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Review

Competence Frameworks of Sustainable Entrepreneurship: A Systematic Review

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Abstract: The importance of the transformation to a sustainable economy for the protection from global crises such as climate change is widely recognized. Sustainable entrepreneurs are considered to play a key role in this transformation process as they create innovative market solutions with ecological, social, and economic value. So far, there is no consensus on competences students need to solve sustainability challenges as sustainable entrepreneurs. The aim of this article is to identify competence frameworks that enable competence-oriented education of future sustainable entrepreneurs. An academic search engine and a bibliographic database were screened for documents written in English and published between January 2010 and November 2020 to identify the existing competence frameworks discussed in the current literature in the field of Sustainable Entrepreneurial Education (SEE). The review process led to a set of 65 empirical and nonempirical works on SEE. A computer-assisted qualitative data analysis was used for this review. The data analysis showed an increasing number of SEE articles published over the last decade mostly in scientific journals (69.2%). Fifty-six (86.2%) of publications related to tertiary education. The data analysis revealed three stand-alone competence frameworks for Sustainable Entrepreneurship (SE). The frameworks show an overlap in content but differences in terms of construction, validation, complexity. All competence frameworks were developed for use in higher education institutions, which necessitates adaptation for use in other educational institutions. The analysis of 28 SEE interventions identified in the literature provides information on the reception of the frameworks for competence-based teaching and assessment.

Keywords: sustainable entrepreneurial education; competence framework; sustainable development; higher education

Citation: Diepolder, C.S.; Weitzel, H.; Huwer, J. Competence Frameworks of Sustainable Entrepreneurship: A Systematic Review. *Sustainability* **2021**, *13*, 13734. https://doi.org/10.3390/su132413734

Academic Editor: Antonis A. Zorpas

Received: 19 October 2021
Accepted: 6 December 2021
Published: 13 December 2021

1. Introduction

The transformation to a sustainable economy is of crucial importance for the recovery from the consequences of the COVID pandemic and the protection from further crises such as climate change [1]. The importance of the entrepreneurial activity to counteract climate change or reduce inequalities to contribute to the implementation of the SDGs is internationally recognized [2,3]. Sustainable Entrepreneurship (SE) is considered to play a key role in the transformation process as it solves sustainability challenges with innovative market solutions [4].

Despite the growing interest of the past decade in the young research field, there is no consensus definition of SE so far [5]. The research from different disciplines has led to different terms describing the link between the concept of sustainable development and entrepreneurship, such as ecological, or social entrepreneurship [6]. However, SE represents a special form of entrepreneurship that can be distinguished from those and other forms of entrepreneurship by a sustainable founding motive and business objective [6]. While the concept of conventional entrepreneurship, focuses on economic value creation [7,8],

systematic literature reviews on SE by Greco and de Jong [9] and Binder and Belz [10] indicate a preference for a definition of SE as the process of discovery or creation, and exploitation of business opportunities to develop and successfully implement innovative goods and services with an ecological, social and economic value on the market [4,11–13] visualized in Figure 1. In this context, the triple bottom line is significant, a framework that, according to Elkington [14], aims at the holistic evaluation of business based on the factors people, profit, and planet.

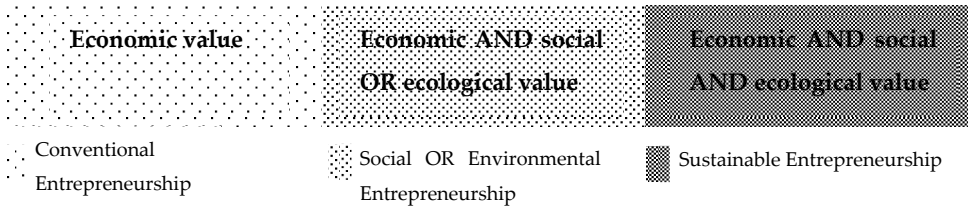

Figure 1. Visualization of the three goal dimensions SE strives for when developing and implementing goods and services at the market compared to other entrepreneurial concepts (adapted from [10]).

The perception that SE is a promising tool for addressing biodiversity loss or, for example, resource depletion, as well as social problems such as poverty and hunger, e.g., [11], may have contributed to the growing interest in the education of sustainable entrepreneurs. Higher education institutes are considered to play a major role in facilitating SE through the support of a SE ecosystem and the educators and students working in it [15]. The core purpose of Sustainable Entrepreneurial Education (SEE) is to provide entrepreneurs with skills and attitudes to evaluate business opportunities in light of environmental and societal needs [16]. The ambition of SEE is therefore to foster the competences (In general, competences are described as a combination of key components knowledge, skills, and attitudes required in specific contexts [17] enabling individuals to act responsibly and be self-organized to mature and achieve objectives [18]. The assessment of competences is challenging because competences are complex interactions of knowledge, skills, values, and attitudes [19,20] and are composed of cognitive, behavioral, and socio-emotional elements [21,22], expressed as "realized abilities" [23] or "performance" [24]. In contrast to context-independent concepts such as intelligence, the concept of competence is characterized as an attribute or disposition a person needs to act successfully in different complex contexts and situations [25]. Competences cannot be taught as predefined solutions, since they are developed by acting learners themselves through experiences and reflection [21]) necessary to enable learners to solve sustainability problems with innovative market solutions, regardless of whether the students go on to start their own business or work for an employer. Lans et al. [16] were the first of several scholars that identified the competences of sustainable entrepreneurs that integrate the competences from the field of entrepreneurship and sustainable development.

Despite the growing interest in the education of sustainable entrepreneurs, lacking integration of sustainability aspects into entrepreneurial education, e.g., [26,27] or vice versa is often criticized. For students to become so-called "change agents for sustainability", specific learning environments that foster SE competences have to be developed [28] (p. 114). In order to contribute to the development and assessment of competence-oriented SEE interventions, previous research findings have to be presented and clarity about relevant sustainable entrepreneurship competences have to be achieved. The aim of the present research is therefore to analyze the literature on SEE to identify existing competence frameworks and their reception in SEE interventions. A systematic review was conducted to systematically map the research done in the field of SEE and identify existing gaps in research.

The literature review was guided by the research question: What is known from the literature about SEE for formal education settings?

The following sub-questions directed the analysis of the literature sample regarding competence frameworks:

- RQ 1: Which SE competence frameworks can be identified?
- RQ 2: How were the SE competence frameworks developed and validated?
- RQ 3: Do the SEE interventions identified in the literature refer to these SE competence frameworks?

In total, three stand-alone SE competence frameworks could be identified in the literature on SEE:

1. Framework: Validated Competence Framework for Sustainable Entrepreneurship by Ploum, Blok, Lans, and Omta (2017) [28].
2. Framework: Key competences for sustainability-driven entrepreneurship by Biberhofer, Bernhardt, and Rieckmann (2019) [29].
3. Framework: Process-Oriented Framework of Competences for Sustainability Entrepreneurship by Foucrier and Wiek (2019) [30].

They differ in terms of their construction, validation, and scope. Their reception in publications reporting on SEE interventions has been low so far.

Published systematic literature reviews of the research area of SEE have focused on three areas: teaching and learning methods and approaches applied in "sustainability-driven entrepreneurship" in tertiary education [31], the scope that research on entrepreneurial education is directed to the international SDGs in the context of fragile states [32], and the structure of the ongoing research in the academic field of "sustainable entrepreneurship education" [15]. The latter article is a very recent systematic review published outside the review period, i.e., after November 2020.

Mindt and Rieckmann [31] introduce their review with a description of sustainability-driven entrepreneurship and the required competences according to Lans et al. [16]. The authors discuss higher ESD, the competences required to solve sustainability problems according to Wiek [33,34], and the teaching-learning approaches suitable to foster these competences in higher education. Mindt and Rickman [31] point out that to promote SE competences, the approaches and methods of higher education for entrepreneurship and sustainable development must be brought together. The focus of their work is to identify the approaches and methods currently used or recommended in research on the two disciplines of higher education for entrepreneurship and sustainable development. The authors [31] found commonality in that collaborative and experiential learning are most often described in both disciplines, but also differences, such as noting more transformative learning in higher ESD or more real-world learning in higher education for entrepreneurship.

The scope of research on entrepreneurial education which addresses several SDGs like responsible consumption and production is analyzed by the literature review of Rashid [32]. The author focused on the status of entrepreneurial education and its exploration in fragile states referencing the importance of employment (of young people) for overcoming the "vicious cycle of poverty and violence" [32]. Rashid [32] identifies several factors, such as unavailability of entrepreneurial education for pupils, lack of experiential teaching and learning approaches, or limited use of educational technology, that constrain the impact of entrepreneurial education in fragile states.

The review by Sharma et al. [15] analyzed literature to gain knowledge about the structure of themes of SEE research and the emerging trends. The authors found that research activities in SEE could be grouped into the three areas: "institutional framework" including the groups acting in it and the infrastructural and strategic aspects as well as the policy and culture of the educational institution, and "external interactions" with stakeholders from the public and private sectors embracing cooperation formats like service-learning. In addition to the distinction between internal and external research areas, Sharma et al. [15] also list the research area "teaching learning approaches" comprising a list of eight approaches and methods.

So far, no systematic review analyzed the literature body of the last decade on SEE research to identify the available SE competence frameworks and their reception in SEE interventions. This review will analyze and condense the previous findings on SE competence frameworks to contribute to the development and assessment of competence-oriented SEE interventions for formal educational settings.

2. Sustainable Entrepreneurial Education (SEE)

The main educational disciplines of Sustainable Entrepreneurial Education (SEE) are entrepreneurial education and the Education for Sustainable Development (ESD) [26,31].

2.1. Entrepreneurial Education

The increasing number of academic courses, faculties, or journals for entrepreneurship indicates its growth as an educational subject and branch of science [35]. Educational measures to facilitate entrepreneurship exist today in educational settings from primary school to doctoral programs [36]. This broad reception is fostered by the notion that entrepreneurship is a driver of economic and social development [37].

To date, there is no uniform definition of the term entrepreneurship [38]. This heterogeneity is reflected in research on entrepreneurial education, a discipline spread over divergent fields [39] covering different definitions. One side of the continuum is "enterprise or enterprising education", which includes European research and is oriented towards a wider definition of entrepreneurship, according to which it is about the personal development of an entrepreneurial mindset and life skills [40,41]. On the other side of the continuum is "entrepreneurship education", which includes North American research and is oriented towards the narrower definition of entrepreneurship, which is about the creation of ventures [42]. Acknowledging the narrower and wider perspective in the review, the expression "entrepreneurial education" is used in this paper as in [43] to refer to education in entrepreneurship.

Contemporary research on entrepreneurial education is moving away from the narrow start-up perspective [44] focused on a target audience of students interested in an entrepreneurial career [45] towards a wider perspective addressing all students to foster entrepreneurial competences regardless of future self- or dependent employment [46]. In the context of the wider enterprising perspective, entrepreneurial education is not limited to business programs and can be integrated across the curriculum [47].

The term competence is interpreted and defined differently depending on the field of application or initial discipline, and country [48], so that even within entrepreneurship research a recent literature review on 32 key publications identified 12 different definitions [18]. Discussing the body of entrepreneurship literature, Tittel and Terzidis [18] define "entrepreneurial competence as the specific set of domain competences, social competences and personal competences needed to generate entrepreneurial action". They further specify the following subcategories within the framework of domain competence: "opportunity recognition, organizational and strategic and management competence" [18].

Pedagogy in entrepreneurial education has evolved, like pedagogy in general, from traditional teacher-guided instructional approaches in the 1980s towards learner-centered constructivist approaches to date [39]. According to the systematic review by Hägg and Gabrielsson [39], pedagogy in entrepreneurial education research today is mainly influenced by six theories and approaches: constructivist educational philosophy [49], experiential learning theory [50], situated learning [51], action learning [52], and problem-based learning [53]. Thus, the theoretical framework of modern entrepreneurial education is experiential and constructivist in nature.

The use of these modern experiential approaches enables the facilitation of innovativeness and creativity among learners [54]. Meta-studies have confirmed the empirical evidence of the impact of entrepreneurship courses and programs on entrepreneurial competences and skills [55,56], while at the same time criticizing the methodology [57]. The evidence of impact of entrepreneurial education regarding intentions towards en-

trepreneurship is less clear, as pre-educational intentions are little affected by education programs [28]. The empirical evidence of entrepreneurial education is also dependent on the age and gender of the learners [56,58].

The content of entrepreneurial education developed from learning *about* to learning *in* or *through* the experience of entrepreneurship [39] e.g., [59,60]. Typical entrepreneurial education content relating to different stages of the entrepreneurial process range from developing ideas or discovering opportunities and writing business plans, to creating a venture and manage related activities [44]. Current methodological contributions to the design of entrepreneurial education include for example effectuation [61] e.g., in Cowden et al. [62] or lean start-up [63], e.g., in Harms [64]. The worldwide homogeneity of used methods like business model canvas, mini-companies, entrepreneurship competitions, and start-up pitches is labeled as "McDonaldization" of entrepreneurial education and criticized as lacking variation acknowledging aspects like gender, or cultural background [65].

Contemporary research on entrepreneurial education is focused not only on the individual but increasingly on the environment and the individual's interaction with it, e.g., [26,66]. In the context of global crisis such as the economic crisis of 2008 or the ongoing destruction of livelihoods, the question of the ethical responsibility of entrepreneurs and entrepreneurial education is gaining importance [39] and interest in concepts such as social entrepreneurship or SE is growing, e.g., [45,46].

2.2. Education for Sustainable Development (ESD)

Papenfuss et al. [67] highlight the 1960s with widely recognized publications on socially induced environmental disasters, such as Silent Spring [68], as the beginning of the emergence of sustainability education. While the focus was initially on environmental problems and the concept of environmental education [69], in subsequent years, issues of development, social justice, and economics arose and the discourse transitioned to the concept of sustainability education [70]. The notion of ESD, a United Nations initiative, was introduced in Rio de Janeiro in 1992 [71] and since then internationally explored by a growing number of scholars [72] and politically promoted, for example, by the United Nations Decade of ESD [73]. Other terms used synonymously with the United Nations terminology for ESD are, e.g., sustainability education or education for sustainability [72].

In 2015, following the Decade of ESD, the United Nations [74] adopted the Agenda 2030 to further enhance sustainable development that "meet the needs and aspirations of the present without compromising the ability to meet those of the future" [75] (p. 51). The political agenda defines 17 Sustainable Development Goals (SDGs) comprising a total of 169 environmental, social, and economic interconnected targets corresponding to sustainability concerns, such as the exploitation of natural resources, environmental pollution, and social injustice [74]. ESD was now included in goal four "Quality Education" [76] and seen as an essential element to achieve all goals [77].

According to the UNESCO, ESD is a 'holistic' approach that addresses all levels of education across all disciplines and requires the consideration of sustainability issues in every aspect of teaching and learning [78]. Pedagogy discourse in ESD has evolved analog to the development of pedagogy in general from content-focused and teacher-guided learning about sustainable development issues to learner-centered transformative and action-oriented pedagogy [67,79] integrating learners in the solution of real-world sustainability challenges [80,81]. Accordingly, innovative teaching-learning methods are often applied in which learners work collaboratively (e.g., service-learning), imagine an alternative to current practices and foster creativity (e.g., story-telling), or work in an interdisciplinary way to analyze complex sustainability challenges from all sides (e.g., community research) [82,83]. Emerging trends in the ESD research literature identified by Grosseck et al. [72] are e.g., referring to education on alternatives to the linear economic system [84] or the broad area of digitalization. Research regarding the latter lies in three main areas: content-related, (e.g., in the effect and handling of fake news [85]), medium-related, (as shown by Carrión-Martínez et al. [86] in mobile learning, e.g., massive open online

courses [87]), or interactive learning environments, (e.g., serious games [88], augmented reality [89]).

The central subjects of ESD are the fundamental topics for sustainable development on a local and global level [61]. The 17 SDGs relevant to sustainable development are again condensed by UNESCO [78] into four key areas: climate change, sustainable consumption and production, biodiversity, and disaster risk reduction. As early as 2006, PISA revealed that almost all learners in OECD member countries attend schools where these and other issues such as pollution and environmental degradation are part of the curriculum [78].

To contribute to solutions for these environmental, economic, and social challenges of the present and the future, and thus contribute to sustainable development of societies, ESD aims to enable learners to make informed decisions and act responsibly as 'sustainability citizens' [74,75]. ESD thus becomes a means of facilitating a range of essential competences necessary to successfully act when facing the complexity and uncertainty of sustainability issues [22]. Among a plethora of different competence concepts like "shaping competences" by de Haan [90], "sustainability literacy" by Stibbe [91], different "key competences in sustainability" by Wiek et al. [33,34], or "key competences for sustainable development" by Rieckmann [92], "sustainable skills" by Wals [93] including so-called "core competences" by Glasser and Hirsch [94] following Redman et al. [95] there is agreement on these key competences: anticipatory or futures-thinking-, collaboration or interpersonal-, values-thinking or normative-, strategic-, and systems-thinking [33], and integrated problem-solving competence [34], as well as following the UNESCO [22] and Rieckmann [82] furthermore: critical thinking and self-awareness competence. Increasingly, there is interest in assessing the impact of ESD interventions on learning attainments and the resulting behavioral and decision-making changes in order to identify elements of the pedagogical reality that are effectively fostering competences [25,79].

Often, learners in ESD are limited to the role of consumers and lifelong workers, rather than as "empowered producer und life-long learner", as Wals and Lenglet call for [96] (p. 56). However, individuals can also contribute to achieving the SDGs as innovative, sustainable producers and service providers [97].

3. Method

To identify the existing SE competence frameworks and their reception in the literature on SEE interventions, a comprehensive systematic literature review was conducted. The review process was guided by the PRISMA 2020 Statement for systematic reviews [98]. Systematic reviews are a distinct research method for analyzing and synthesizing existing research literature, with a systematic and replicable approach [99].

3.1. Eligibility Criteria and Restrictions

3.1.1. Eligibility Criteria

The review included all kinds of documents dealing with research on SEE considering nonempirical and empirical research. To map the current state of research internationally, publications were included if they were written in English and published between January 2010 and November 2020. To enable a comprehensive examination of the research field, all documents, including so-called gray literature (unpublished articles [100] such as conference proceedings [101]) were collected.

3.1.2. Restrictions

Publications were excluded if they did not meet the research interest and were limited, for example, to promoting SE only in specific educational contexts, such as engineering education, e.g., [102]. Similarly, studies were excluded that did not fit the defined concept of sustainability and were limited, for example, to the economic dimension of sustainability, e.g., [103].

3.2. Information Sources

The data collection was conducted in November 2020 inclusive using the academic search engine Google Scholar and the bibliographic database Web of Science. A survey of the Scopus bibliographic database was not conducted because the Web of Science provides analogous results according to Harzing and Alakangas [104]. The research question was translated into a search strategy that included the following three groups of terms:

- sustainable (green, ecologic, environment)
- entrepreneurship
- education (teach, train)

The listed synonyms were identified by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) Thesaurus for the group "Education—Teaching and training" [105]. The roots of these terms were broadened with the wildcard character asterisk (*) that represents none, one or more characters [106] which ensures the inclusion of spelling variants. The search was performed as a title search in Google Scholar and Web of Science.

3.3. Search Strategy and Selection Process

In the academic bibliographic database Web of Science, the following search string was used:

- TI = (sustainab* OR green OR eco OR ecol* OR environment*) AND TI = entrepreneur * AND TI = (educat* OR teach* OR train*),
- TI = ecopreneur* AND TI = (educat* OR teach* OR train*),
- and TI = sustainopreneur* AND TI = (educat* OR teach* OR train*).

The syntax was discussed among the authors regarding the appropriate use of Boolean operators and brackets.

Additionally, the academic search engine Google Scholar was used. This provides the most comprehensive results compared to the 12 most used academic search engines and bibliographic databases [107]. Google Scholar cannot apply search queries with wildcards, such as the asterisk (*). The complex search query applied in the Web of Science was therefore translated into 418 individual search queries. Search queries for Google Scholar were performed as title searches using Harzing's 'Publish or Perish' software. The software returns identical results to an Advanced Google Scholar search [108]. The first 1000 records of every search on Google Scholar were captured and the results were downloaded as a file in CSV format.

All search results were exported into the spreadsheet program Excel, and 176 duplicates were removed. The titles and abstracts of the remaining publications were screened regarding the eligibility and restriction criteria and 487 records were excluded. Another 67 records were excluded after screening the full texts. The reference lists of the remaining 54 records were scanned and 11 additional publications were identified. The review process shown in the flow diagram (Figure 2) illustrates the records identified, included, and excluded in each of the three phases: identification, screening, and inclusion.

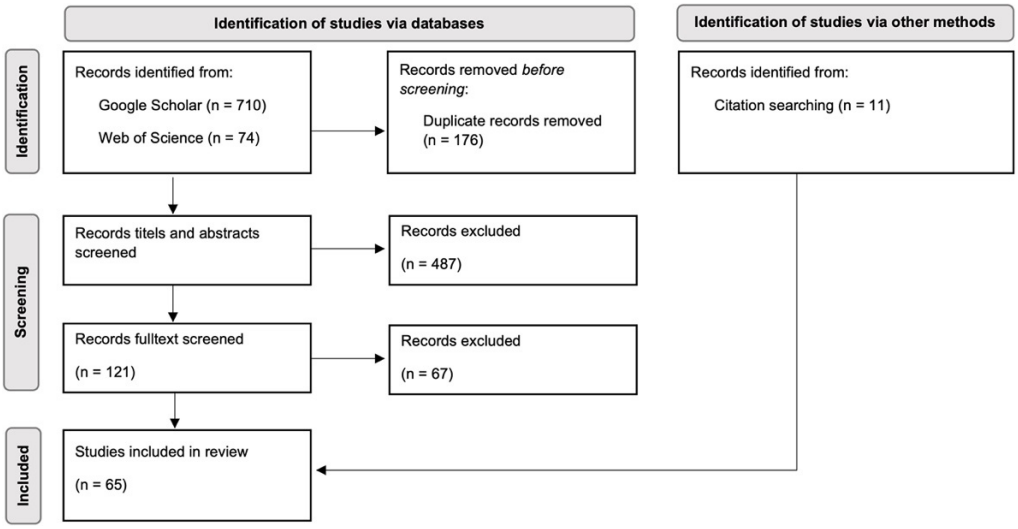

Figure 2. Flow diagram adapted from The PRISMA 2020 statement [98].

Sixty-five publications alphabetically listed in Appendix A Table A1 remained in the selection and were analyzed using the MAXQDA [109] software which led to the following results.

4. Results

The bibliographic data analysis provides information regarding the number of publications over the last decade, the publication formats, and the most frequent journals as well as information on the authors, for example, the geographical location of the first author's university. The content analysis of the publications provides general information regarding the paper type, educational level, and the most frequent words.

The information on competence frameworks is structured into a detailed description and the analysis of the reception in SEE interventions.

4.1. Bibliographic Results

As Figure 3 shows the number of articles addressing SEE has risen over the last ten years. Between 2010 and 2015 a total number of 19 publications was identified while between 2016 and November 2020 the publication volume has more than doubled and 46 publications were identified. This emphasizes the increasing discussion on SEE.

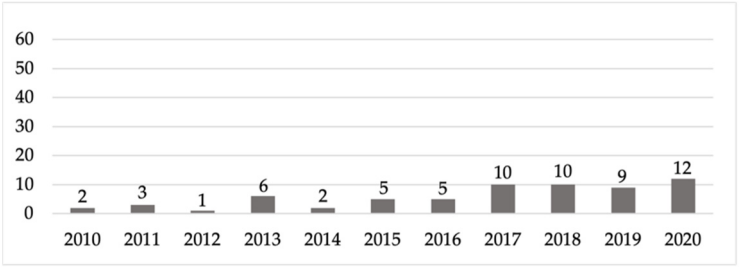

Figure 3. Annual volume of publications on SEE between January 2010 to November 2020 inclusive.

The identified publication formats are shown in Figure 4. Forty-five articles were published in journals. Ten conference proceedings, seven chapters from books, and three project reports were identified. Scientific results regarding SEE are therefore mostly communicated via journal articles.

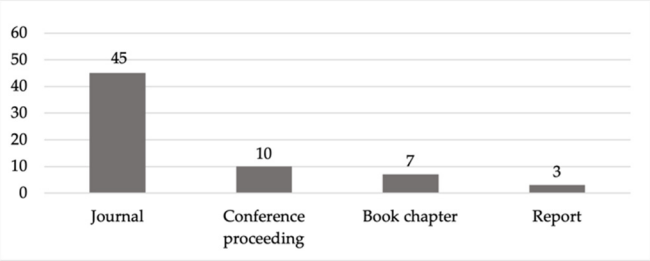

Figure 4. Chart of publication formats.

The three most frequent journals are the Journal of Cleaner Production with five articles, the Journal Sustainability with four articles, and the journal Discourse and Communication for Sustainable Education with two articles. The remaining 77% of articles were all published in different journals either from the field of sustainability, specifically sustainability education, or from the field of economics, specifically entrepreneurship or management education. No paper was published in a special journal on SEE which highlights the fact that it is still a scientific niche.

The information on the geographical location of the first authors' university was collected and grouped into continents (Figure 5). The country may therefore differ from the country of the author's citizenship or birth. Thirty-seven (56.9%) first authors were located at universities on the European continent, 14 (21.5%) on the American continent, 10 (15.4%) on the Asian continent followed by four (6.2%) on the African continent. The three countries where most of the first author's universities were located are the United States of America (11; 16.9%), followed by the United Kingdom (eight; 12.3%), Austria, Germany, and the Netherlands (each five; 7.7%).

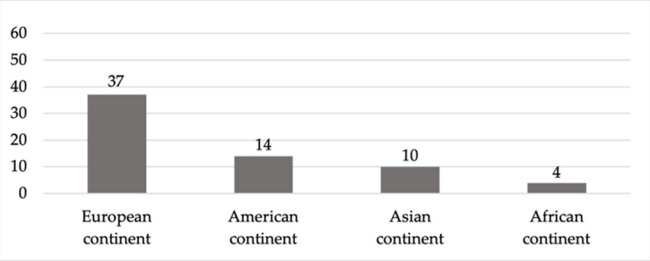

Figure 5. Chart of the geographical location of the first authors' university by continents.

In summary, 138 different authors contributed to the identified publications on SEE. Fourteen (10.1%) authors contributed to more than three but less than six publications and another 14 (10.1%) authors contributed to two publications. The majority of 111 (80.4%) authors contributed to one publication. Eighteen (27.7%) publications were written by a single author.

4.2. Content Results

4.2.1. Paper Type

All publications were differentiated according to the classification of paper types (Figure 6) adopted from Emerald Open Research [110]. Thirty (46.2%) publications were classified as Research Papers, as the authors reported on some type of research undertaking (e.g., the construction or testing of a SE competence framework, action research on SEE interventions, or surveys on SEE intentions). Seventeen (26.2%) publications were classified as Conceptual Papers as they were discursive, covering philosophical discussions and focused on developing hypotheses. Case studies describing SEE interventions or SEE experiences within organizations were classified 16 (24.6%) times. Two (3.1%) literature reviews with the main purpose of annotating and critiquing the literature in the field of SEE were identified in the sample.

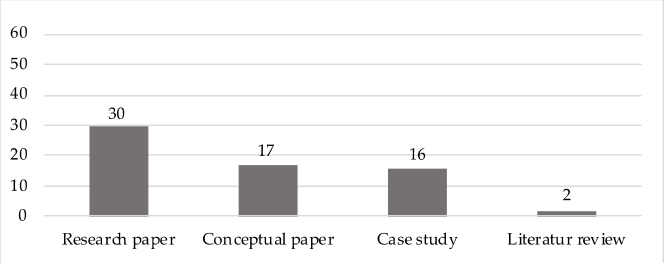

Figure 6. Chart of the paper types of each publication. (No multiple categorization possible).

4.2.2. Educational Level

Fifty-six (86.2%) of 65 publications related to tertiary education by researching or testing SEE in universities or colleges. Similarly, five (7.7%) publications refer to secondary education. Four publications are categorized as undefined or overlapping (6.2%) of which one publication mentions various target groups in the school or university education sector [111] and three other publications do not refer to a specific education sector. No publication of the data set refers to the primary education sector. Figure 7 shows the clear focus of the testing and research on SEE at the tertiary level.

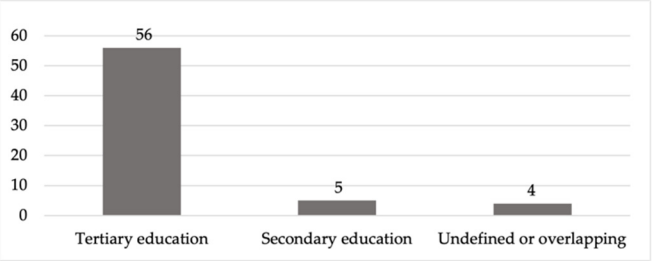

Figure 7. Chart of the educational level of each publication. (No multiple categorization possible).

4.2.3. Keywords

To analyze the keywords, the number of publications containing the respective keyword assigned by the authors were counted. Table 1 shows their frequency among the 65 publications. Keywords that were counted in at least two publications are shown in Table 1. A further 91 keywords are not shown in Table 1, as each was only counted in one publication. The most frequent keyword is entrepreneurship education (18 publications).

Table 1. Table of keyword frequencies.

Keyword	Frequency	Keyword	Frequency
entrepreneurship education	18	eco-entrepreneurship education	2
sustainability	11	competence	2
higher education	10	intention	2
entrepreneurship	10	key competencies	2
sustainable entrepreneurship	10	learning	2
education	8	problem-based learning	2
Education for sustainable development	6	social entrepreneurship	2
innovation	6	corporate social responsibility	2
sustainable development goals	5	sustainability competencies	2
eco entrepreneurial	5	sustainability education	2
sustainable development	3	sustainability-driven entrepreneurship	2
entrepreneur	3	creativity	2
curriculum and course development	3	authentic learning	2
environmental education	2	change agents	2
environmental problems	2	teaching	2
experiential learning	2	transformation	2
gamification	2	values	2

4.2.4. Word Frequencies

The evaluation of the word frequencies of all publication's full texts [112] was conducted using a lemma list by Měchura [113]. The analysis showed that the term from the root competence (e.g., competences) and hyphenated compounds (e.g., competence-mix) appears 2620 times in 46 (70.77%) documents and occurs under the 10 most frequent words. However, a comparison with the other most frequent words (Table 2) shows that the term is not mentioned in about one-third of the publications. The number of publications in which the term competence was mentioned increased from 18 publications (2010–2015) in the first half of the last decade to 49 publications (2016–November 2020).

Table 2. Table of word frequencies.

Rank	Word	Frequency	Documents	Documents %
1	sustainability	6699	62	95.38
2	learn	4260	61	93.85
3	student	3930	61	93.85
4	entrepreneurship	3918	62	95.38
5	education	3462	63	96.92
6	business	2876	62	95.38
7	development	2631	63	96.92
8	competence	2620	46	70.77
9	course	1781	54	83.08
10	social	1710	60	92.31

4.3. Sustainable Entrepreneurship Competence Frameworks

In 65 publications, four papers were found that report on relevant competences for SE and deal with the development of a competence framework or a list of key competences [16,28–30]. The four publications were subjected to a detailed analysis. Using the mind mapping method, a development context between the competence framework of [16] and [28] was identified, and the number of stand-alone competence frameworks was reduced to three.

The analysis of the three competence frameworks was carried out along three criteria: construction, validation, and complexity, derived from the research question.

4.3.1. Validated Competence Framework for Sustainable Entrepreneurship

The following competence framework includes six competences and was identified in Ploum et al. [28]. It is the only empirically validated competence framework identified in the literature sample for SEE. The authors conducted the research to identify the central competences for SE and equip higher education institutes with the necessary information for the further development of higher education learning settings.

- Construction: The competence framework is the result of a validation of the first competence framework on SE developed by Lans et al. [16] which is therefore not separately listed. The initial framework by Lans et al. [16] includes seven key competences that integrate entrepreneurial and sustainable competences. It was based on focus group discussions about two literature-based lists of competences for sustainable development [114] and entrepreneurship [115,116] with eight educators in the field. The developed framework was tested among 210 students and results were analyzed by explorative factor analysis [16]. Lans et al. [16] identified a specific spectrum of SE competences that overlap and differ from the entrepreneurship and sustainability competence domains. For example, normative competence is unique to sustainability competences.
- Validation: Ploum et al. [28] tested the initial framework by Lans et al. [16] using confirmatory factor analysis of data gained from a questionnaire with competence self-reports of 402 students that showed the intention to become a sustainable en-

trepreneur (would-be entrepreneurs). For a better model fit the two competences strategic management competence and action competence were merged.

- Complexity: The validated competence framework for SE consists of six competences listed in Table 3. Descriptions of individual competences do not appear in the framework but are summarized based on Lans' et al. [16] previous framework. For example, system thinking competence is described according to [33] as the "ability to identify and analyze all relevant (sub)systems across different domains (people, planet, profit) and disciplines, including their boundaries" [28] (p. 119).

Table 3. Competence framework adopted from Ploum et al. [28].

Excerpt of the Validated Competence Framework for Sustainable Entrepreneurship (Ploum et al., 2017, p. 124)	
1.	Strategic action competence
2.	Diversity competence
3.	System thinking competence
4.	Normative competence
5.	Foresighted thinking competence
6.	Interpersonal competence

Excerpt of the competence framework adopted from Ploum et al. [28] including the key competences (p. 124).

4.3.2. Key Competences for Sustainability-Driven Entrepreneurship

The following competence framework includes five key competences and was identified in Biberhofer et al. [29]. According to the authors, it is the only framework in whose development process any corporate practitioners with experience in implementing sustainability strategies were interviewed. The authors conducted the research to identify the required competences for SE that should be integrated into higher education programs for SE.

- Construction: To identify necessary competences for SE 48 managers and entrepreneurs experienced in the application of sustainability strategies in their ventures were interviewed including questions on challenges and tasks of sustainable entrepreneurs and the competences necessary to cope with them [29]. The answers then were categorized between key categories which correspond to five key competences. Those five key competences had been derived from the interview guide which was modified considering the sustainability competences framework by Wiek et al. [33,34] as well as the SE competences framework developed by Lans et al. [16].
- Validation: An empirical validation was not identified in the literature.
- Complexity: The key competences for SE consist of five competences listed in Table 4 [29] and several condensed and assigned interview answers.

Table 4. Competence framework adopted from Biberhofer et al. [29].

The Key Competences for Sustainability-Driven Entrepreneurship and Excerpts of the Condensed and Assigned Interview Answers (Biberhofer et al. 2019, p. 28)		
1.	Systemic competency	Coping with and understanding the complexity of sustainability
2.	Anticipatory competency	Integrational thinking, time horizons
3.	Normative competency	Dealing with norms and ethics promoting sustainability
4.	Strategic competence	Openness for possibilities
5.	Interpersonal competency	Work in multi-stakeholder networks; sustaining them via a culture of cooperation

Excerpt of the competence framework adopted from Biberhofer et al. [29] including the key competences and exemplary details of the condensed and assigned interview answers (p. 28).

4.3.3. Process-Oriented Framework of Competences for Sustainability Entrepreneurship

The competence framework by Foucrier and Wiek [30] does not list stand-alone competences, but rather the tasks to be accomplished and the knowledge, skills, and attitudes required to accomplish them, structured in a five-stage entrepreneurial process model. It is the only competence framework in the literature sample for SE considering the process of building and running an enterprise. The authors conducted the research to identify the essential competences for SE along the entrepreneurship process to provide information for the development and evaluation of higher education programs for SE.

- Construction: The framework is based on a literature review including the articles about the previous competence frameworks from Ploum et al. [28] and Biberhofer et al. [29]. The authors derive a fundamental five-phase entrepreneurship process model from literature and aggregate the main tasks and necessary competences identified in the literature on entrepreneurs, sustainability professionals, social—and sustainable entrepreneurs for each phase. The competences for SE are described in the parts: knowledge, skills, and attitudes (Table 5). An overarching term is not stated.
- Validation: An empirical validation was not identified in the literature.
- Complexity: The competence framework by Foucrier and Wiek [30] is found on an entrepreneurial process model including the five phases of discovery, planning, start-up, build-out, and consolidation. Each phase is completed with the main inherent tasks followed by a detailed description of the necessary competences separated into the elements of knowledge, skills, and attitudes. In addition, the authors added to each phase the sustainability competences according to Wiek et al. [33].

Table 5. Competence framework adopted from Foucrier and Wiek [30].

Excerpt of the Process-Oriented Framework of Competences for Sustainability Entrepreneurship (Foucrier and Wiek 2019, pp. 8,9)			
First Entrepreneurship Phase		**Exemplary Sustainability Entrepreneurship Task**	**Exemplary Sustainability Entrepreneurship Competence (Knowledge, Skills, Attitudes)**
1.	Discovery	Recognition of social, environmental, and sustainability issues manageable through entrepreneurial activity from a systems perspective e.g., [28]	Knowledge about social, environmental, and sustainability challenges Information search skills Entrepreneurial mindset e.g., [29]

Excerpt of the competence framework adopted from Foucrier and Wiek [30] including the first phase of the generic entrepreneurial process model and exemplary details of the discovery phase (pp. 8,9).

4.4. Reception of Competence Frameworks

To evaluate the reception of the SEE competence frameworks, all SEE interventions in the literature were identified and evaluated. The majority of 37 (56.9%) publications do not report on the performance of a SEE intervention (Figure 8). Another 25 (38.5%) publications report on the performance of one or more SEE interventions. However, consideration of any of the three competence frameworks for these interventions is not cited. Two publications [117,118] report on one SEE intervention planned considering the competence framework by Fourcier and Wiek [30]. It should be mentioned that the same authors were involved in these two publications. One publication [119] reports on the performance of 21 SEE interventions planned considering the competence framework by Biberhofer et al. [29]. It should be mentioned that the same authors were involved in this publication. No paper reports on the performance of a SEE intervention that considers the competence framework by Ploum et al. [28].

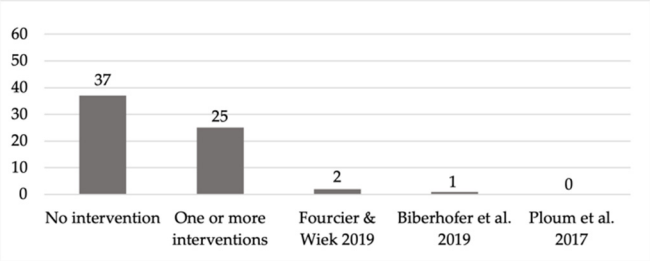

Figure 8. Number of publications reporting on one or more performed SEE interventions and considered SE competence frameworks. (No multiple categorization possible.).

5. Discussion

5.1. Summary

The conduction of the literature review was guided by the research question: What is known from the literature about the SEE for formal education settings? A total of 65 publications were identified and analyzed in terms of bibliographic data. Table 3 showed an increasing volume of publications. Whether this is caused by the generally increasing global scientific output [120] or the increasing interest in SEE cannot be answered.

The analysis shows that although the majority of publications were identified in journals, 30.7% of the publications are disseminated in alternative formats. Future literature reviews should also consider articles outside scientific journals to minimize inclusion bias.

The geographical location of the first authors' university indicates the international interest in the research area. An example of international collaboration in research on SEE can be seen on the European continent where most publications came from (37; 56.9%). Seven (18.9%) of these 37 European publications could be assigned to the project called CASE. It is a project funded by the European Commission program Erasmus Plus—Knowledge Alliances to develop a European Master Program on Sustainability-driven Entrepreneurship [31].

The results of the analysis of the paper types showed that more than a quarter (26.2%) of the publications are of a conceptual nature. This is a significantly higher proportion compared to the ESD research literature, where the percentage of 17.7% conceptual essays is criticized as too high [70]. The results also showed that just under a quarter (24.6%) were conducted as case studies. Although case studies, for example, create great practical relevance [121] they are criticized in research on entrepreneurial education as well as environmental education and ESD for the limited generalizability of their research findings, e.g., [121,122].

This literature review shows a clear focus of implementation and research on SEE at tertiary education (86.2%) and a limited investigation at secondary education (7.7%). The lack of consideration of secondary education indicates a research and implementation gap. To empower learners, regardless of whether the students go on to start their own business or work for an employer, to cope with sustainability challenges in a professional context, the implementation of and research on SEE cannot be limited to academic careers because not all learners receive tertiary education. On average, internationally, less than half (45%) of the 25–34 year-olds have tertiary education [123], and even among entrepreneurs, an average of 13.5% in the European Union do not have a university degree [124].

The analysis of the frequencies of keywords provided by authors indicates that the fields of sustainability education and entrepreneurial education are currently still merged in the literature. Only two publications use the keyword eco-entrepreneurship education [125,126], one publication uses the keyword higher education for sustainability-driven entrepreneurship [31] and another mentions sustainable entrepreneurial education [127]. In contrast, the separately used keywords entrepreneurship education (18) or sustainability (11) are assigned most often.

The evaluation of the word frequencies of the full texts showed that the term competence is among the 10 most frequent words, but only occurs in 70.77% of all publications.

Despite the increasingly perceived importance of competence orientation in teaching-learning research, there is a need for further research and development. This result leads to the analysis of the competence frameworks in the literature sample.

The following sub-questions directed the analysis of the literature sample regarding competence frameworks:

- RQ 1: Which SE competence frameworks can be identified? In total, four competence frameworks for SE could be identified in the literature sample. The earliest competence framework is by Lans et al. [16]. The framework was validated by Ploum et al. [28] and resulted in a modified competence framework. Another SE competence framework was developed by Biberhofer et al. [29] in the context of the CASE project. The latest competence framework was developed by Foucrier and Wiek [30] and integrates an entrepreneurial process.
- RQ 2: How were the SE competence frameworks developed and validated? The six-factor competence framework by Ploum et al. [28] is the result of validation by means of confirmatory factor analysis of an initial competence framework on SE by Lans et al. [16] using competence self-reports of 402 would-be entrepreneurs. The competence framework by Biberhofer et al. [29] includes five key competences. The development process included interviews of sustainability experienced managers and entrepreneurs. The competence frameworks by Wiek et al. [33,34] and Lans et al. [16] were considered when evaluating the interviews. An empirical validation was not found. Foucrier and Wiek's [30] competence framework does not list individual competences, but rather the tasks to be accomplished and the knowledge, skills, and attitudes required to accomplish them, structured in a five-stage entrepreneurial process model. The framework is based on a literature review that also includes the publications by Ploum et al. [28] and Biberhofer et al. [29] mentioned earlier.
- RQ 3: Do the SEE interventions identified in the literature refer to these SE competence frameworks? The SE competence frameworks are applied in three publications reporting on the performance of one or more SEE interventions. The low reception of the frameworks to interventions beyond the use in the research groups in which they originated can possibly be explained by their relative novelty. However, in 2018 two, 2019 three, and in 2020 five publications were identified that report on performed SEE interventions but none of them cited the consideration of a competence framework nor the first SE competence framework by Lans et al. [16].

5.2. Limitations

The review process shows some limitations as only publications written in English were eligible. This may cause the exclusion of publications and information for example on local SEE projects in non-anglophone countries like South America written in Spanish or Portuguese. Of 14 publications assigned to the American continent, only three (4.6%) publications from South America were identified. Whether this result was influenced by the exclusion of publications written in Portuguese or Spanish cannot be determined.

Likewise, only the Web of Science and Google Scholar were examined, although there are other data sources that should be assessed to ensure a complete dataset. To enable a comprehensive examination of the SEE research field, all documents should be captured, including unpublished so-called gray literature [100], such as conference proceedings [101]. However, in the review, the search for gray literature was limited to the Google Scholar data platform. To minimize the weaknesses of the search tool as a stand-alone means of identifying gray literature, the recommendations made by Haddaway et al. [100] were to use the title search and capture the first 1000 entries in each case. Nevertheless, gray literature is not comprehensively identified in this way [100].

5.3. Conclusions and Implications

This systematic literature review outlines the current state of research on SE competence frameworks to contribute to the development and assessment of competence-oriented

SEE interventions. Condensed information on three SE competence frameworks is provided, to allow for a comprehensive and straightforward comparison. SEE is a young but very dynamic research field that has already yielded three stand-alone competence frameworks for tertiary education in the time period between 2014 and 2019. The preceding appearance and further development of the frameworks clearly show the progress and professionalization of the field and thus the maturity of the interdisciplinary SE discipline.

The literature review was guided by the research question: What is known from the literature about SEE for formal education settings? The research question did not limit the selection of literature to a specific educational setting such as primary or vocational education. Despite the open nature of the research question, the selection of the literature sample shows a clear focus of implementation and research on SEE at tertiary education and a limited focus on secondary education. The absence of implementation and research in educational institutions beyond higher education is also criticized in the context of entrepreneurial education [128]. Ismail and Sawang [128] emphasize that the vast majority of entrepreneurial education programs target college participants in their 20s, and thus are more likely to start suddenly than to be cumulatively funded. Against the backdrop of lifelong learning and according to the skill formation model of Cunha et al. [129] learning processes that start early and build on each other are particularly successful. Thus, if early support is lacking, for example in the context of fostering SE competences, later learning processes are less productive. If SEE is to empower learners, regardless of whether the students go on to start their own business or work for an employer, to cope with sustainability challenges in a professional context the implementation of and research on SEE should address further levels of education like early, secondary, vocational or continuing education.

Hallinger and Nguyen [70] highlighted in their review on ESD a geographical imbalance in publications more frequently identified from countries assigned to the global south and Rashid [32] identified in a review on entrepreneurship education to achieve the SDGs in fragile states, several challenges like limited access to programs, lack of qualified teachers or funding in countries like Mozambique or Indonesia. A geographical imbalance can also be observed in this review, which is challenging because these countries, underrepresented in the sample, are particularly affected by environmental issues [130] as well as by underemployment contributing to social conflicts [131]. Therefore, research on SEE in these countries should be encouraged and collaboration with countries of the global north should be strengthened, whereby the field of SEE research would benefit from diversification.

The review sheds light on gaps existing in research and practice that can be addressed in the future. Therefore, the question arises whether the development of three independent competence frameworks into one coherent framework is possible and necessary. Furthermore, the question if particular competences should be prioritized in the development of SEE interventions is open for discussion. The limited reception of the frameworks in the literature sample beyond their use in the research groups in which they originated emphasises the desideratum for the development and assessment of further competence-oriented interventions. The extent to which the competence frameworks need to be adapted for use at educational levels other than higher education, such as vocational or secondary education, also remains to be addressed.

Author Contributions: Conceptualization, C.S.D.; methodology, C.S.D.; software, C.S.D.; validation, C.S.D., H.W. and J.H.; formal analysis, C.S.D.; investigation, C.S.D.; resources, C.S.D., H.W. and J.H.; data curation, C.S.D.; writing—original draft preparation, C.S.D.; writing—review and editing, C.S.D., H.W. and J.H.; visualization, C.S.D.; supervision, H.W. and J.H.; project administration, C.S.D., H.W. and J.H.; funding acquisition, C.S.D., H.W. and J.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by a doctoral scholarship of the Konrad-Adenauer-Foundation. The APC was funded by University of Konstanz.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Tha dataset generated during the study is reported in Appendix A Table A1.

Acknowledgments: We would like to thank the authors of the articles from the literature sample for making their publications available and for answering occasional questions. We thank the anonymous reviewers for their valuable comments, which helped to improve the quality of the publication.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Alphabetically sorted list of all publications of the literature sample.

Author (s)	Year	Title	Author (s)	Year	Title
Abina et al. [132]	2015	Determinants of Eco Entrepreneurial Intention among Students: A Case Study of University Students in Ilorin and Malete	Letovsky & Banschbach [133]	2011	Developing "Green" Business Plans: Using Entrepreneurship to Teach Science to Business Administration Majors and Business to Biology Majors
Amatucci et al. [134]	2013	Sustainability: A Paradigmatic Shift in Entrepreneurship Education	Lindner [135]	2018	Entrepreneurship Education for a Sustainable Future
Ambros & Biberhofer [136]	2018	Fostering Higher Education for Sustainability-Driven Entrepreneurship	Lloyd [137]	2010	Sustainability and Entrepreneurship Education at the University Level
Aviles et al. [138]	2019	Is Sustainable Entrepreneurship a Learning Competence?: Vision from High Education Organisation	Lourenço et al. [139]	2012	Promoting sustainable development: The role of entrepreneurship education
Baade et al. [140]	2020	The History of Sustainability and the Case of the Global Entrepreneurship Summer School: An Incentive to International Education	Masjud [141]	2020	Ecopreneurship as a Solution to Environmental Problems: Implications for University
Basu et al. [142]	2011	A new Course on Sustainability Entrepreneurship	McEwen [143]	2013	Ecopreneurship as a Solution to Environmental Problems: Implications for College Level Entrepreneurship Education
Beeri et al. [144]	2020	The Impact of Training on Druze Entrepreneurs' Attitudes Towards and Intended Behaviors Regarding Local Sustainability Governance: A Field Experiment at the Mount Carmel Biosphere Reserve	Mindt & Rieckmann [31]	2017	Developing Competences for Sustainability-driven Entrepreneurs in Higher Education: A Literature Review of Teaching and Learning Mehods
Bernhardt et al. [145]	2015	CASE Needs Analysis. Summary. Findings on Competences for Sustainability-driven Entrepreneurship. Based on interviews with partners from sustainability-driven enterprises and universities	Moon [146]	2017	100 Global innovative sustainability projects: Evaluation and implications for entrepreneurship education

Table A1. *Cont.*

Author (s)	Year	Title	Author (s)	Year	Title
Bernhardt et al. [119]	2017	Joint CASE Report on Cooperation between higher education institutions and companies and Evaluation of regional pilots Including an Executive summary	Moon [125]	2015	Green universities and eco-friendly learning: from league tables to eco-entrepreneurship education
Biberhofer et al. [147]	2016	Joint CASE Report on Content and Methods for the Joint Master Program on Sustainability-Driven Entrepreneurship	Nadim & Singh [148]	2011	A System's View of Sustainable Entrepreneurship Education
Biberhofer et al. [29]	2019	Facilitating work performance of sustainability-driven entrepreneurs through higher education: The relevance of competences, values, worldviews and opportunities	Nuringsih & Puspitowati [149]	2017	Determinants of Eco Entrepreneurial Intention Among Students: Study in the Entrepreneurial Education Practices
Brazdauskas & Žirnelė [150]	2018	Promoting Sustainable Entrepreneurship in Higher Education	Nurita et al. [151]	2020	Worksheet of Entrepreneurship Students to Train Ecopreneurship Characters:
Cincera et al. [97]	2018	Designing a sustainability-driven entrepreneurship curriculum as a Social Learning Process: A Case Study from an International Knowledge Alliance	Obrecht [152]	2016	Sustainable entrepreneurship education: a new field for research in step with the 'effectual entrepreneur'
de Jong [153]	2019	Educating sustainable entrepreneurship: the case of the University of Groningen	Özuyar [154]	2020	How to Teach Strategic Sustainable Entrepreneurship? A Proposal for Higher Education
Foster et al. [155]	2010	Teaching environmental entrepreneurship at an urban university: Greenproofing	Parra [156]	2013	Exploring the Incorporation of Values for Sustainable Entrepreneurship Teaching/Learning
Foucrier & Wiek [30]	2019	A Process-Oriented Framework of Competences for Sustainability Entrepreneurship	Ploum et al. [28]	2017	Toward a Validated Competence Framework for Sustainable Entrepreneurship
Foucrier & Wiek [117]	2020	Assessing Students' Competence in Sustainability Entrepreneurship Through In-Vivo Simulated Professional Situations	Ploum et al. [157]	2018	Exploring the relation between individual moral antecedents and entrepreneurial opportunity recognition for sustainable development
Foucrier et al. [118]	2020	Educating Students and Professionals in Sustainability Entrepreneurship—Strengths and Weaknesses of Innovative Course Formats	Ploum et al. [158]	2019	Educating for self-interest or -transcendence? An empirical approach to investigating the role of moral competences in opportunity recognition for sustainable development: Business Ethics: A European Review
Gilje & Erstad [159]	2017	Authenticity, agency and enterprise education studying learning in and out of school	Ramírez-Pasillas & Evansluong [160]	2017	Sustainable entrepreneurship undergraduate education: A community of practice perspective

Table A1. *Cont.*

Author (s)	Year	Title	Author (s)	Year	Title
Halberstadt et al. [5]	2019	Learning Sustainability Entrepreneurship by Doing: Providing a Lecturer-Oriented Service Learning Framework	Rashid [32]	2019	Entrepreneurship Education and Sustainable Development Goals: A literature Review and a Closer Look at Fragile States and Technology-Enabled Approaches
Hermann & Bossle [161]	2020	Bringing an entrepreneurial focus to sustainability education: A teaching framework based on content analysis	Refai et al. [127]	2017	Promoting Values through Sustainable Entrepreneurial Education—An Axiological perspective
Hermann et al. [162]	2020	Lenses on the post-oil economy: integrating entrepreneurship into sustainability education through problem-based learning	Severo et al. [163]	2019	The teaching of innovation and environmental sustainability and its relationship with entrepreneurship in Southern Brazil
Holzbaur [111]	2016	An Educational Game for Entrepreneurship and Sustainability	Shu et al. [164]	2020	The Development of a Sustainability-Oriented Creativity, Innovation, and Entrepreneurship Education Framework: A Perspective Study
Holzbaur [165]	2016	VAL-U: Development of an Educational Game for Entrepreneurship and Sustainability in and for Developing Countries	Strachan [166]	2018	Can Education for Sustainable Development Change Entrepreneurship Education to Deliver a Sustainable Future?
Huda [167]	2016	Towards Sustainopreneurship Development at the Tertiary Level Education: A Case study on Southern University Bangladesh	Suparno et al. [168]	2019	Do Entrepreneurial Education and Training Impact on Entrepreneurial Skills-Based Ecopreneurship?
Iscenco & Li [169]	2014	The game with impact: Gamification in Environmental Education and Entrepreneurship	Throop [170]	2013	From environmental advocates to sustainability entrepreneurs: Rethinking a sustainability-focused general education program
Ivanov [171]	2017	Fostering Sustainable Innovations and Entrepreneurship through Strategic Niche Management: The Bulgarian Case in Higher Education	Tripathi et al. [172]	2017	Innovation in sustainable entrepreneurship education in Africa. Strategy and social impact
Iyer [173]	2015	Strengthening of Extension Learning and Education or Sustainable Entrepreneurship	Voldsund et al. [174]	2020	Entrepreneurship Education Through Sustainable Value Creation
Jenkins [175]	2018	Entrepreneurial Learning for Sustainable Futures	Wokocha [176]	2020	Perspectives of Biology in Entrepreneurial Education for Sustainable Development in River State
Karari & Munyua [126]	2018	Entrepreneurship Education and Eco-Preneurship Innovation as Change Agents for Environmental Problems	Wyness & Jones [26]	2018	Boundary crossing ahead: perspectives of entrepreneurship by sustainability educators in higher education

Table A1. *Cont.*

Author (s)	Year	Title	Author (s)	Year	Title
Karlusch et al. [177]	2018	Educating for the development of sustainable business models: Designing and delivering a course to foster creativity	Wyness et al. [178]	2015	Sustainability: what the entrepreneurship educators think
Lans et al. [16]	2014	Learning apart and together: towards an integrated competence framework for sustainable entrepreneurship in higher education	Zain et al. [179]	2013	Innovation in Sustainable Education and Entrepreneurship through the UKM Recycling Center Operations
			Zain et al. [180]	2013	Sustainable Education and Entrepreneurship Triggers Innovation Culture in 3R

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