship Education and Pedagogy*, 1(28).
- Baumgartner, R. (2003). Tools for sustainable business management. *WIT Transactions on Ecology and the Environment*, 63.
- Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning: An approach to medical education*. Springer.
- Belz, F. M., & Binder, J. K. (2017). Sustainable entrepreneurship: A convergent process model. *Business Strategy and the Environment*, 26(1), 1-17.
- Bendell, T. (2006). A review and comparison of six sigma and the lean organisations. *The TQM magazine*.
- Biberhofer, P., & Rammel, C. (2017). Transdisciplinary learning and teaching as answers to urban sustainability challenges. *International Journal of Sustainability in Higher Education*.
- Bocken, N., Short, S., Rana, P. & Evans, S. (2013). A value mapping tool for sustainable business modelling. *Corporate Governance*, 13(5), 482-497.
- Bolmsten, J., & Kitada, M. (2020). Agile social learning—capacity-building for sustainable development in higher education. *International Journal of Sustainability in Higher Education*, 12(9).
- Bonwell, C. C., & Eison, J. A. (1991). *Active learning: Creating excitement in the classroom*. 1991 ASHE-ERIC higher education reports. ERIC Clearinghouse on Higher Education, The George Washington University, One Dupont Circle, Suite 630, Washington.
- Brooke G. C., & Andrade H. L. (2012). Learner-Centered Teaching. In N. M. Seel (Ed.), *Encyclopedia of the sciences of learning*. Springer.
- Brundiars, K., Barth, M., Cebrián, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W., Habron, G., Harrè, N., Jarchow, M., Losch, K., Michel, J., Mochizuki, Y., Rieckmann, M., Parnell, R., Walker, P., & Zint, M. (2021). Key competencies in sustainability in higher education—Toward an agreed-upon reference framework. *Sustainability Science*, 16(1), 13–29.
- Brundiars, K., Wiek, A., & Redman, C. L. (2010). Real-world learning opportunities in sustainability: from classroom into the real world. *International Journal of Sustainability in Higher Education*.
- Burns, H. (2009). *Education as sustainability: An action research study of the Burns model of sustainability pedagogy*. Portland State University.
- CASE. (2021a). *Project description*. Retrieved last on April 11th, 2022 from <https://www.case-ka.eu/index.html%3Fp=96.html>

- CASE. (2021b). *Manual CASE sustainability competencies tool*. Retrieved last on April 11th, 2020 from https://www.case-ka.eu/wp/wp-content/uploads/2018/02/Competencies-Tool_EN.pdf
- Courtneil, J. (2021, April 28). *10 top process improvement tools you need to create a more sustainable business*. Taskmanager. Retrieved last on April 11th, 2022 from <https://www.ntaskmanager.com/blog/top-process-improvement-tools/>
- Dahle (2020). *Entrepreneørskap – En praktisk håndbok*. Universitetsforlaget.
- Dobson, H.E., Tomkinson, C.B. (2012). Creating sustainable development change agents through problem-based learning. *International journal of sustainability in higher education*, 13(3), 263-278.
- Del Vecchio, P., Secundo, G., Mele, G., & Passiante, G. (2021). Sustainable entrepreneurship education for circular economy: Emerging perspectives in Europe. *International Journal of Entrepreneurial Behavior & Research*, 27(8).
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public interest*, 14(1), 4–58.
- Easterby-Smith, M., Thorpe, R., & Jackson, P. (2015). *Management and business research* (5th ed.). Sage Publications.
- Eriksson, K.M., Ahlbäck, A., Gustavsson, M., Silow, N. & Pettersson, J.B.C. 2019. The SDG Impact Assessment Tool-a free online tool for self-assessments of impacts on Agenda 2030. *Policy*, 1, 150-167.
- Feng, L. (2012). Teacher and student responses to interdisciplinary aspects of sustainability education: What do we really know?. *Environmental Education Research*, 18(1), 31-43.
- Figge, F., Hahn, T., Schaltegger, S., & Wagner, M. (2002). The sustainability balanced scorecard—linking sustainability management to business strategy. *Business strategy and the Environment*, 11(5), 269-284.
- Fiore, E., Sansone, G., & Paolucci, E. (2019). Entrepreneurship education in a multidisciplinary environment: Evidence from an entrepreneurship programme held in Turin. *Administrative Sciences*, 9(1), 28.
- Flourishing Business. (2021). *Flourishing enterprise innovation toolkit*. Flourishingbusiness.org.
- Garcia, R., & Dacko, S. (2015). Design thinking for sustainability. *Design thinking: New product development essentials from the PDMA*, 381-400.

- Gerlach, R. (2019a). *The Tools & Business Practices to Promote Sustainable Product & Business Model Innovation*. Retrieve last on April 11th, 2022 from <https://www.threebility.com/post/the-tools-business-practices-to-promote-sustainable-product-business-model-innovation>.
- Gerlach, R. (2019b). *The Digital Product Ethics Canvas*. Retrieved on April 11th, 2022 from <https://www.threebility.com/post/the-digital-product-ethics-canvas>.
- Golhar, D. Y., & Stamm, C. L. (1991). The just-in-time philosophy: a literature review. *The International Journal of Production Research*, 29(4), 657-676.
- Hägg, G., & Gabrielsson, J. (2020). A systematic literature review of the evolution of pedagogy in entrepreneurial education research. *International Journal of Entrepreneurial Behavior and Research*, 26(5), 829–861.
- Halberstadt, J., Schank, C., Euler, M., & Harms, R. (2019). Learning sustainability entrepreneurship by doing: Providing a lecturer-oriented service learning framework. *Sustainability*, 11(5), 1217.
- Halberstadt, J., Timm, J. M., Kraus, S., & Gundolf, K. (2019). Skills and knowledge management in higher education: how service learning can contribute to social entrepreneurial competence development. *Journal of Knowledge Management*.
- Hall, J. K., Daneke, G. A., & Lenox, M. J. (2010). Sustainable development and entrepreneurship: Past contributions and future directions. *Journal of Business Venturing*, 25(5), 439–448.
- Henriksen, K., Bjerre, M., Øster, J., Bisgaard, T. (2012). Green Business Model Innovation. Policy Report. *Nordic Innovation Report 2012*:18.
- Hesselbarth, C., & Schaltegger, S. (2014). Educating change agents for sustainability—Learnings from the first sustainability management master of business administration. *Journal of Cleaner Production*, 62, 24–36.
- Hynes, B., & Richardson, I. (2007). Entrepreneurship education: A mechanism for engaging and exchanging with the small business sector. *Education+ Training*.
- Joyce, A., & Paquin, R. L. (2016). The triple layered business model canvas: A tool to design more sustainable business models. *Journal of Cleaner Production*, 135, 1474–1486.
- Jørgensen, S., & Pedersen, L. J. T. (2017). *Restart: 7 veier til bærekraftig business*. Cappelen Damm Akademisk.
- Jørgensen, S., & Pedersen, L. J. T. (2018). *RESTART sustainable business model innovation*. Springer Nature.
- Kakouris, A., & Liargovas, P. (2021). On the about/for/through framework of entrepreneurship education: A critical analysis. *Entrepreneurship Education and Pedagogy*, 4(3), 396–421.

- Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. FT press.
- Lackéus, M. (2015). *Entrepreneurship in education: What, why, when, how. Background paper*. OECD report.
- Lans, T., Blok, V., & Wesselink, R. (2014). Learning apart and together: Towards an integrated competence framework for sustainable entrepreneurship in higher education. *Journal of Cleaner Production*, 62, 37–47.
- Lourenço, F., Jones, O., & Jayawarna, D. (2013). Promoting sustainable development: The role of entrepreneurship education. *International Small Business Journal*, 31(8), 841–865.
- Lüdeke-Freund, F., & Dembek, K. (2017). Sustainable business model research and practice: Emerging field or passing fancy?. *Journal of Cleaner Production*, 168, 1668-1678.
- Lynch, M., Andersson, G., & Johansen, F. R. (2021). Merging systems thinking with entrepreneurship: Shifting students' mindsets towards crafting a more sustainable future. *Sustainability*, 13(9), 4946.
- MacVaugh, J., & Norton, M. (2012). Introducing sustainability into business education contexts using active learning. *International Journal of Sustainability in Higher Education*.
- Matzembacher, D. E., Raudsaar, M., de Barcellos, M. D., & Mets, T. (2019). Sustainable entrepreneurial process: From idea generation to impact measurement. *Sustainability*, 11(21), 5892.
- Metzger E., del Pino, S. P., Prowitt, S., Woodward, Perera, A. (2012) sSWOT - A Sustainability SWOT. Washington: World Resources Institute, 2012.
- Mezirow, J. (2000). *Learning as Transformation: Critical Perspectives on a Theory in Progress*. The Jossey-Bass Higher and Adult Education Series. Jossey-Bass Publishers, 350 Sansome Way, San Francisco.
- Mickelsson, M., Kronlid, D. O., & Lotz-Sisitka, H. (2019). Consider the unexpected: scaling ESD as a matter of learning. *Environmental Education Research*, 25(1), 135-150.
- Mindt, L., & Rieckmann, M. (2017). Developing competencies for sustainability-driven entrepreneurship in higher education: A literature review of teaching and learning methods. *Teoría de la Educación; Revista Interuniversitaria*, 29(1), 129.
- Muñoz, P., & Cohen, B. (2018). Sustainable entrepreneurship research: Taking stock and looking ahead. *Business Strategy and the Environment*, 27(3), 300–322.
- Moro Piekarski, C., Mendes da Luz, L., Zocche, L., & De Francisco, A. C. (2013). Life cycle assessment as entrepreneurial tool for business management and green innovations. *Journal of Technology Management & Innovation*, 8(1), 44–53.

- Ndofirepi, T. M. (2020). Relationship between entrepreneurship education and entrepreneurial goal intentions: Psychological traits as mediators. *Journal of Innovation and Entrepreneurship*, 9(1), 1–20.
- Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: A handbook for visionaries, game changers, and challengers* (Vol. 1). John Wiley & Sons.
- Pittaway, L., Aissaoui, R., Ferrier, M., & Mass, P. (2020). University spaces for entrepreneurship: a process model. *International Journal of Entrepreneurial Behavior and Research*, 26(5), 911–936.
- Ploum, L., Blok, V., Lans, T., & Omta, O. (2018). Toward a validated competence framework for sustainable entrepreneurship. *Organization & Environment*, 31(2), 113–132.
- Roorda, N. (2010). *Sailing on the winds of change: The Odyssey to sustainability of the universities of applied sciences in the Netherlands*. Datawyse / Universitaire Pers Maastricht.
- Sarasvathy, S. D., & Venkataraman, S. (2011). Entrepreneurship as method: Open questions for an entrepreneurial future. *Entrepreneurship Theory and Practice*, 35(1), 113–135.
- Schaltegger, S., & Wagner, M. (2011). Sustainable entrepreneurship and sustainability innovation: Categories and interactions. *Business Strategy and the Environment*, 20(4), 222–237.
- Schoormann, T., Stadtländer, M., & Knackstedt, R. (2021). Designing business model development tools for sustainability—a design science study. *Electronic Markets*, 1-23.
- Schön, D. (1987). *Educating the reflective practitioner*. Jossey-Bass.
- Schwarz, E. J., Gregori, P., Krajger, I., & Wdowiak, M. A. (2021, March). Entrepreneurial lean thinking for sustainable business modeling: a workshop design for incumbent firms. In *Sustainability Management Forum/ Nachhaltigkeits Management Forum* (Vol. 29, No. 1, pp. 41-55). Springer Berlin Heidelberg.
- Seel, N. M. (Ed.). (2011). *Encyclopedia of the sciences of learning*. Springer Science & Business Media.
- Sharma, S., Goyal, D. P., & Singh, A. (2020). Systematic review on sustainable entrepreneurship education (SEE): A framework and analysis. *World Journal of Entrepreneurship, Management and Sustainable Development*, 17(3).
- Slavich, G. M., & Zimbardo, P. G. (2012). Transformational teaching: Theoretical underpinnings, basic principles, and core methods. *Educational psychology review*, 24(4), 569-608.
- Smith, G. A., & Sobel, D. (2010). *Place- and community-based education in schools*. Routledge, New York.
- Soltero, C. (2007). Hoshin Kanri for improved environmental performance. *Environmental Quality Management*, 16(4), 35-54.

- Sterling, S., & Thomas, I. (2006). Education for sustainability: The role of capabilities in guiding university curricula. *International Journal of Innovation and Sustainable Development*, 1(4), 349–370.
- Strachan, G. (2018). Can education for sustainable development change entrepreneurship education to deliver a sustainable future? *Discourse and Communication for Sustainable Education*, 9(1), 36–49.
- Thomassen, A. O., & Stentoft, D. (2020). Educating students for a complex future—why integrating a problem analysis in problem-based learning has something to offer. *The Interdisciplinary Journal of Problem-Based Learning*, 14(2).
- Tejedor, G., Segalàs, J., & Rosas-Casals, M. (2018). Transdisciplinarity in higher education for sustainability: How discourses are approached in engineering education. *Journal of Cleaner Production*, 175, 29–37.
- Thomas, J. (1985). Force field analysis: A new way to evaluate your strategy. *Long range planning*, 18(6), 54-59.
- Thomassen, A. O., & Stentoft, D. (2020). Educating students for a complex future—Why integrating a problem analysis in problem-based learning has something to offer. *The Interdisciplinary Journal of Problem-Based Learning*, 14(2).
- Threebility. (2020). *Threebility: Tools for sustainable innovation*. Threebility.com.
- Torres, A. S., & Parini, F. P. (2019). Circular economy: perspective of changes in entrepreneurial dynamics. In *New paths of entrepreneurship development* (pp. 315–349). Springer.
- Uhrqvist, O., Carlsson, L., Kall, A. S., & Asplund, T. (2021). Sustainability stories to encounter competences for sustainability. *Journal of Education for Sustainable Development*, 15(1), 146–160.
- UNESCO. (2012). Education for sustainable development sourcebook. Education for sustainable development in action. *Learning & Training Tools*, 4. Retrieved last on April 11th, 2022 from <https://sustainabledevelopment.un.org/content/documents/926unesco9.pdf>
- Van Wynsberghe, R., & Moore, J. L. (2015). UN decade on education for sustainable development (UNDESD): enabling sustainability in higher education. *Environment, development and sustainability*, 17(2), 315-330.
- Vuorio, A. M., Puumalainen, K., & Fellnhofer, K. (2018). Drivers of entrepreneurial intentions in sustainable entrepreneurship. *International Journal of Entrepreneurial Behavior and Research*, 24(2), 359–381. 10.1108/IJEBR-03-2016-0097.
- Walmsley, C. (2020). The Impact Canvas: An Ethical Design Experiment. *Design Management Review*, 31(1), 20-25.
- Wiek, A., Xiong, A., Brundiers, K., & Van Der Leeuw, S. (2014). Integrating problem-and project-based learning into sustainability programs: A case study on the School of

Sustainability at Arizona State University. *International Journal of Sustainability in Higher Education*.

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: A reference framework for academic program development. *Sustainability Science*, 6(2), 203–218.

Wigger, K., Vestrum, I., Jin, F., & Solvoll, S. (Forthcoming). From utopia to sustainable entrepreneurship: A novel case methodology. In Wigger, K., Aaboen, L., Haneberg, D., Jakobsen, S. & Lauvås, T.A. (Eds.), *Reframing the case method for entrepreneurship education. Cases from the Nordics*. Edward Elgar Publishing.

Yang, M., Vladimirova, D., Rana, P. and Evans, S., 2014. Sustainable value analysis tool for value creation. *Asian J. Management Science and Applications*, 1(4),312-332.

Appendix 1: Overview of identified methods and tools

Methods and tools	Purpose	Description	User group	Literature	Sustainability Scale (1–5)	Entrepreneurial Scale (1–5)	Other relevant literature of the method
The Impact Canvas	The tool can be used to systematically identify the critical positive and negative externalities of your business or product.	This tool helps businesses to identify the positive and negative impacts of their product or business idea, therefore generating the first input for a realistic impact assessment. The tool has three levels that consider all the potential impact categories of a product or business. This tool can help social entrepreneurs underpin their discussions with (impact) investors.	All tools on the Threebil-ity platform can be used by businesses and in education.	Walmsley (2020).	5. This tool is developed to analyse the externalities of a product or process.	4. It is developed for entrepreneurs and businesses, but it is more aimed at sustainability.	https://www.threebilibity.com/sustainability-impact-canvas
The Triple-layered Business Model Canvas	The Triple-layered Business Model Canvas is a tool for sustainable business model innovation, and it can be used to visualise existing business models or raise awareness about the current one (Joyce & Paquin, 2016).	This Triple-layered Business Model Canvas is based on the original Business Model Canvas by Osterwalder and Pigneur (2010) but with two added layers. One environmental layer is based on a life cycle perspective, and a social layer is based on a stakeholder perspective (Joyce & Paquin, 2016). These three layers show how a business can generate different values: economic, environmental and social (Joyce & Paquin, 2016).	A model for business and education.	Joyce & Paquin (2016).	3. Sustainability is added to an existing tool.	5. Sustainable business model development.	Lüdeke-Freund & Dembek (2017).
The Sustainable Business Innovation Game	The game was developed to ease the adaptation of the Sustainability Impact Canvas and the Sustainable Business Model Canvas.	The game contains 38 business model cue cards. Each cue card contains an overview of a viable business plan that has been successfully implemented in the real world. Users can quickly recognise the model's typical positive and negative implications, as well as learn about it through a real-world example. The group can be divided into teams, with each team receiving an equal	Teams of 2–10 people.	Gerlach (2019a).	5. Game with a sustainable goal.	5. The goal is to learn about sustainable business models.	https://www.threebilibity.com/sustainable-business-model-game

		number of sustainable business model cue cards. The teams evaluate the viability of the specific business model for the product or business in question as they go through each cue card and then determine together whether components of the model can be successfully implemented.					
The Digital Product Ethics Canvas	The purpose of this tool is to identify the risk of digital products to individuals and society.	By following the Canvas Instructions, professionals, at the very least, can increase awareness among top management about the hazards of digital products to persons and society and, in the best case, reduce their negative impact.	Product managers, UX designers and information architects.	Gerlach (2019b)	4. Sustainability in the context of digital consumption (digital sustainability).	3. The tool can be used for innovation and development.	https://www.threebillion.com/digital-product-ethics-canvas
The Sustainability SWOT Analysis	The purpose of the sSWOT is to assess environmental risk but also to engage employees, make it easier to work across departments and then create long-term sustainable value for the company.	The sSWOT helps companies identify and assess environmental risks and drive action on environmental challenges The sSWOT can be useful to initiate new product and business ideas.	Internal departments, as well as with suppliers, customers and other stakeholders.	Metzger et al., (2012).	3. Sustainability is added to an existing tool.	3. The tool can be used for innovation and development.	https://in-lac.org/ve/wp-content/uploads/2020/08/sustainability_swot_user_guide.pdf
The Sustainability Balanced Score Card	The aim of this tool is to measure sustainability performance, and implement strategies for sustainable development.	The Sustainability Balanced Score Card (sBSC) provides for the measurement of sustainability performance and related management approaches. It gives executives a thorough framework for translating a company's strategic goals into a logical set of performance indicators.	It can be used by businesses to approach the challenges of corporate sustainability.	Figge et al., (2002)	3. Sustainability is added to an existing tool.	3. The tool can be used for innovation and development.	
The Sustainability Performance Tool	A qualitative tool for assessing and improving sustainability in businesses and nonprofits	The tool gives a comprehensive picture of how different business units within a company interact, allowing for methodical identification and the development of sustainability possibilities and challenges.	Can be used as a self-evaluation tool by businesses and by students	CASE (2021b).	5. This tool is sustainable in nature.	2. The tool is not entrepreneurial in nature, but it increases the competencies needed for SE. It can also be	https://www.case-ka.eu/index.html%3Fp=1481.html

	(performance management).	The tool takes ecological, social and economic aspects into account.	in collaboration projects with business partners.			used by entrepreneurs.	
The Sustainability Competencies Tool	The Sustainability Competencies Tool is a tool to make individual competencies for sustainable development visible and give support to further development.	This is a tool for making individual sustainable development competencies evident and providing support for further development. It is predicated on a holistic concept of competence, which encompasses values, knowledge and the ability to put ideas into action. The tool's goal is to encourage people to reflect on and talk about their own abilities, as well as to urge them to pursue their potential.	It can be used as a tool for self-evaluation, as well as peer group, coach or teacher feedback procedures. The tool is primarily utilised by students in the context of sustainability-focused instructional events, but it can also be modified and transferred to sustainability-focused businesses and non-profit organisations.	CASE (2021b).	5. This tool is sustainable in nature.	2. The tool is not entrepreneurial in nature, but it increases the competencies needed for SE. It can also be used by entrepreneurs.	
The Sustainability Innovation Cube	The sustainability cube can be used to determine a company's position	This tool contains the three perspectives of sustainable development (economical, ecological and social). A metric system is used in each of the three perspectives. The position within the	The cube can be used for whole organisations, parts of an	Baumgartner (2003).	5. This tool is sustainable in nature.	2. Not developed for entrepreneurship.	

	regarding sustainable development.	cube enables one to define strategies for further sustainable development.	organisation or for individual products or services.				
Sustainability Quality Function Deployment	The tool aims to transfer customer requirements into product features. In the article, it is mentioned that sustainability can be added in each step of the matrix and then lead to eco-efficiency.	Quality Function Deployment (QFD) is a tool for product development and consists of four steps. By including sustainability requirements in every step, the Sustainability Quality Function Deployment (SQFD) was created. The intention is maximising the benefit and minimising the environmental impact of the product/service.	Product development.	Baumgartner (2003).	3. Sustainability is added to an existing tool.	4. The tool is entrepreneurial in nature, and it is used for product development	
EPOSEA Tool	This tool aids teachers in enhancing their ESD classroom activities, and it is a tool for coproducing sustainability stories. Sustainability stories can provide a valuable method for students to increase their competencies: <i>systems perspectives, action competence, creativity and critical thinking.</i>	The EPOSEA tool creates a holistic perspective for ESD by providing six dimensions; it is a tool for coproducing sustainability stories. This mapping tool is named EPOSEA after the first letter in each of its six dimensions: environment, pluralism, organisation, social, economy/technology and agents. The tool can be used to compose a story and bring the six dimensions together.	It is a tool for teachers for enhancing their ESD classroom activities. It can also be used in sustainable storytelling.	Uhrqvist, et al., (2021).	5. Sustainability is the aim of this educational tool.	3. This tool is made for ESD, not EE. Still, competencies relevant in SEE are achieved through this method.	
The Burns Model of Sustainability Pedagogy	The goal of the model is to provide opportunities for transformative learning where	The Burns Model of Sustainability Pedagogy has five key dimensions: (1) content; (2) perspectives; (3) process; (4) context; and (5) design.	The model can be used by educators to create	Burns (2009).	5. Sustainability is the goal of this model.	2. The model is aimed at ESD, not EE.	

	<p>learners are motivated and inspired to shift their values and make sustainable and authentic changes in their own lives, as well as within their communities and places.</p> <p>The second goal of the model is to use an ecological course design process and create transformative learning experiences.</p>	<p>An ecological course <i>design</i> links the other four dimensions of the Burns Model of Sustainability Pedagogy with the purpose of creating learning that has the potential to transform learners' attitudes and values, ultimately transforming unsustainable systems within unsustainable cultures.</p>	<p>transformative learning processes for sustainable development.</p>				
<p>Sustainable Entrepreneurial Process Flow Model</p>	<p>This model explains the entrepreneurial process flow, and it can increase people's understanding of the sustainable entrepreneurial process.</p> <p>'In order to promote SE, it is necessary to understand the sustainable entrepreneurial process' (Matzembacher et al., 2019).</p>	<p>Matzembacher et al. (2019) identify the Sustainable Entrepreneurial Process Flow Model as having five steps: idea generation, opportunity recognition, opportunity development, venture launch and positive impact. They provide a systematic view of this model.</p> <p>Relevant finding: The inclusion of positive impact measurement on society as part of the sustainable entrepreneurial process model.</p>	<p>This model can be used by students and teachers.</p>	<p>Matzembacher, et al., (2019)</p>	<p>5. Sustainable entrepreneurial process model.</p>	<p>5. Entrepreneurial process model.</p>	<p>Belz & Binder (2017).</p>
<p>The Five Capitals Model</p>	<p>The purpose of this model is for businesses to analyse and assess</p>	<p>"The concept of capital is familiar in a monetary context as financial capital, but the Five Capitals model identifies four additional forms of capital, which</p>	<p>This model was made for businesses to</p>	<p>Strachan (2018).</p>	<p>5. Sustainability is the main purpose of this model.</p>	<p>2. The model is not entrepreneurial in nature but can be</p>	<p>https://www.forumforthefuture.org/the-five-capitals</p>

	sustainability in five different forms of capital. Then, they can consider strategies for how to maximise the value of each capital.	have a perceived value that can increase and decrease. The five different forms of capital are natural, human, social, manufactured and financial. Daly (2007) sees natural capital as a limiting factor and the way this model is presented by Forum for the Future is in line with the concept of sustainable development that recognises that all social and economic activity should take place within the ecological limits of the Planet. This model can be applied to specific entrepreneurial activities to assess how an activity might increase or decrease the various capitals and how it might cause one capital to be transferred into another” (Strachan, 2018, p.8).	assess sustainability, but it can also be incorporated into education programmes.			used for business development.	
The Natural Step	The purpose of this model is to assess sustainability through four different principles.	‘The Natural Step is based around four Sustainability Principles, the first concerns the concentration of substances from the Earth’s crust, the second concerns the concentration of substances produced by society, the third concerns physical degradation and the fourth concerns the provision of people’s basic needs in society. These four principles could be applied to any entrepreneurial activity or enterprise in order to make a judgment about its sustainability’ (Strachan, 2018, p. 7-8).	The Natural Step can be incorporated into education programmes and used by students. It can also be used by businesses to assess sustainability.	Strachan (2018).	5. Sustainability is the main purpose of this model.	2. The model is not entrepreneurial in nature but can be used for business development.	
Design Thinking as a Sustainability Approach	A sustainability approach is merged with design thinking to develop socially responsible and	Design Thinking brings a human-centred approach to designing for sustainability by combining empathy for the people impacted by the service/product being designed with creativity in developing radical solutions and rationality	A model for both business and education.	Garcia & Dacko (2015).	3. Sustainability is the aim, but it is added to an existing approach.	4. The aim is to develop sustainable products.	

	environmentally sustainable products.	to analyse what is feasible in the given context.					
Re-Solve	A reflective and iterative process tool with the goal of scaling education for sustainable development (ESD).	The method consists of a series of workshops that allow stakeholders to reflect on and self-evaluate existing ESD initiatives or projects and then establish visions, strategies and actions to achieve their desired goals based on this self-assessment.	Teachers and other stakeholders of ESD.	Mickelson, et al., (2019).	5. Sustainability is the main purpose of this model.	2. The tool is not made for EE.	
Re-Start	The purpose of this model is to show businesses how they can innovate their business model by finding new ways of creating, delivering and capturing value. It is based on the three forces: sustainability, digitalisation and customer preferences.	The method can be divided into four phases: recognise, rethink, reinvent and reorganise. Each phase contains different questions for the business to answer. It is more of a process than a direct method/tool and is very tangible.	A model for both business and education.	Jørgensen & Pedersen (2017).	4. This model includes sustainability as one of three basis forces.	5. The model is suitable for entrepreneurship.	
Utopia Realising	The purpose of this method is for the students to learn about sustainability and entrepreneurship. The learning outcomes are to learn what sustainability is, to be able to identify new sustainable opportunities and to mobilise resources for their idea.	Methodology that combines entrepreneurship and sustainability tools using a case method process with different activities. The method is used in interdisciplinary teams where students are given a case from a local business.	A teaching approach to be used in education.	Wigger et al., (forthcoming)	5. The method is developed for ESD.	5. The students also learn how to develop an idea using methods from EE.	

Flourishing Business Model Canvas / Flourishing Enterprise Innovation Toolkit	The purpose of this canvas is to create a visual framework through collaboration where it is possible to prototype, sketch, improve, communicate, understand, measure, diagnose and tell stories about any business model.	The Flourishing Business Canvas is a tool that embeds a common language to enable more effective collaboration by any group of stakeholders deemed relevant to designing the economic, social and environmental aspects of an organisation's business model.	Businesses and the canvas can also be used in education.	Developed by the Strongly Sustainable Business Model Group (SSBMG), at the Strategic Innovation Lab at Toronto's OCAD University.	4. Existing model remade for sustainability.	5. Model made for entrepreneurship.	http://flourishing-business.org/the-toolkit-flourishing-business-canvas/
Project Canvas	This tool identifies research and development projects.	The project canvas is a tool with questions that guides the individual to identify if they have a research and development project. It can also be a good way to communicate with other stakeholders involved in the project.	To be used by businesses and consultants in research and development projects.	Developed by the Norwegian Research Council	4. Not developed for sustainability, but it is included in the canvas.	5. Model made for entrepreneurship, business development, innovation and R&D.	https://www.forskningsrådet.no/sok-om-finansiering/hvem-kan-soke-om-finansiering/naringsliv/prosjektkanvas/
Green Business Model Innovation	A tool that encourage businesses to be greener.	For policies to be implemented successfully in the Nordic countries, it will be necessary to uncover whether there are current upcoming strategies of initiatives in each of the countries where the above recommendations would fit and whether the policy recommendations can be implemented in the current frameworks. Existing relevant green innovation funding programmes could include or have a strategic focus on the life cycle and incentive models such as European Skills, Competences and Occupations (ESCO).	This is a tool that is used for established firms.	Henriksen et al. (2012)	4. Sustainability is added to an existing tool.	5. Business model innovation = entrepreneurship.	

<p>ASU-SOS (School Of Sustainability) Model For Learning Sustainability Through Real-world Learning</p>	<p>A ‘functional and progressive’ model of real-world learning opportunities for students to collaborative research between academic researchers and practitioners. The stepwise process combined with additional principles allows for building competencies such as problem solving, linking knowledge to action and collaborative work, while applying concepts and methods from the field of sustainability.</p>	<p>In the ASU-SOS model for real-world learning, they use project- and problem-based learning, service learning and internships as examples of real-world learning opportunities. The model explains how real-world learning for sustainability can be integrated in an undergraduate curriculum from years 1 to 4.</p> <p>Years 1–2: Bringing the real world into the classroom, visiting the real world and simulating the real world.</p> <p>Years 3–4: Engaging with the real world and capstone real-world learning opportunities.</p>	<p>Used by educators to plan and integrate real-world learning into the curriculum.</p>	<p>Brundiers, et al., (2010).</p>	<p>4. Real-world learning is a regular learning method but is used in education for sustainability.</p>	<p>3. Gaining knowledge about entrepreneurship is not the aim of this particular use of real-world learning, but the methods mentioned are still used in EE.</p>	<p>https://www.researchgate.net/publication/235255127_Real-world_learning_opportunities_in_sustainability_From_classroom_into_the_real_world</p>
<p>Entrepreneurial Lean Thinking</p>	<p>Here: Used for sustainable business modelling: a workshop design.</p> <p>Entrepreneurial Lean Thinking (ELT) can guide innovation processes in complex environments. Through constant feedback loops of creating, testing and improving of innovative solutions,</p>	<p>How ELT was integrated into the workshop for sustainable business modelling. In each session/stage, ELT is used by creating, testing and improving the idea.</p> <p>Session 1 – Opportunity identification: Sustainable Business Model Canvas, Value Mapping and Value Uncaptured Perspective.</p> <p>Session 2 – Opportunity: Pestel Analysis.</p> <p>Session 3 – Opportunity</p>	<p>In this study, ELT was used for incumbent companies, but this method could be used in education.</p>	<p>Schwarz, et al., (2021).</p>	<p>3. This tool is not developed for sustainability; however, it can be used for guiding innovation processes as well as sustainability processes in businesses.</p>	<p>4. The tool is entrepreneurial in nature, and it is used for product development (sustainable product development).</p>	<p>https://link.springer.com/article/10.1007/s00550-020-00508-y/tables/2</p>

	uncertainty can be reduced, which leads to more flexible and faster implementation of innovations.	<p>development through sustainable business model design: Sustainable Business Model Canvas and Sustainable Business Model Archetypes.</p> <p>Session 4 – Reflection and decision to exploit the opportunity: Last presentation of the final project.</p>					
Life Cycle Assessment as Entrepreneurial Tool for Business Management and Green Innovations	LCA is a tool used for measuring the environmental impact of a product's life cycle in all stages, from production to disposal or recycling. In a business, it can be used as a managerial tool for decision making. It can also be used to develop sustainable strategies.	<p>The LCA consists of three stages according to ISO 2006 (Piekarski, 2013). It is an iterative process, and goals and strategies can change through the assessment. Interpretation is used in all stages of this process.</p> <p>Stage 1. Goal and scope definition This stage sets the direction for the LCA study.</p> <p>Stage 2. Inventory analysis stage This stage is important for data collection, and environmental impacts of inputs and processes are measured.</p> <p>Stage 3. Impact assessment This stage will use the data from stage 2 for classification, characterisation, normalisation and valuation. In this stage, a conclusion is made.</p>	LCA can be used by businesses or taught in education.	Moro Piekarski, et al., (2013).	5. This is a tool used to measure sustainability.	4. The tool is entrepreneurial in nature, and it is used for product development (sustainable product development).	Website for using this tool: https://lca.no/hva-er-lca/ - It also includes tools such as the Environmental Product Declaration (EPD) generator, transportation calculator and environmental impact accounting.
SDG Impact Assessment Tool	The SDG Impact Assessment Tool is a learning tool that can be used to visualise self-assessment of how different activities, innovations or companies impact the	The SDG Impact Assessment Tool helps assess the impact of solutions, research activities, organisations, projects and other initiatives onto the Sustainable Development Goals (SDGs). It can identify opportunities (positive impacts), risks (negative impacts) and knowledge gaps. At the end, there will be a better understanding of how the	Businesses.	Eriksson et al., (2019)	5. The tool was made to measure SDGs.	4. It is not made specifically for entrepreneurs, but it can still be used for entrepreneurship.	https://sdgimpactassessmenttool.org/en-gb

	SDGs. The tool aims for the user to better understand how complex sustainable development is and what can affect sustainable development.	solution relates to the SDGs and be better equipped to prioritise actions ahead.					
Green Business Modelling Editor (Currently Being Developed)	<p>Software(prototype)/a tool that supports sustainability-oriented reflection in the process of (re-)developing a business model.</p> <p>The tool is software because of the ability to generate and evaluate a wide range of ideas and functions that might be harder to apply with paper-based versions. For example, keeping track of design decisions, attaching elements to other data/web-based documents, searching and filtering checklist items or working from different locations.</p>	<p>Focus on collaboration, replication of the sticky note experience, experimentation and creativity.</p> <p>‘Even though tools for business model development are well-established, they typically focus on economic obligations and pay little attention to ecological and social concerns. To bridge this gap, we shed light on the question of how functions for software can be designed to respect sustainability in business models’ (Schoormann et al., 2021, p. 1).</p> <p>The software will provide the user with guidance on how to reflect on sustainability.</p>	Business model developers and entrepreneurs.	Schoormann, et al., (2021).	3. The goal is to achieve a sustainable business model regarding the economic, ecological and social aspect.	3. Can be used to innovate existing business models or in the process of creating a new one.	
Business Transformation Tool	To assist a business in developing a new business model from a new value	The tool offers a structured method for comprehending and managing complex multidimensional change, as well as sustainable business transformation.	Workshops within companies.		3. Developed for entrepreneurship but used for	3. Developed for entrepreneurship.	https://www.ifm.eng.cam.ac.uk/research/industrial-

	opportunity. The tool aids in the creation of a change strategy, the implementation of business model changes and the development of action plans.				sustainable business transformations.		sustainability/sustainable-business-models/tools/
The Cambridge Value Mapping Tool	The tool's goal is to analyse various types of value in the business and network in a methodical way, as well as to encourage innovation in sustainable value generation.	The tool takes a multistakeholder approach, allowing for analysis of value exchange and the identification of potential stakeholder conflicts to generate positive value in the network. In addition, it gives managers a new way to look at their business and generates new economic, social and environmental value.	Teaching material or within businesses.	Bocken et al. (2013).	5. Developed for sustainability.	3. Developed for sustainability.	https://www.ifm.eng.cam.ac.uk/research/industrial-sustainability/sustainable-business-models/tools/
Sustainable Value Analysis Tool (SVAT)	The tool's goal is to assist manufacturing firms in identifying the possibilities to build sustainable value by analysing captured and uncaptured value across the product life cycle.	'Reducing any kind of the uncaptured value would create sustainable value. However, identifying the uncaptured value and creating value from it is not always easy. The tool supports this process, providing companies with a scheme to systematically look for each form of value uncaptured (i.e. value surplus, value absence, value destroyed and value missed) at the beginning, middle and end of the product life cycle, and with a method to turn the identified value uncaptured into value opportunities' (Yang et al, 2014, p.22).	Manufacturing firms, research, consultancy and education.	Yang et al. (2014).	4. Sustainability is added to an existing tool.	4. Can be used by any business.	https://www.ifm.eng.cam.ac.uk/research/industrial-sustainability/sustainable-business-models/tools/
Gap Analysis	The purpose of this tool is to examine and determine how a company currently handles sustainability and then	It contains three steps: -Identifying the current situation -The ideal situation -Determine what needs to be done to go from the current to ideal.	Used by companies.	Courtneil (2021).	5. Developed for sustainability.	3. Can be used by any company.	https://www.ntaskmanager.com/blog/top-process-improvement-tools/

	make an action plan on how to bridge the gap between the current and ideal situation.	To track current sustainability performance, sustainability standards such as European Eco-Label and Business Social Compliance Initiative are used.					
Root Cause Analysis	The tool helps identify and understand businesses' biggest sustainability pain points.	This tool fits well into step three in Gap Analysis. Completion of several steps leads to a fishbone diagram. Identify the problem, brainstorm possible causes, construct the diagram with the main problem in centre and fill in possible causes; the branches will become more and more specific until reaching the root cause.	Can be used by businesses.	Courtneil (2021).	5. Developed for sustainability.	3. Can be used by any company.	https://www.ntaskman-ager.com/blog/top-process-improvement-tools/
Hoshin Kanri	The purpose is to ensure that a whole organisation works towards the same sustainable goals.	This is a bottom-up approach where everyone is involved in the process.	Can be used by businesses.	Soltero (2007).	5. Developed for sustainability.	2. Not entrepreneurial in nature.	https://www.ntaskman-ager.com/blog/top-process-improvement-tools/
PDCA Cycle	A tool for successfully implementing sustainability improvements.	Plan: Decides on the changes they want to make. Do: There are improvements being made Check: The enhanced process is compared with the old procedure to see if the changes were beneficial. Act: Everyone involved in the process contributes to the advancement of sustainability. This is a continuously cycle and builds on the idea that <i>more can always be done</i> .	Can be used by businesses.		5. Developed for sustainability.	3. Can be used by any company.	https://www.ntaskman-ager.com/blog/top-process-improvement-tools/
Force Field Analysis	The purpose of this method is to get an overview of the different forces –	Presents an overview of the situation and divides components into those that are driving and restraining forces against organisational change. There is	Can be used by businesses.	Thomas (1985).	5. Developed for sustainability.	2. Not entrepreneurial in nature.	https://www.ntaskman-ager.com/blog/top

	driving and hindering forces – that influence a wanted change.	no change when these forces are in equilibrium. Driving forces must be strengthened while restraining forces must be reduced to fulfil change. This process contains three steps: 1. Unfreeze: Determines the changes that are needed and which parts of the organisation that will be affected. 2. Make the change: New practices are implemented. Look for and acknowledge negative feelings in the team related to the changes. 3: Refreeze to new status quo: After measurements and feedback has been acted on —seal the changes. Engage every part of the team helps, despite individuals’ varying commitment to sustainability.					-process-improvement-tools/
SEAM	The Systemic Entrepreneurship Activity Method aims to help entrepreneurs develop their ideas and businesses.	The model consists of seven steps: goals, resources, business idea, business model, goals, tasks and forecast.	Can be used by consultants and entrepreneurs.	Dahle (2020).	3. Sustainability is not the main focus of this method; however, it is included in this method.	5. The method is developed specifically for entrepreneurship.	
Design Kit: The Human-Centred Design Toolkit	Creative approach to problem solving: starts with people and ends with innovative solutions.	Understand problems from peoples’ perspectives to find effective solutions to their problems. Consists of three steps: inspiration, ideation and implementation.	Can be used by business and in education.		4. Social entrepreneurship is important in SE.	5. Developed for social entrepreneurship	https://www.designkit.org
JIT – Just in Time	Just in Time is used to control production processes. It is about producing what the customer wants, when they want it, in the	Making JIT work effectively requires careful planning and lots of preparation. Steps in the JIT framework process include the following: Draw up a plan and appoint a sponsor, communicate JIT plans to the	Businesses.	Golhar & Stamm (1991).	3. This tool is developed for business process management, and sustainability is part of this process, not the main goal.	2. This tool is developed for business process management, not entrepreneurship.	https://www.ntaskmanager.com/blog/top-process-improvement-tools/

	quantities requested, where they want it and without delays. It keeps stock levels to a minimum on order to reduce waste and natural resource use.	workforce, gather data and validate inventory levels, establish a production plan, communicate with the supply chain and document the processes and train staff.					
Lean Six Sigma (DMAIC)	Structured approach to scrutinise operations, looking at data and processes to uncover and remove waste and establish greener business solutions.	<p>The Lean Six Sigma process improvement tool can be implemented through the five-step model, DMAIC:</p> <p>Define what business operations need to be improved. G. What operations produce the most waste? Where can you save energy?</p> <p>Measure current process performance. Just like during Gap Analysis.</p> <p>Analyse data to determine how the business operation needs to be improved.</p> <p>Improve the process continuously. You can implement the PDCA cycle to make continuous improvements.</p> <p>Control your processes for ongoing sustainability and optimised performance. Create a system or process to monitor results.</p>	Businesses and the process can be used in education.	Bendell (2006).	5. This business process management tool is developed to remove waste from production processes.	2. This tool is developed for business process management, not entrepreneurship.	Lean Six Sigma in 8 Minutes: https://www.ntaskmanager.com/blog/top-process-improvement-tools/ https://www.youtube.com/watch?v=s2HCrhNVfak&t=380s

Appendix 2: Summaries of interviews

Can-di-date	Industry	Summary from the interview
1	Consulting for business development and innovation	They consult businesses with research and development. Sustainability is always considered in every project, and they focus on social, environmental and economic aspects of sustainability, also referred to as the triple bottom line. They also have an innovation cluster consisting of businesses in the industry. The methods and tools they use in consulting are the Flourishing Business Model Canvas and the Research Council's Project Canvas, and they have their own process for their incubator. An interesting finding is how the methods are used. The consultants do not show the businesses that they use the Flourishing Business Model Canvas; they know it by heart. It is then possible for the consultants to create a more realistic approach to figure out the state of the business and their needs.
2	Centre for sustainable development	This is a newly started centre for sustainable development in Bodø. They are based on the UN's sustainability goals. Their method is to measure KPIs for SDGs. The Norwegian state aims for every municipality to follow the SDGs, and they use the same KPI measurement system provided by the UN. This method is used to map where the municipality is according to the SDG. It is then possible to analyse where improvements need to be made.
3	Construction (start-up)	This is a former student from NTNU School of Entrepreneurship and is one of the cofounders of the start-up. The start-up works to certify buildings of their footsteps (environmental certification). It is a software solution that has a goal to be as sustainable as possible. This was a long-term goal they are working towards. The interviewee also gave us some more contacts that we could look further into.
4	Facilitator for innovation, knowledge and business development	They primarily work with established companies and those that have ambitions for growth and development but also accept entrepreneurs, even though they do not belong to the primary group. They do not use any specific tools or methods but link each project to the UN's sustainability goals. This is also a requirement for the vast majority of funding applications.
5	Consulting for entrepreneurs	This is an international consulting firm for entrepreneurs. They use a well-developed method for helping their customers called SEAM, and it can be adapted to every customers' needs. They focus on sustainability, and it is an important part of their work with entrepreneurs; however, it is not the main purpose of the SEAM methodology. The company also focuses on sustainability in their day-to-day operation.
6	Consulting	This consultant has a doctor's degree in SE and works with sustainable business models in one of Norway's biggest consultant companies. Because of the information given, the person and company want to remain anonymous. Sustainability is becoming a constant and exciting topic both internally and externally. They receive a good deal of requests from their customers about sustainability and development assistance. This makes the company more eager to learn and use new methods and tools that satisfy their needs. Two methods the company uses are 'materiality assistance' for the external needs and surveys internally. The consultant also says that they need to remember that they must relate to frameworks such as Environmental, Social and Governance (ESG), for example, which is used for financial relations. Finally, they also use methods such as business model canvas or value proposition but more adapted based on what the customer wants.

7	Academia	<p>There is a perception that it is in recent years that the relationship between entrepreneurship and sustainability has become a focus area and gained its position. This area has used or is familiar with several methods and tools, including Design thinking for Sustainability (Garcia & Dacko, 2015), the Triple-layered Business Model Canvas (Joyce & Paquin, 2016), Re-Solve (Mickelsson, 2020) and Re-Start (Jørgensen & Pedersen, 2017). Sustainability can quickly become a word one does not fully understand, making it difficult for individuals to connect it to its own field of work. Something more tangible is definitely needed. Many sustainable methods and tools are based on pre-existing ones. Is it really sufficient to simply add sustainability to these? Or should something entirely new be created? At the very least, more options are needed because many of the existing methods and tools require extensive work. It must be simplified so that people other than experts can connect sustainability to established businesses and entrepreneurship.</p>
---	----------	---