Ida Matilde Fauske, Elli Verhulst, Karin A. Wigger, Sølvi Solvoll, Siri Jakobsen*

Teaching Entrepreneurship for Sustainability – a Review of Educational Tools**

Abstract

Entrepreneurial competences geared towards sustainable actions are necessary for the transition towards sustainability. Higher education institutions are dedicated to training students to acquire these competences, which entails equipping teachers with educational tools that facilitate students' learning to act for a sustainable future. This paper discusses educational tools for sustainable entrepreneurship, focusing on the competences they intend to train. We map a sample of 51 educational tools used to teach sustainable entrepreneurship in higher education. We then discuss the intended sustainable entrepreneurship competences that each tool seeks to impart and the underlying pedagogical traditions upon which these tools are built. Our mapping reveals that the educational tools in our sample are predominantly adapted from business administration and lack a specific focus on teaching entrepreneurship for sustainability. Additionally, alternative post-growth economic paradigms are notably absent in our sample of tools. Our exploration of each tool in terms of its intended competences and the underlying tradition contributes to the ongoing discourse on sustainable entrepreneurship education as a field that combines entrepreneurship education and education for sustainable development.

Keywords: entrepreneurship education, sustainable entrepreneurship, sustainability, educational tools, higher education
(JEL: A23, I23, I29, O30)

Introduction

Entrepreneurship is viewed as part of the solution to sustainability issues, underscoring the teaching of sustainable entrepreneurship (SE) as an essential contribution to sustainability (Dean & McMullen, 2007; Patzelt & Shepherd, 2011). Entrepreneurs and entrepreneurial firms are crucial in the transition towards sus-

* Ida Matilde Fauske1*, Elli Verhulst 2,4, Karin A. Wigger 1,3,4, Sølvi Solvoll 1,4, Siri Jakobsen1
1 Nord University, Business School, Universitetsalleen 11, 8049 Bodø, Norway
2 Norwegian University of Science and Technology, Department of Industrial Economics and Technology Management, Academic section of Experts in Teamwork, Trondheim, Norway
3 Linköping University, Department of Management and Engineering (IEI)
4 SFU Engage Centre for Engaged Education through Entrepreneurship, Norway
*corresponding author.

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tainability, as they can identify new sustainable opportunities (Lans et al., 2014) that, when exploited, contribute to the movement towards sustainability.

Sustainable entrepreneurship education (SEE) integrates two fields of education: education for sustainable development (ESD) and entrepreneurship education (EE). With the pressing need to move towards sustainability, there is an ongoing debate on combining both EE and ESD to teach students competencies crucial for acting entrepreneurially for sustainability (Hermann & Bossle, 2020; Lourenço et al., 2013). Examples of SE competencies are normative, system, and foresight thinking competencies (Lans et al., 2014; Ploum et al., 2018), which enable students to sense and act upon sustainable opportunities. These competencies are increasingly incorporated into SEE and are often key learning outcomes of courses or programmes (Lourenço et al., 2013; Ploum et al., 2018).

Educators rely on educational tools to teach students new competencies—instruments with a particular task or goal that facilitate learning and provide new competencies. However, educational tools need to be translated from the desired learning outcomes at the course and programme levels and aligned with the required competencies for SE. Such pedagogical interventions facilitate students' development of SE competencies by combining the 'what' to teach with the 'how' to teach (Mindt & Rieckmann, 2017). This is related to the diverse approaches to how sustainability can be incorporated into EE, ranging from the view that there is no need for changes (traditional EE will do the trick) to the assumption that sustainability must be integrated into EE or that EE should be transformed over time to teach students competences for SE (Hägg & Kurczewska, 2022; Kolmos et al., 2016; Sharma et al., 2021). These different approaches have engendered debates on whether original tools for EE can be used to teach SEE without changes, whether sustainability elements are sufficient as add-ons to existing tools, or if SEE requires novel tools, for example when teaching entrepreneurship for sustainability from a degrowth perspective (Hägg & Kurczewska, 2022).

Although competencies for SE are a desired learning outcome, how these competencies can be acquired through different tools is not yet fully understood. Hence, there is a need to understand how competencies are taught in practice (i.e. which tools educators use when teaching SE and which competencies are targeted with the tools) (Lourenço et al., 2013; Sharma et al., 2021). This study aims to contribute to our understanding of the kinds of tools used to teach SE in higher education, the intended SE competencies to which they contribute, and the traditions upon which these tools are built.

Such an overview can provide educators with a collection of tools that can be utilised for teaching SE. Moreover, a more nuanced understanding of the available tools can increase the effectiveness of educational practices in the field. Increased awareness can facilitate a more informed selection of tools, empowering educators to make more informed choices that enhance students' learning experiences. Thus,

we map educational tools collected through four different research projects on SEE. We then assign them to the competencies they aim to contribute, inspired by Ploum et al. (2018) competence framework. Finally, we discuss the origins of the tools. This allows us to contribute to the ongoing debate on how to teach entrepreneurship for sustainability.

This study makes three primary contributions. First, by mapping tools for SEE, we provide novel insights into the debate on the tools used to teach SE and their origins. Second, by designating the target sustainable entrepreneurship competencies that can be acquired through the pedagogical interventions of each of the mapped tools, we offer a novel matrix of the intended outcomes of each tool regarding competencies enabling entrepreneurial action for sustainability. Third, our combinations of tools and intended competencies provide educators with a valuable outline of relevant tools that can facilitate reaching the defined learning outcomes of courses and study programmes that bring together entrepreneurship and sustainability.

Competences for Sustainable Entrepreneurship

Entrepreneurship is important for sustainable development, as it contributes to solving social and environmental challenges by recognising opportunities and developing financially viable and innovative business models (Gregori & Holzmann, 2020). Entrepreneurs are often driven by an urge to solve problems and create change, and the link between sustainability and entrepreneurship is often discussed about change agency, with sustainable entrepreneurs as 'change agents', defined as '*action-oriented people with strong sustainability beliefs and a wide repertoire of competencies, which they apply effectively to create sustainability transformations on individual, organisational, and systems levels*' (Buhr et al., 2023). Universities are challenged to produce candidates with the necessary competencies and the will to act as societal change agents (Heiskanen et al., 2016). In this setting, SEE plays a significant role in embedding sustainability and entrepreneurship competencies that support students in developing the knowledge, skills, and mindset needed to create sustainable value for sustainable development (Obrecht, 2016). However, the literature on the nature of SE competencies and how they can be taught is still limited.

SEE draws on two fields—ESD and EE—which represent two distinct discussions of the types of competencies students should require from an entrepreneurship or sustainability course. Indeed, the competencies that students should develop are described separately in each field. Examples include (1) the European Commission's EntreComp framework (Bacigalupo et al., 2016), which presents entrepreneurial competence as one of eight key competencies for lifelong learning and divides the competencies into three main areas: 'ideas & opportunity', 'resources', and 'into action'; and (2) Brundiers et al. (2021) consensus framework of seven key compe-

tences for sustainability in higher education (implementation competence, strategic thinking competence, values thinking competence, futures thinking competence, systems thinking competence, interpersonal competence, and integrated problem-solving competence). A limited number of studies have combined competencies for EE and ESD, indicating a partial overlap of competencies (Hermann & Bossle, 2020; Lans et al., 2014). A recent literature review conducted by (Diepolder et al., 2021) identified three SEE frameworks that focus on higher education. Based on this, Ploum et al. (2018) presented a validated competence framework, which, to date, is the only framework that specifically addresses the competencies required for SE and how they can be measured. Second, al.'s (2019) work contributes to a more profound and detailed understanding of SE's key competencies, which are underpinned by values and worldviews. The third framework, by Foucrier and Wiek (2019), combines SE competencies with the entrepreneurial process, connecting knowledge, skills, and attitudes to different SE tasks.

This article builds on the *competence framework for sustainable entrepreneurship* presented by Ploum et al. (2018), as this is the only empirically validated framework identified in the literature (Diepolder et al., 2021). Ploum et al. (2018) presented seven of the SE competencies suggested by Lans et al. (2014) (see Table 1) and found a strong correlation between strategic management and action competencies. As a result, they merged these two competencies, arguing that since entrepreneurship is about turning ideas into actions, in entrepreneurial contexts, action and strategic management competencies have a strong relationship. However, in this article, we choose to keep the two as separate and distinct competencies in the framework, as our goal is to nuance and add more detail to how the different competencies can be taught, thereby effectively applying the framework to plan or adjust educational programmes in higher education institutions. In this context, action competence stresses the importance of *acting* to make change, while strategic management focuses more on *planning* for change.

Table 1. Competences for Sustainable Entrepreneurship (Lans et al., 2014; Ploum et al., 2018)

Competence	Description
Systems-thinking competence	The ability to identify and analyse all relevant (sub)systems across different domains (people, planet, profit) and disciplines, including their boundaries.
Embracing diversity and interdisciplinary competence	The ability to structure relationships, spot issues, and recognise the legitimacy of other viewpoints in business decision-making processes, whether environmental, social, and/or economic issues.
Foresighted thinking competence	The ability to collectively analyse, evaluate, and craft 'pictures' of the future in which the impact of local and/or short-term decisions on environmental, social, and economic issues is viewed on a global/cosmopolitan scale and in the long term. This competence is also called 'anticipatory thinking'.
Action competence	The ability to actively involve oneself in responsible actions for the improvement of the sustainability of social–ecological systems.

Competence	Description
Normative competence	The ability to map, apply, and reconcile sustainability values, principles, and targets with internal and external stakeholders, without embracing any given norm but based on the good character of the one who is involved in sustainability issues.
Strategic management competence	The ability to collectively design and plan projects, implement interventions, transitions, and strategies for sustainable development practices.
Interpersonal competence	The ability to motivate, enable, and facilitate collaborative and participatory sustainability activities and research.

Educational Tools for Sustainable Entrepreneurship

The literature on SEE is moving towards a consensus on the most important competencies for SE (Diepolder et al., 2021), indicating what competencies students need to acquire (Table 1). However, there is a significant gap in our knowledge about the linkages between SEE in practice and the competencies for SE (Ploum et al., 2018), thereby lacking insights into how students should learn these competencies. Connections between teaching-learning approaches, on the one hand, and competence-based learning outcomes, on the other hand, are rarely made explicit (Mindt & Rieckmann, 2017). Learning approaches and educational tools are important to support the translation from learning objectives to what SE content to teach and how to teach it to support students in developing competencies for SE. In their work, Lozano et al. (2023) made the connection between pedagogical approaches and tools regarding ESD competencies, with the aim of gleaning insights into the relationship between the tools and their intended learning outcomes. In SEE, such a connection between educational tools for SE and competencies is not yet fully understood.

Educational tools turn learning approaches into concrete teaching instruments that have particular tasks and goals, facilitating learning within a specific context and within a limited timeframe. Mindt and Rieckmann (2017) emphasised the need for insights on how methods and tools specifically contribute to developing a particular competence – thereby keeping in mind the fact that pedagogical interventions are only a part of the larger picture, whereas students develop comprehensive SE competencies over the course of an entire study programme.

Both the ESD and EE educational fields have access to a wide range of tools that have also been applied in the SEE context. Meanwhile, there are examples available of educators adapting existing tools and developing novel ones in their search for tools that serve the purposes of SEE. Examples of such efforts include new tools, such as the triple-layered business model canvas (Joyce & Paquin, 2016) and design thinking for sustainability (Garcia & Dacko, 2015). This illustrates the need for an overview that guides educators regarding when and how to use distinct educational tools in class.

Researchers also emphasise being conscious of combining EE and ESD, particularly given the contradictory underlying dominant logics, such as the discussion on growth and value creation in entrepreneurship (Kyrö, 2001; Shevchenko et al., 2016) versus resource minimisation and even de-growth in sustainability (Martínez-Alier et al., 2010). There is a need to acknowledge the differences in key and underlying assumptions when combining the two fields to ensure that the combinations are compatible and complementary rather than conflicting and contradictory.

Hence, to address these knowledge gaps, there is a need for an increased level of consciousness regarding the origins of educational tools as well as a need for a better understanding of the outcomes of the educational tools applied in practice today. In the following sections, we discuss how this paper aims to contribute to building this knowledge base by focusing on various educational tools, their origins, and linkages to competencies for SE.

Methods

The educational tools gathered in this article are based on the results of four different research projects in which SFU Engage – Centre for Engaged Education through Entrepreneurship (Nord University, Norway and Norwegian University of Science and Technology [NTNU]) has been involved as one of the project partners. SFU Engage is a centre for excellence in education that aims to increase the number of students in higher education who possess entrepreneurial skills and the mindset to become change agents for the better (SFU Engage, 2023). The four research projects are Toolkit for Teaching Sustainable Entrepreneurship (hereafter 'TES') (Schadenberg et al., 2021), Sustainable Entrepreneurship in the Nordic and Baltic Region (hereafter 'NordSEnt') (Christiansen et al., 2022), Teaching Sustainable Entrepreneurship: Learning Approaches, Pedagogical Approaches and Teaching Tools (hereafter 'EngageSust') (Fauske et al., 2022), and Enhance's Tools and Methods for Sustainable Entrepreneurship and Innovation (hereafter 'Enhance') (ENHANCE, 2023). See Table 2 for further information on the different outcomes this article uses as the starting point for mapping different educational tools.

Table 2. Background Information on the Four Research Projects

Project	Financing	Partner Institution	Tools and methods described	Tools that fit our criteria
Toolkit for Teaching Sustainable Entrepreneurship (TES)	Erasmus+	Uppsala University, University of Groningen, and Nord University	20 tools	20 tools
Sustainable Entrepreneurship in the Nordic and Baltic Region (NordSEnt)	Nordplus	Royal Academy of Engineering Sciences, Estonian Business School, NTNU, Aarhus University, Danish Foundation for Entrepreneurship, Copenhagen Business School	17 best practices and 9 tools from the Nordic and Baltic countries	8 tools

Project	Financing	Partner Institution	Tools and methods described	Tools that fit our criteria
Teaching Sustainable Entrepreneurship: Learning Approaches, Pedagogical Approaches and Teaching Tools (EngageSust)	Engage	Nord University and NTNU	13 learning approaches, 15 pedagogical methods, and 24 educational tools	14 tools
Enhance Tools and Methods for Sustainable Entrepreneurship and Innovation (Enhance)	EU, Horizon 2020	Chalmers Tekniska Högskola AB, Eidgenössische Technische Hochschule Zürich, Politechnika Gdańska, NTNU, Politecnico di Milano, RWTH Aachen, TU Berlin, TU Delft, Universitat Politècnica de València, Politechnika Warszawska	22 educational tools (Retrieved March 10, 2023)	22 tools

Inclusion and Exclusion of Educational Tools

For the selection of SEE educational tools, we used four inclusion and four exclusion criteria (Table 3). As shown in Table 3, the proportion of tools that fit our inclusion and exclusion criteria in each project varied. We have included the number of tools that fit our selection criteria for each project, along with overlapping tools from the other projects. Appendix A gives a description of each tool and the project from which it was gathered.

Table 3. Inclusion and Exclusion Criteria for Educational Tools

Inclusion and exclusion criteria for educational tools	
Inclusion	**Exclusion**
1. Tools and methods found in the TES project, EngageSust, NordSEnt, or Enhance	1. Lack of available information in English
2. Tools and methods suggested for sustainable entrepreneurship	2. Exclude tools and methods that charge a user fee.
3. Applicable in education	3. Not suitable for use in classroom education (e.g. due to complexity)
4. Execution time in class from 1 hour to 2–3 days	4. Exclude tools and methods that are so extensive you need to design an entire course around them (more than 3 days).

In the TES and Enhance projects, all the tools described fit our inclusion criteria, whereas in the EngageSust project, only 14 out of 24 tools fit our criteria. The reason could be that the TES and Enhance projects have clear descriptions of each tool and how to use it; thus, the tools collected in each of those projects are also user-friendly in education. In the EngageSust report, however, the focus is not on describing each tool and how to use it but rather on gaining an understanding of which SEE tools exist and how they can be paired with learning approaches and pedagogical methods in education. The NordSEnt project is a report on best-practice examples for SEE education, with a limited number of tools described (8). There are several overlaps, as 12 of the tools appear in different projects, leaving us with 51 educational tools in the final sample. Subsequently, these tools were coded

on two different aspects: (a) coding based on competencies for SE and (b) coding based on origin.

Coding Based on Competences for SE

Each tool was classified according to the competencies in the framework presented by Lans et al. (2014), and we coded the tools according to the degree to which they could provide users with each of the seven competencies shown in Table 1. We divided the competence ratings into three categories—0 ('To no degree'), 1 ('To some degree'), and 2 ('To a high degree')—for each of the seven competences.

Our approach to coding is inspired by the work of Lozano et al. (2023, p. 4), who showed the degree to which pedagogical approaches such as case studies and lecturing address competencies for sustainability. In their article, they colour-coded the pedagogical approaches into three different categories based on the degree to which the pedagogical approach could address the competence: 'A high likelihood of addressing the competence', 'May address the competence', and 'Does not address the competence'. The colour codes used in their work to show the relationship between the pedagogical approaches and competencies inspired us to present our findings similarly (Lozano et al., 2023, p. 4).

Since no effective and accurate method for measuring competencies for SE exists (Ceulemans et al., 2011), this difficulty is reflected in knowing the extent to which each tool can actually address each competence. However, this article can provide a starting point for more research on tools and competencies for SE and the degree to which tools for SE can address and provide competencies for SE. Therefore, we based the coding of competencies on the information and execution of tools and their degree of relevance to each competence.

The coding process was done in Excel, and the tools were coded sequentially. In the coding process, we started by first reading about the competence we were going to rate (e.g. the systems-thinking competence) to identify which activities or steps a tool needs to include to provide a user with this competence. We then read about the tool in the available reports (e.g. the sustainability SWOT) to assess the degree to which the activity in the tool relates to the characteristics of the selected competence. We followed this process for all competencies and tools. The sustainability SWOT yielded, for example, a rating of 1 ('To some degree') on systems-thinking competence because it relates to systems thinking in some activities. The sustainability SWOT is used to analyse environmental challenges and trends in society related to a selected company. The sustainability SWOT also analyses how a company can create innovative solutions to environmental problems. The tool, however, does not explicitly mention systems thinking. Based on the activities, this tool can be considered to support the development of systems-thinking competence to some degree, since systems thinking is the ability to analyse different systems

across different domains (e.g. people, planet, and profit) (Ploum et al., 2018) and to understand how these systems are connected and influence each other.

An example of a tool that scored a 3 ('To a high degree') for systems-thinking competence is the Flourishing Business Model Canvas. This tool provides users with an understanding of a company's business model and how it impacts the three different layers of the environment, society, and economy. The steps in this canvas include describing business resources and activities, value co-creators and co-destructions, and stakeholders. This tool does not mention systems thinking either, but the activities strongly support the development of this competence with the inclusion of a triple-bottom-line perspective and an understanding of how a company can have a positive or negative impact on these three layers.

Coding Based on Origin

We also coded each educational tool based on origin using the same process presented above to assure inter-coder reliability. Considering the origin provides us with insights into how many of the tools were developed in the fields of business administration, sustainability, or through a combination of both. With business administration, we refer to educational fields such as entrepreneurship, innovation, business development, strategy, organisation, leadership, and project management. The reasoning behind this is that entrepreneurship education has traditionally borrowed several concepts from related fields within business administration (Neck & Greene, 2011). We also wanted to ascertain whether some were adapted from business administration for sustainability, or vice versa. Thus, we coded the tools based on their origin in six categories describing the originating fields of the tools: (1) business administration, (2) business administration but adapted for the sustainability context, (3) sustainability, (4) sustainability but adapted for business administration, (5) a combination of business administration and sustainability, and (6) a category for tools from other fields.

An example of a tool that has its origin in the business administration field is the pitch competition, which is an event in which students can present a business plan to a panel and 'pitch' their ideas. This tool is not adapted for sustainability in any way, and it is therefore in the category 'comes from business administration'. A tool that has its origin in the sustainability field is the SDG Impact Assessment Tool. This tool was created to assess how a business impacts each of the SDGs and whether the impact is positive or negative. No other fields, such as business administration, have been used to develop this tool, and its entire focus is on assessing the sustainability impact. Therefore, we coded it in the category 'comes from sustainability'.

An example of a tool that has been adapted is the sustainability SWOT analysis. It has its origin in business administration, as it is based on the original SWOT analysis. However, it has been adapted for a sustainability context; therefore, it

is in the category 'comes from business administration but has been adapted for the sustainability context'. Another tool is the Digital Product Ethics Canvas. This canvas is based on the ethics canvas, which originated in the sustainability field but has been adapted to suit a business administration context with customers who have digital products in mind. This explains why we rate this tool as adapted from sustainability for business administration.

An example of a tool that integrates both fields is the Flourishing Business Model Canvas (FBMC). FBMC integrates both fields, as it draws on theory from sustainability, such as the triple bottom line perspective, integrated with the building blocks from the original business model canvas, which originates in the business administration field. However, not all the building blocks in the FBMC are the same as in the original business model canvas by Osterwalder and Pigneur (2010); some focus on how to collaborate with stakeholders to create sustainable and social value, and the user must analyse each of the building blocks in a triple bottom line context. In comparison, we coded the Triple Layered Business Model Canvas as 'adapted from business administration for sustainability' because it does not provide entirely new building blocks as the FBMC does. Indeed, it has three layers and a triple-bottom-line perspective, but it does not integrate both fields in the same way as the FBMC.

Intercoder Reliability

To ensure intercoder reliability, every tool was coded by at least two independent coders. This is an appropriate procedure when multiple researchers code together to clarify and recode data until consensus is achieved (Olson et al., 2016). After we coded half of the tools independently, we had a meeting to discuss the coding for each tool to reach a consensus before we coded the rest, following the same procedure. We did this to align the perspectives and mindsets of the different researchers involved in rating the tools regarding the competencies they could support.

The coding process was successful, even though it was difficult to determine the degree to which some of the tools addressed each of the competencies or their origins. Some tools had more detailed descriptions of how they are used, and we also had more experience with some of the tools than others (e.g. design thinking and business model canvas tools). These tools were easier to code than tools that had a limited amount of information, or where we had limited experience with. For most of the tools, both coders agreed on the rating of competencies and origins. However, differences in coding occurred when we had different understandings of the tools or when we were unsure of how much certain aspects of the competencies should count in deciding how much they supported each competence or the origin of the tools. For example, for action competence, we were unsure if using a tool had to result in realising an idea or if it was acceptable to test it with prototyping for it to be scored as a "high degree" of action competence. Ultimately, having meetings

for such discussions helped us decide that prototyping was sufficient as a tool to address action competence in education, given that students have a limited amount of time in their courses.

Study Limitations

The first limitation of this study is related to the selection of reports. By selecting four research projects that entail educational tools, other collections of tools for SEE that would have been a good fit for this study have been left out, such as the toolbox provided by the Scale-up 4 Sustainability project (*Scale-up 4 Sustainability*, n.d.). However, this work presents a solid and robust sample of teaching tools for SEE, and our goal is not to provide a complete and comprehensive list of all available teaching tools. Another limitation of this study is related to the fact that it is based on available educational tools; we have limited insight into which of the tools are being used in practice and how effectively these tools contribute to the development of sustainable entrepreneurship competencies. A last limitation is related to the analysis being based on the description of the different tools and how they claim to support the development of certain competencies, which does not offer proof that the competencies are indeed being developed by students when the tools are applied in education.

Results

This study has three main results. First, we present an outline of the 51 educational tools selected for SEE. Second, we present and discuss our mapping of these tools linked to the intended contribution to the development of different competencies for SE. Third, we look back at the origin of each of these tools and discuss how business administration, sustainability, a combination of both fields and other disciplines have contributed to providing educational tools for SEE.

Fifty-One Educational Tools for SEE

A short description of each tool and the project from which it originated is available in Table 4. Some of the tools are found in more than one project, and all projects in which each tool is found are therefore shown in the overview. Most cases of overlap are among the tools in the Enhance and EngageSust projects, which are also the projects with the largest number of tools.

Table 4. Overview and Short Description of the Educational Tools for SEE

Tool	Description	Project
ABCD Method (Naturalstep.ca, 2011)	Tool for co-creation of strategic progress towards sustainability at an organisational level. The method is designed in a way that the group can backcast through sustainability principles or future scenarios and includes envisioning, analysing, creating, and designing actions, community building, and co-creation.	TES
Abundance Cycle Canvas (Friedlander & Motzkin, n.a.)	This is a strategic tool for sustainability that helps businesses build on their strengths and change their perspective for creating sustainable value. It identifies what measures need to be taken for sustainability, using a triple-bottom-line perspective.	NordSEnt
Agile Pattern Cards (dandypeople.com, 2018)	Coaching tool created to facilitate structured and valuable conversations to enable agile change.	TES
Backcasting (Holmberg & Robèrt, 2000)	Planning method for sustainability through creating a vision of success in the future. The user then visualises backwards into the current situation to look for ideas and strategies to achieve that future vision.	TES, NordSEnt
Circular Business Model Planning Tool (Nussholz, 2018)	Tool developed to help design a business model that maintains and capitalises on the embedded value in products for as long as possible. It integrates business model thinking with circular principles to support business model planning across a product's life cycle.	Enhance
Circular Canvas (Circulab.com, n.a.)	Tool that can be used in analysing an existing business model or activity, define the main challenges to take on and design the best solutions to generate positive impacts.	Enhance
Circular Collaboration Canvas (Brown et al., 2021)	This canvas acts as a physical artefact that helps users collect, share, explore and order ideas. It supports the idea that groups in co-design processes go through divergence and convergence, sharing mental models to ascertain knowledge that is present and to create a common understanding of both the problem and solution space.	Enhance
Design Thinking (for sustainable practices) (Brown, 2008)	Design thinking is a non-linear, iterative process that teams use to understand users, challenge assumptions, redefine problems, and create innovative solutions to prototype and test. Involves five phases: Empathise, Define, Ideate, Prototype, and Test.	TES, EngageSust, Enhance, NordSEnt
Eco-design Strategy Wheel (Belletire et al., 2012)	This tool clusters strategies according to the stages of the life cycle of the product. The wheel serves as a brainstorming tool to explore areas of product development or improvement that have not yet been considered.	Enhance
Ethical Explorer Guide (Ethicalexplorer.org, 2020)	This tool was developed for product leaders in technology. It can be used as a guide when developing new digital products to prevent possible downsides and to empower digital product users.	Enhance
Field Visit for Sustainability (n/a)	A trip made by students to observe and visit sustainability practices and phenomena at a place of interest, for example, an organisation or an ecosystem.	NordSEnt
Flourishing Business Model Canvas (Flourishingbusiness.org)	This canvas includes a visual framework to prototype, communicate, and measure economic, social, and environmental aspects of a business model.	TES, Enhance
Force Field Analysis (Mindtools.com)	The tool presents an overview of a situation and divides components into those that are driving forces and restraining forces against organisational change.	TES
Foresight Tool (van Rijn & van der Burgt, 2016)	A tool to determine the change that have occurred or may occur in the future by considering the development of a random issue.	TES

Tool	Description	Project
Future Scenarios (Mason, 2023)	The future scenarios tool is about creating stories and pictures about how the future might unfold for a given phenomenon, location, or organisation. The aim is to create plausible descriptions of futures that build the foundation for future strategies.	TES
Future Wheel (Bengston, 2016**)**	Future wheels build on the foresight method. The tool builds a model of the future based on the consequences of an event or trend.	TES
Gap Analysis (Baker, 2021)	The tool examines and determines how a company currently handles sustainability and leads to an action plan on how to bridge the gap between the current and the ideal situation.	EngageSust
Hackathon (Pe-Than et al., 2018)	Hackathons are designed as an event that brings together people to solve a problem or a challenge in a short period of time.	TES
Hackathon for sustainability (Christiansen et al., 2022)	A hackathon that is specially designed to solve a sustainability problem or challenge.	NordSEnt
Hoshin Kanri (Jacobson, 2022)	This is a strategic planning tool that guides employees to work towards the same goals and keeping all levels of an organisation involved in the same goals.	EngageSust
Impact Gap Canvas (Systemledleadership.com)	This tool helps to bridge the gap between challenges and solutions by analysing the landscape of a problem and identifying possible solutions.	Enhance
Individual Development Plan (*Individual development plan*, 2022)	This is a document used to assess individual skills and values and to identify goals and strategies for meeting them. It can be used to define career goals and helps identify the necessary skills and knowledge for a student's career path.	TES
Life Cycle Assessments (LCAs) (Matthews et al., 2014)	A tool for assessing environmental impacts associated with all the stages of the life cycle of a commercial product, process, or service. LCAs study environmental aspects and potential impacts throughout a product's life cycle.	TES, EngageSust, NordSEnt
Market Opportunity Navigator (2020) (*Market Opportunity Navigator*, 2023)	This tool helps answer questions regarding the opportunity space and possible market opportunities for a business venture. It offers an app, canvases, online courses, and videos for navigating a market.	Enhance
Megatrends (Sitra, 2018)	The tool uses trend cards to expand the user's perspective on possible ideas and visions about the future.	TES
NABC (Carlson & Wilmot, 2006)	NABC can be used to guide the development of innovative ideas; it stands for need, approach, benefit, and competition. It focuses on the user's needs, competitive advantages, and value creation.	NordSEnt
Pitch Competition (e.g. *Pitch competition*, 2021)	This is a competition in which students pitch their business ideas to a panel, and they need to have a business plan. The pitch should include a description of the company's value proposition, strategies, and financial predictions.	TES
Project Resilience Review (*Project Resilience Review*)	This tool can be used to view projects from different sustainability perspectives by analysing the possible forces that can impact a project and the challenges and opportunities that can arise.	Enhance
Reverse Brainstorming (Mindtools.com, 2023)	In reverse brainstorming, the idea is to imagine the worst case of a problem and the reasons behind this situation. These ideas are then examined, aiming to detect new aspects that were not visible in the past.	TES
Root Cause Analysis (Mindtools.com)	This tool is used to identify the different causes of a sustainability problem in a company and, eventually, to uncover the root cause of the problem.	EngageSust

Tool	Description	Project
Scenario Planning (n/a)	A strategic planning method to make flexible, long-term plans to pay more attention to future changes in the natural environment. This method enables the inclusion of difficult-to-formalise aspects, such as shifts in societal values, regulations, or inventions.	Enhance
SDG Impact Assessment Tool (sdgimpactassessmenttool.org, 2022)	This is a learning tool that helps assess the impact of solutions, research activities, organisations, projects, and other initiatives on the UN Sustainable Development Goals (SDGs). It can identify opportunities (positive impacts), risks (negative impacts), and knowledge gaps, as well as prioritise future actions.	TES, EngageSust
Social Impact Intention Mapper (Boardofinnovation.com)	The tool helps to determine what the impact of given aggregate of activities might be and how one would go about approaching it. The mapper requires familiarity with UN SDGs.	Enhance
Sustainability as a Persona (Designbetterbusiness.com)	This tool uses sustainability as a persona to see sustainability from multiple aspects, for example, positive and negative sides or which sustainable opportunities exist. The tool is most suitable for defining sustainable customers.	TES
Sustainability SWOT (Metzger et al., 2012)	The tool's purpose 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.	EngageSust, Enhance
Sustainability Value Proposition Builder (Vladimirova, 2019)	This is a practical approach for helping to build value propositions that result in more sustainable businesses. The tool was developed to support the development and communication of value propositions to multiple stakeholders participating in the process of sustainable business model innovation.	Enhance
Sustainable Value Analysis Tool (SVAT) (Yang et al., 2017)	This tool helps manufacturing firms create sustainable value by analysing captured and uncaptured value in product lifecycles.	EngageSust, Enhance
The Cambridge Value Mapping Tool (Bocken et al., 2013)	This tool can be used to identify uncaptured value for different stakeholders across the entire business network, including the environment and society.	TES, EngageSust, Enhance
The Digital Product Ethics Canvas (Threebility.com)	The tool aims to identify the risk of digital products to individuals and society. By following canvas instructions, professionals can increase awareness among top management about the hazards of digital products to persons and society and reduce their negative impact.	EngageSust
The Five Capitals Model (Porritt, 2012)	The purpose of this tool is for businesses to analyse and assess sustainability in five different forms of capital. Users can consider strategies for maximising the value of each capital.	EngageSust
The Idea Canvas (Imperialenterpriselab.com)	This is a tool to use once an ideator (student or budding entrepreneur) has thought of an initial business idea. Completing the Idea Canvas can help clarify the idea before moving on to tools such as the Business Model Canvas.	Enhance
The Impact Canvas (Threebility.com)	Used to systematically identify the critical positive and negative externalities of a business or product. The tool has three levels that consider all the potential impact categories of a product or business.	EngageSust, Enhance
The Impact Compass (Malhotra et al.)	Helps to conceptualise impact and provides the tools to assess the relative social impact potential of various organisations, programs, or start-up ventures. The goal is to conform to three main principles: no proven failure, no negative societal outcome, and no unethical behaviour.	Enhance
The Mission (Brunner & Duveborg, 1996)	The goal of this tool is to start a process where the student gradually discovers vital elements in a sustainable world and gets a feeling of how they influence each other.	TES

Tool	Description	Project
The Project Canvas (Forskningsrådet, 2023)	This is a guiding and planning tool that can be used to communicate your project idea to stakeholders.	EngageSust
The Sailboat Retrospective (EasyRetro)	The sailboat retrospective is a retrospective technique where you and your agile team members envision the last sprint of a sailboat. It is a visual way for a team to identify what pushed the project forward as well as what held it back.	TES
The Sustainability Balanced Scorecard (Threebility.com)	This tool aims to measure sustainability performance on three levels – economy, ecology, and society – and implement strategies for sustainable development.	EngageSust, Enhance
The Sustainable Business Model Canvas (Threebility.com)	This is a tool to enable users to think about the most relevant areas of their business within a triple-bottom-line context. It allows users to maximise the sustainability impact of their ventures while minimising negative externalities.	EngageSust, Enhance
The Thing from the Future (situationlab.org, 2015)	This is an imagination game that challenges players to collaborate and compete in describing objects from a range of alternative futures. The object of the game is to come up with the most entertaining and thought-provoking descriptions of hypothetical objects from different near-, medium-, and long-term futures.	TES
The Triple-Layered Business Model Canvas (Joyce & Paquin, 2016)	This is a tool that can be used to visualise existing business models, adapt, or create new ones. It has three business model canvas layers that show how businesses can generate value: economic, environmental, and social.	EngageSust, Enhance, NordSEnt
Timeout Dialogue (Laaksolahti & Alhanen, 2021)	Tool to increase expertise in the planning and implementation of dialogue-based participatory practices and the capability for constructive discussion in society. It aims to help deepen understanding, as well as build trust and participation in the community.	TES

Connecting Educational Tools to SEE Competences

Table 5 shows all 51 tools and the degree to which each tool may contribute to the different SE competencies. Dark grey indicates that using that tool aims to contribute to the specific competence (a score of 2), light grey indicates that the tool aims to contribute to the specific competence to some degree (a score of 1), and white indicates that the tool is unlikely to contribute to the competence (a score of 0).

By aggregating the scores in each column and summing up the total scores (ranging from 0 to 2), we can determine how many tools contribute to the different competencies, as presented in Table 6. We classified the competencies into three distinct groups based on the degree of contribution from educational tools, ranging from high to low levels. The competencies related to strategic management, systems thinking, and foresighted thinking form the first group, with the potential benefit from a wide range of educational tools. The second group consists of normative and interpersonal competencies, which may receive support from a moderate number of tools. Lastly, the third group encompasses embracing diversity/interdisciplinary and action competencies, which currently have limited available tool-based support.

Table 5. Overview of Educational Tools Related to Competences for SE

Tools	Systems Thinking Competence	Embracing Diversity and Inter-disciplinary	Foresighted Thinking Competence	Action Competence	Normative Competence	Strategic Management Competence	Interpersonal Competence
ABCD Method							
Abundance Cycle Canvas							
Agile Pattern Cards							
Backcasting							
Circular Business Model Planning Tool							
Circular Canvas							
Circular Collaboration Canvas							
Design Thinking							
Eco-design Strategy Wheel							
Ethical Explorer Guide							
Field Visit for Sustainability							
Flourishing Business Model Canvas							
Force Field Analysis							
Foresight Tool							
Future Scenarios							
Future Wheel							
Gap Analysis							
Hackathon							
Hackathon for Sustainability							
Hoshin Kanri							
Impact Gap Canvas							
Individual Development Plan							
Life Cycle Assessments (LCAs)							
Market Opportunity Navigator							
Megatrends							
NABC							
Pitch Competition							
Project Resilience Review							

Tools	Systems Thinking Competence	Embracing Diversity and Inter-disciplinary	Foresighted Thinking Competence	Action Competence	Normative Competence	Strategic Management Competence	Interpersonal Competence
Reverse Brainstorming							
Root Cause Analysis							
Scenario Planning							
SDG Impact Assessment Tool							
Social Impact Intentions Mapper							
Sustainability as a Persona							
Sustainability SWOT							
Sustainability Value Proposition Builder							
Sustainable Value Analysis Tool (SVAT)							
The Cambridge Value Mapping Tool							
The Digital Product Ethics Canvas							
The Five Capitals Model							
The Idea Canvas							
The Impact Canvas							
The Impact Compass							
The Mission							
The Project Canvas							
The Sailboat Retrospective							
The Sustainability Balanced Scorecard							
The Sustainable Business Model Canvas							
The Thing from the Future							
The Triple-Layered Business Model Canvas							
Timeout Dialogue							
SUM	65	32	61	27	46	69	44

Table 6. Overview of Educational Tools that Support Each Competence for SEE

Strategic management competence (22)	
ABCD Method	NABC
Abundance Cycle Canvas	Pitch Competition
Circular Business Model Planning Tool	Project Resilience Review
Circular Canvas	Scenario planning
Circular Collaboration Canvas	Sustainability Value Proposition Builder
Eco-design Strategy Wheel	Sustainable Value Analysis Tool (SVAT)
Hackathon	The Cambridge Value Mapping Tool
Hackathon for Sustainability	The Five Capitals Model
Hoshin Kanri	The Impact Canvas
Impact Gap Canvas	The Project Canvas
Market Opportunity Navigator	The Sustainability Balanced Scorecard
Systems-thinking competence (20)	**Foresighted thinking competence (17)**
ABCD Method	ABCD Method
Abundance Cycle Canvas	Backcasting
Circular Business Model Planning Tool	Ethical Explorer Guide
Circular Canvas	Foresight tool
Eco-design Strategy Wheel	Future Scenarios
Field Visit for Sustainability	Future Wheel
Flourishing Business Model Canvas	Gap Analysis
Foresight Tool	Impact Gap Canvas
Future Wheel	Life Cycle Assessments (LCAs)
Life Cycle Assessments (LCAs)	Megatrends
Scenario Planning	Project Resilience Review
SDG Impact Assessment Tool	Scenario Planning
Social Impact Intentions Mapper	Sustainability SWOT
Sustainability Value Proposition Builder	The Cambridge Value Mapping Tool
Sustainable Value Analysis Tool (SVAT)	The Impact Compass
The Cambridge Value Mapping Tool	The Mission
The Digital Product Ethics Canvas	The Thing from The Future
The Impact Compass	
The Mission	
The Triple-Layered Business Model Canvas	

Strategic management competence (22)	
Normative competence (9)	**Interpersonal competence (7)**
ABCD Method	Agile Pattern Cards
Agile Pattern Cards	Hackathon
Flourishing Business Model Canvas	Hackathon for Sustainability
Future Scenarios	Scenario Planning
Megatrends	The Mission
The Cambridge Value Mapping Tool	The Sailboat Retrospective
The Digital Product Ethics Canvas	Timeout Dialogue
The Mission	
The Triple Layered Business Model Canvas	
Embracing diversity/interdisciplinary competence (3)	**Action competence (4)**
Flourishing Business Model Canvas	Design Thinking
Future Scenarios	Hackathon
Timeout Dialogue	Hackathon for Sustainability
	Hoshin Kanri

In our selection of tools, the competence most often covered is strategic management competence. The large number of tools that can support the development of strategic management competence shows that the basic entrepreneurial competencies, such as planning, organising, and leadership (e.g. Man et al., 2002), are at the core of many tools in our sample. Table 5 shows which specific tools contribute to each competence (a score of 2 in our mapping), indicating that many of the tools aimed at building strategic management competence are well-known entrepreneurial tools with a sustainability add-on (e.g. the sustainability balanced scorecard, hackathon for sustainability, and different sustainability business model canvases).

This finding contributes to the debate on whether traditional tools for EE can be used without changes, whether sustainability elements can be added to existing tools, or whether SEE requires novel tools. Our findings show that tools related to strategic management competence fall, to a large degree, in the second category, with add-ons to existing tools. We elaborate on this later in the article. While most of the tools in our selection contribute to the entrepreneurship-based competence of strategic management, a second large group of tools supports the more sustainability-based competence of systems thinking. The tools that support this competence mostly originate from the sustainability field, with the remaining tools either adapted from sustainability for business administration or derived from both the business administration and sustainability fields. A third group of tools strongly supports foresighted thinking, which is also a more sustainability-oriented competence, hence reflecting that these tools originated in the sustainability field.

Normative competence and interpersonal competence receive some support in quite a few tools; however, only a limited number of tools—fewer than 10—support these competencies to a significant degree. Competences that are supported by the fewest number of tools in our selection include embracing diversity/interdisciplinary and action competencies, with fewer than five tools for each competence. Since our analysis focuses solely on the number of tools supporting each competence and does not include data on how and to what extent these competencies are taught, it is important to note that our findings indicate only the availability of tools that can support each of the competencies. This does not necessarily imply that these competencies are taught to a lesser extent. However, considering the emphasis on interdisciplinary collaboration in addressing sustainability challenges, as highlighted in ESD (Brundiers et al., 2021), the limited availability of tools for competencies related to embracing diversity/interdisciplinary collaboration suggests that educators have fewer options to effectively teach this particular competence.

In our analysis, we followed the competence framework proposed by Ploum et al. (2018), but we chose to keep action competence separate from strategic management competence as in the framework proposed by Lans et al. (2014). We acknowledge the action competence to be much narrower than the strategic management competence, which includes more items. Coding the tools related to action competence shows similar findings as interdisciplinary competence, with few available tools to choose between. A goal of SEE is to support students in becoming change agents for sustainability (Hesselbarth & Schaltegger, 2014), and taking action is an essential part of bringing about change. Therefore, the lowest score assigned to this competence in our mapping reveals that the majority of the tools for SE in our selection primarily focus on teaching students how to plan for change. This could mean that there are limited tools available for instructing students to take action to realise the desired change. However, we do not have a full overview of all the existing tools that are suitable for SE education, and there could be more tools that consider action competence. The tools that were coded as contributing to action competence included specific activities such as prototyping (design thinking), intensive problem-solving activities (hackathon), and the implementation of goals (Hoshin Kanri).

Table 5 provides us with indications that most tools aim to support several competencies simultaneously. We can see this by looking at each educational tool and counting the number of competencies (a score of 2) that it supports. Thirty-six tools explicitly support one or two competencies (e.g. Circular Canvas, Life cycle assessments, market opportunity navigator), eight tools directly support three to four competencies (e.g. ABCD method, hackathon, scenario planning), and up to seven tools only support competencies to some extent (a score below 2; e.g. sustainability as a persona, the idea canvas, root cause analysis). These numbers show that many educational tools have a clear focus on specific competencies. The results can be related to the nature of educational tools as having a limited time

span, which influences the degree to which they provide for the development of competencies. However, the results also indicate that some of the tools provide no clear support for any of the competencies, leading one to wonder what these tools can add to students' learning. Further, the degree of development that students can achieve when presented with up to four competencies simultaneously through an educational intervention for a maximum of three days can be debated.

The Origins of Tools to Teach Entrepreneurship for Sustainability

In the following section, we discuss the origins of the 51 identified tools, thus contributing to the debate on whether to borrow existing tools to teach SE or to use tools specifically designed for SEE. We have analysed the origins of the tools and divided the tools into six categories (Table 7): (1) business administration (i.e. tools that are traditionally used in entrepreneurship education, including applied tools from business development, strategy, innovation, management, and leadership); (2) adapted business administration tools (e.g. with social and environmental aspects as add-ons); (3) tools that combine business administration and sustainability; (4) adapted sustainability tools (e.g. with entrepreneurial and business perspectives as add-ons; (5) original sustainability tools; and (6) tools borrowed from disciplines other than business administration and sustainability.

Table 7. The Origin of 51 Educational Tools for Sustainable Entrepreneurship

Tools	Business administration	Business administration adapted to sustainability	Combination business administration and sustainability	Sustainability adapted to business administration	Sustainability	Tool from other fields
ABCD Method					X	
Abundance Cycle Canvas			X			
Agile Pattern Cards	X					
Backcasting					X	
Circular Business Model Planning Tool		X				
Circular Canvas		X				
Circular Collaboration Canvas			X			
Design Thinking						X
Eco-design Strategy Wheel					X	
Ethical Explorer Guide					X	
Field Visit for Sustainability						X
Flourishing Business Model Canvas			X			

Tools	Business administration	Business administration adapted to sustainability	Combination business administration and sustainability	Sustainability adapted to business administration	Sustainability	Tool from other fields
Force Field Analysis						X
Foresight tool						X
Future Scenarios						X
Future Wheel					X	
Gap Analysis	X					
Hackathon						X
Hackathon for Sustainability						X
Hoshin Kanri	X					
Impact Gap Canvas	X					
Individual Development Plan						X
Life Cycle Assessments (LCAs)					X	
Market Opportunity Navigator	X					
Megatrends					X	
NABC	X					
Pitch Competition	X					
Project Resilience Review		X				
Reverse Brainstorming	X					
Root Cause Analysis						X
Scenario Planning				X		
SDG Impact Assessment Tool					X	
Social Impact Intentions Mapper					X	
Sustainability as a Persona					X	
Sustainability SWOT		X				
Sustainability Value Proposition Builder			X			
Sustainable Value Analysis Tool (SVAT)					X	
The Cambridge Value Mapping Tool				X		
The Digital Product Ethics Canvas				X		
The Five Capitals Model		X				
The Idea Canvas	X					

Tools	Business administration	Business administration adapted to sustainability	Combination business administration and sustainability	Sustainability adapted to business administration	Sustainability	Tool from other fields
The Impact Canvas					X	
The Impact Compass					X	
The Mission					X	
The Project Canvas						X
The Sailboat Retrospective	X					
The Sustainability Balanced Scorecard		X				
The Sustainable Business Model Canvas		X				
The Thing from The Future						X
The Triple-Layered Business Model Canvas		X				
Timeout Dialogue						X
Numbers of Tools	10	8	4	3	14	12

Our mapping of the origins of the identified tools indicated that approximately two-thirds were either originally business administration tools or tools from sustainability. The latter are tools borrowed from sustainability that have not been adapted for the purpose of teaching entrepreneurship for sustainability. Within the traditional business administration tool category, we notice a heterogeneous collection of tools, from traditional business development and growth-oriented strategic management tools aimed at exploiting business opportunities (e.g. the idea canvas) to leadership and personal empowerment tools (e.g. the individual development plan). Key aspects of tools that originated in the sustainability field are that they address the future–present gap, assessing unsustainability and ethics.

Moreover, our analysis showed that business administration tools are more often adapted than sustainability tools. We identified three tools adapted from the sustainability discipline, compared to eight adapted tools from business administration. Regarding adapted business administration tools, we observed a trend of tools traditionally focused on economic aspects, such as business growth, business development, or business modelling, that have been adapted by adding social and/or environmental aspects and dimensions as well. These might be, for instance, linked to how to reduce negative environmental impacts and social injustices or to how nature and social aspects can be crucial features of an opportunity. Examples include the Triple-Layered Business Model Canvas and the Circular Business Model Planning Tool. These exemplify how the well-established business model canvas (Osterwalder & Pigneur, 2010) has evolved over time through conscious

integration and the addition of sustainability dimensions and sustainable economic principles, such as the circular economy (Joyce & Paquin, 2016).

We have further identified four tools that combine aspects from the business administration and sustainability disciplines. For example, the Sustainability Value Proposition Builder was recently developed as a new tool to include sustainability in value propositions, which is a central concept in marketing, strategy, and entrepreneurship, among others. Vladimirova (2019) discussed how multi-theoretical perspectives were applied to design the tool before it went through a thorough testing phase. Furthermore, the collaborative canvas builds on the effectual logic of decision-making from entrepreneurship theory and includes eco-design principles aimed at fostering the collaborative ideation of circular propositions (Brown et al., 2021). These examples show how different views and disciplines can build a basis for novel SEE tools.

Our mapping indicates that a large number of the selected tools were originally developed and adapted for teaching within business administration, including EE, or borrowed tools from sustainability and other disciplines, such as design studies, information technology, and future studies. Borrowing tools from other disciplines have a long tradition in entrepreneurship education (Neck & Greene, 2011), such as from management and strategy. Following this line of argument, our mapping indicates that a bricolage approach of combining educational tools that are at hand is largely applied rather than designing novel tools to teach SE.

Discussion and Research Agenda

Our mapping of SEE tools, the debate about how each tool contributes to competencies for SE, and the origin of tools for SE resulted in three main avenues of discussion: (1) teaching competencies for SE through educational tools at hand, (2) how much of each competence is needed to ensure entrepreneurial action for sustainability, and (3) teaching alternative economic perspectives with tools from growth and consumerism perspectives. These three avenues build the foundation for our research agenda on educational tools for SEE.

Teaching Competences for SE Using Educational Tools at Hand?

We observed a mismatch between the established understanding of SEE as a combination of EE and ESD and the current practices derived from the tools in use. On the one hand, there is an assumption that teaching sustainable entrepreneurship entails unique characteristics distinct from conventional entrepreneurship education. This has led to calls for novel tools for sustainability that apply, for example, a transformative learning perspective (Klapper & Fayolle, 2023; Sharma et al., 2021). On the other hand, we identified many non-adapted tools that are well-established in other fields. These insights indicate the urge to use, adapt, or create novel educational tools for SEE in a systematic, informed, and reflective way, thus ensuring

that the key competencies the tools are designed to address are taught while the characteristics of individual educational contexts are considered.

Following this line of argument, we propose two main questions as a starting point for future research: 1) 'Does the development of novel tools for SEE occur in the aftermath of debate on the idiosyncratic aspects of teaching SE?' and 2) 'Are the tools that are currently applied adequate for SEE, considering that different types of tools can be combined in a course?' This implies that the competencies needed for sustainable entrepreneurial action can be acquired in a course or teaching module that combines tools for entrepreneurship and tools for sustainability without necessarily integrating these two aspects that form the foundation of SE in tools.

To increase our understanding of whether combining entrepreneurship and sustainability courses is adequate to teach the competencies for SE, we call for further research that measures the effectiveness of original entrepreneurship and sustainability tools when used specifically for SEE, and also when several tools are applied in one course to achieve the intended learning outcomes (i.e. the competences that students develop). Moreover, we call for additional research that looks closer at the gap between the current practice of borrowing what is at hand and the conceptions of transformative SEE. To do so, novel knowledge about the possibilities and limitations of each tool is required, which afterwards can be elaborated on in relation to the learning approaches of transformative SEE and how possible gaps can be lessened or closed.

How Much of Each Competence Is Necessary to Ensure Entrepreneurial Action for Sustainability?

Our analysis of the identified tools highlights an imbalance in the availability of resources for teaching different competencies within SEE. Specifically, there is a shortage of tools dedicated to teaching interpersonal skills, embracing diversity/interdisciplinary collaboration, and action-oriented competencies in the current SEE toolbox. By contrast, a considerable number of tools are designed to support strategic management and systems thinking competencies. As our analysis is based solely on the number of tools available and not on the extent to which they are taught, it opens up interesting avenues for future research. For instance, one compelling research question could be: "How can the existing tools be effectively combined to ensure the comprehensive development of all SE competencies?" This includes questioning the importance of each of the competencies and articulating a hierarchy of competencies for SE with a complete study programme in mind (Brundiers et al., 2021), which can provide supplementary insights into what (new) educational tools should be focused on. Other complementary research questions could address what educators and study programmes need to actively apply these tools in teaching, which challenges can occur when integrating the mapped tools into existing curricula, and which potential institutional barriers can be expected

(Verhulst & Lambrechts, 2015). Another relevant enquiry is, "Are the available tools adequate for cultivating competencies, such as interpersonal skills and action-oriented capabilities?"

From this point of departure, we propose several avenues for future research. First, we propose research that provides novel insights into how the identified tools contribute to developing competencies that enable acting entrepreneurially to achieve sustainability and aspects of SE competencies that are yet to be fostered. Building on this, we advocate for further research addressing the relationship between the learning outcomes of SE courses and tools, methods, and learning approaches, including research on the use of educational tools for SE and how possible adaptations to the local context affect this relationship. Further research is needed to increase our knowledge of whether focusing on how individual tools can foster students' competencies is meaningful, given that tools are used for short-term pedagogical interventions and competencies are developed over the course of study programmes. Following this line of thinking, we call for more research that considers the portfolio of tools applied in a course, in combination with the learning approach, and in relation to the competencies for SE and intended learning outcomes, and how this can, in turn, be integrated into an entire study programme.

Teaching Alternative Economic Perspectives with Tools from Growth and Consumerism Perspectives

A large cluster of the identified tools, which are available for and used in education, has been developed within the current dominant growth paradigm; thus, they aim to help firms increase their competitiveness and develop strategies. Examples are the SWOT analysis and the Business Model Canvas. While this paper evaluates the selected tools in relation to the competencies for SE, we have not considered other competencies and abilities that students acquire when the tools are applied during a pedagogical intervention. These might be competencies that conflict with or contradict the need for a paradigm shift that enables a sustainable future and the aim of providing students with the competencies that they need to make this possible. In other words, do the current tools applied in SEE also foster competencies that promote unsustainable behaviour in future entrepreneurs and employees?

Building on the arguments of transformative learning approaches, we call for more research into how to design tools that are aligned with transformative approaches, such as post-consumerism and de-growth perspectives. Research that discusses which other fields could be inspirational in providing students with SE competences would also be valuable.

Conclusion

We presented a mapping of 51 tools that are available for SEE, their origins, and the competencies for SE that each tool develops. Our mapping shows that 1) available educational tools at hand for educators are borrowed from business administration, sustainability, or other disciplines, and thus are not developed for the purpose of teaching entrepreneurship for sustainability; 2) the number of tools that support each SE competence varies, meaning that educators have fewer available choices when teaching certain competencies; and 3) the alternative post-growth economic paradigm is not reflected in the collection of tools identified.

This work has practical implications for educators. First, through this study, we bring together educational tools for SEE based on different international research projects. We thereby provide an overview of a significant number of educational tools available to teach SE, and we provide insights into their fields of origin. Second, our evaluation of the competencies that can potentially be acquired through the mapped educational tools offers a novel matrix of the potential outcomes of each tool regarding competencies to act entrepreneurially for sustainability. Third, combining the tools and the potential competencies offers educators a more profound foundation upon which to base their selection and a combination of relevant tools that can facilitate reaching the defined learning outcomes of courses and study programmes that bring together entrepreneurship and sustainability. For future research, this study provides valuable insights that feed into the debate on educational tools for SEE and offers avenues for further study within the field. An interesting avenue could be to perform a case study of the different tools in practice and/or a critical review of the effectiveness of the different tools in developing sustainable entrepreneurship competencies. The results of this study provide a research agenda that aims to contribute to the further development of entrepreneurship education for sustainability in higher education, which ultimately leads to a more sustainable society.

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References

Bacigalupo, M., Kampylis, P., Punie, Y., & Van den Brande, G. (2016). EntreComp: The entrepreneurship competence framework. *Luxembourg: Publication Office of the European Union*, *10*, 593884.

Baker, R. (2021). *0 Top Process Improvement Tools You Need to Create a More Sustainable Business. Ntaskmanager.*.

Belletire, S., St. Pierre, L., & White, P. (2012). *The Okala Ecodesign Strategy*.

Bengston, D. N. (2016). The futures wheel: A method for exploring the implications of social–ecological change. *Society & natural resources*, *29*(3), 374–379.

Biberhofer, P., Lintner, C., Bernhardt, J., & Rieckmann, M. (2019). Facilitating work performance of sustainability-driven entrepreneurs through higher education: The relevance of competencies, values, worldviews and opportunities. *The International Journal of Entrepreneurship and Innovation*, *20*(1), 21–38.

Boardofinnovation.com. *Social impact intentions mapper*.

Bocken, N., Short, S., Rana, P., & Evans, S. (2013). A value mapping tool for sustainable business modelling. *Corporate Governance*, *13*(5), 482–497.

Brown, P., Baldassarre, B., Konietzko, J., Bocken, N., & Balkenende, R. (2021). A tool for collaborative circular proposition design. *Journal of Cleaner Production*, *297*, 126354.

Brown, T. (2008). Design thinking. *Harvard business review*, *86*(6), 84.

Brundiers, K., Barth, M., Cebrián, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W., Habron, G., Harré, N., & Jarchow, M. (2021). Key competencies in sustainability in higher education—toward an agreed-upon reference framework. *Sustainability Science*, *16*, 13–29.

Brunner, W., & Duveborg, H. (1996). *Solvagnen-visioner till din miljöundervisning*. Liber utbildning.

Buhr, M., Harms, D., & Schaltegger, S. (2023). Individual change agents for corporate sustainability transformation: a systematic literature review. *Benchmarking: An International Journal*(ahead-of-print).

Carlson, C. R., & Wilmot, W. W. (2006). *Innovation: The five disciplines for creating what customers want*. Currency.

Ceulemans, K., De Prins, M., Cappuyns, V., & De Coninck, W. (2011). Integration of sustainable development in higher education's curricula of applied economics: Large-scale assessments, integration strategies and barriers. *Journal of Management & Organization*, *17*(5), 621–640.

Christiansen, S. K., Moberg, K., & Normann, E. (2022). *Sustainable Entrepreneurship in the Nordic and Baltic region. Examples of sustainable entrepreneurship courses and initiatives at higher education institutions.*.

Circulab.com. (n.a.). *Circulab. Circular Canvas: A Tool to Design Circular Business Models*.

dandypeople.com. (2018). *Agile Pattern Cards*

Dean, T. J., & McMullen, J. S. (2007). Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action. *Journal of Business Venturing*, *22*(1), 50–76.

Designbetterbusiness.com. *Sustainability as a persona*.

Diepolder, C. S., Weitzel, H., & Huwer, J. (2021). Competence frameworks of sustainable entrepreneurship: A systematic review. *Sustainability*, *13*(24), 13734.

EasyRetro. *The Sailboat Retrospective*.

ENHANCE. (2023). *Sustaianble entrepreneurship and innovation – methods and tools*. Retrieved March 10th from

Ethicalexplorer.org. (2020). *Ethical Explorer*.

Fauske, I. M., Vallipuram., H., Foldnes, B., Verhulst, E., Wigger, K., & Solvoll, S. (2022). *Teaching sustainable entrepreneurship: Learning approaches, pedagogical methods and teaching tools*

Flourishingbusiness.org. *The Flourishing Business Canvas v2.1.*

Forskningsrådet. (2023). *The Project Canvas*.

Foucrier, T., & Wiek, A. (2019). A process-oriented framework of competencies for sustainability entrepreneurship. *Sustainability*, *11*(24), 7250.

Friedlander, J., & Motzkin, J. (n.a.). *Abundance cycle canvas*.

Garcia, R., & Dacko, S. (2015). Design thinking for sustainability. In M. G. Luchs, K. S. Swan, & A. Griffin (Eds.), *Design thinking: New product development essentials from the PDMA* (pp. 381–400). Wiley.

Gregori, P., & Holzmann, P. (2020). Digital sustainable entrepreneurship: A business model perspective on embedding digital technologies for social and environmental value creation. *Journal of Cleaner Production*, *272*, 122817.

Heiskanen, E., Thidell, Å., & Rodhe, H. (2016). Educating sustainability change agents: The importance of practical skills and experience. *Journal of Cleaner Production*, *123*, 218–226.

Hermann, R. R., & Bossle, M. B. (2020). Bringing an entrepreneurial focus to sustainability education: A teaching framework based on content analysis. *Journal of Cleaner Production*, *246*, 119038.

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.

Holmberg, J., & Robèrt, K.-H. (2000). Backcasting—A framework for strategic planning. *International Journal of Sustainable Development & World Ecology*, *7*(4), 291–308.

Hägg, G., & Kurczewska, A. (2022). *Entrepreneurship education: Scholarly progress and future challenges*. Taylor & Francis.

Imperialenterpriselab.com. *The idea canvas*.

Individual development plan. (2022). University of Nebraska.

Jacobson, G. (2022). *The meaning of Hoshin Kanri: what, why, and how.*

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.

Klapper, R. G., & Fayolle, A. (2023). A transformational learning framework for sustainable entrepreneurship education: The power of Paulo Freire's educational model. *The International Journal of Management Education*, *21*(1), 100729.

Kolmos, A., Hadgraft, R. G., & Holgaard, J. E. (2016). Response strategies for curriculum change in engineering. *International Journal of Technology and Design Education*, *26*, 391–411.

Kyrö, P. (2001). To grow or not to grow? Entrepreneurship and sustainable development. *The International Journal of Sustainable Development & World Ecology*, *8*(1), 15–28.

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.

Lozano, R., Barreiro-Gen, M., D'amato, D., Gago-Cortes, C., Favi, C., Martins, R., Monus, F., Caeiro, S., Benayas, J., & Caldera, S. (2023). Improving sustainability teaching by grouping and interrelating pedagogical approaches and sustainability competences: Evidence from 15 Worldwide Higher Education Institutions. *Sustainable Development*, *31*(1), 349–359.

Laaksolahti, H., & Alhanen, K. (2021). *TIMEOUT-dialogue*.

Malhotra, N., Clavier, B., & Bailard, E. The Impact Compass. In: Stanford Graduate School of Business Center for Social Innovation.

Man, T. W., Lau, T., & Chan, K. (2002). The competitiveness of small and medium enterprises: A conceptualization with focus on entrepreneurial competencies. *Journal of Business Venturing*, *17*(2), 123–142.

Market Opportunity Navigator. (2023).

Martínez-Alier, J., Pascual, U., Vivien, F.-D., & Zaccai, E. (2010). Sustainable de-growth: Mapping the context, criticisms and future prospects of an emergent paradigm. *Ecological Economics*, *69*(9), 1741–1747.

Mason, M. K. (2023). *Future Scenarios: The Art of Storytelling*.

Matthews, H. S., Hendrickson, C. T., & Matthews, D. (2014). Life cycle assessment: quantitative appro aches for decisions that matter. Open access textbook. In: Self published.

Metzger, E., del Pino, S. P., Prowitt, S., Goodward, J., & Perera, A. (2012). sswot – a sustainability swot.

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*.

Mindtools.com. *Force Field Analysis*.

Mindtools.com. *Root Cause Analysis*.

Mindtools.com. (2023). *Reverse Brainstorming*.

Naturalstep.ca. (2011). *Applying the ABCD Method*.

Neck, H. M., & Greene, P. G. (2011). Entrepreneurship education: known worlds and new frontiers. *Journal of Small Business Management*, *49*(1), 55–70.

Nussholz, J. L. (2018). A circular business model mapping tool for creating value from prolonged product lifetime and closed material loops. *Journal of cleaner production*, *197*, 185–194.

Obrecht, J.-J. (2016). Sustainable entrepreneurship education: A new field for research in step with the'effectual entrepreneur'. *International Journal of Entrepreneurship and Small Business*, *29*(1), 83–102.

Olson, J. D., McAllister, C., Grinnell, L. D., Walters, K. G., & Appunn, F. (2016). Applying constant comparative method with multiple investigators and inter-coder reliability. *The qualitative report*, *21*(1), 26.

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers* (Vol. 1). John Wiley & Sons.

Patzelt, H., & Shepherd, D. A. (2011). Recognizing Opportunities for Sustainable Development. *Entrepreneurship Theory and Practice*, *35*(4), 631–652.

Pe-Than, E. P. P., Nolte, A., Filippova, A., Bird, C., Scallen, S., & Herbsleb, J. D. (2018). Designing corporate hackathons with a purpose: The future of software development. *Ieee Software*, *36*(1), 15–22.

Pitch competition. (2021). North Carolina State University.

Ploum, L., Blok, V., Lans, T., & Omta, O. (2018). Toward a validated competence framework for sustainable entrepreneurship. *Organization & environment*, *31*(2), 113–132.

Porritt, J. (2012). *Capitalism as if the World Matters*. Routledge.

Scale-up 4 Sustainability. (n.d.).

Schadenberg, D., Long, T., & Folmer, E. (2021). *Systematic literature review. Report for Teaching Entrepreneurship for Sustainability (TES).*.

sdgimpactassessmenttool.org. (2022). *SDG Impact Assessment Tool*. Gothenburg Centre for Sustainable Development.

Sharma, S., Goyal, D., & Singh, A. (2021). Systematic review on sustainable entrepreneurship education (SEE): A framework and analysis. *World Journal of Entrepreneurship, Management and Sustainable Development*, *17*(3), 372–395.

Shevchenko, A., Lévesque, M., & Pagell, M. (2016). Why firms delay reaching true sustainability. *Journal of management studies*, *53*(5), 911–935.

situationlab.org. (2015). *The Thing From The Future*.

Systemledleadership.com. *Impact Gap Canvas*.

Threebility.com. *The Digital Product Ethics Canvas*.

Threebility.com. *The Impact Canvas*.

Threebility.com. *The Sustainability Balanced Scorecard*.

Threebility.com. *The Sustainable Business Model Canvas*.

van Rijn, M., & van der Burgt, R. (2016). *Handboek scenarioplanning: toekomstscenario's als strategisch instrument voor het managen van onzekerheid: kijk over de horizon, voorzie, anticipeer en word succesvol*. Vakmedianet.

Verhulst, E., & Lambrechts, W. (2015). Fostering the incorporation of sustainable development in higher education. Lessons learned from a change management perspective. *Journal of Cleaner Production*, *106*, 189–204.

Vladimirova, D. (2019). Building sustainable value propositions for multiple stakeholders: A practical tool. *Journal of Business Models*, *7*(1), 1–8.

Yang, M., Evans, S., Vladimirova, D., & Rana, P. (2017). Value uncaptured perspective for sustainable business model innovation. *Journal of Cleaner Production*, *140*, 1794–1804.