Editorial

Current Practices and Future Pathways towards Competencies in Education for Sustainable Development

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Abstract: The 2030 Agenda for Sustainable Development reflects the urgency to embed the principles of education for sustainable development (ESD) into all levels of education. ESD, understood as an integral part of quality education and where all educational institutions, from preschool to higher education and in non-formal and informal education, can and should foster the development of sustainability competencies. This Special Issue entitled "Competencies in Education for Sustainable Development II" responds to this urgency and the papers presented deliver recent developments in the field of sustainability and ESD competencies. They focus on various perspectives: systematic literature reviews and conceptual contributions; curriculum developments and pedagogical approaches to explore competencies' development, such as action research, serious games, augmented reality, multi-course project-based learning and group model building processes; testing and validation of assessment tools and processes for linking sustainability competencies to employability and quality assurance processes. The contributions show how the field of sustainability and ESD competencies has become a major focus in recent years and present emerging research developments. Further research efforts need to be put into operationalizing sustainability competencies and developing tools that help measure and assess students' and educators' competencies development.

Keywords: competencies; education for sustainable development; sustainability; assessment; pedagogical approach; curriculum

1. Introduction

The 2030 Agenda for Sustainable Development, adopted by world leaders at the United Nations Sustainable Development Summit in 2015 [1], reflects the urgency to embed the principles of Education for Sustainable Development (ESD) into all levels of education. Through the concretion of the 17 Sustainable Development Goals (SDGs), education is reaffirmed as a crucial goal to contribute to more sustainable, socially just and equitable societies. Target 4.7 of SDG 4 is devoted to ESD and the sustainability knowledge and competencies to be promoted amongst learners to cultivate global citizens as change agents towards more sustainable societies, embracing human rights, sustainable consumption, gender equality and cultural diversity amongst others [2]. In addition, the new *Education for Sustainable Development: Towards achieving the SDGs (ESD for 2030)* framework outlines five priority action areas focused on policy, learning environments, building capacities of educators, youth and local level action, stressing further the key role of ESD for the achievement of the 17 SDGs and the individual and societal transformation required to address climate change and sustainability challenges [3].

In this context, individuals and communities will have to engage in what amounts to significant learning and "unlearning", particularly concerning content, competencies and vision for the purposes and outcomes of education [4,5]. Individuals as part of society should be empowered to act in complex situations in a sustainable manner, which may

require them to strike out in new directions and to participate in socio-political processes, moving their societies towards sustainable development [6,7]. A fundamental reorientation of education at all levels and in all areas of education is required to promote sustainable lifestyles, democracy and the welfare of human beings. ESD must be understood as an integral part of quality education, inherent in the concept of lifelong learning: all educational institutions—from preschool to higher education and in formal, non-formal and informal education—can and should foster the development of sustainability competencies.

Over the last decades, an emerging body of literature regarding ESD and sustainability competencies has emerged. We understand the term sustainability competencies as the combination of cognitive skills, practical abilities, and ethical values and attitudes mobilised in a real situation or context related to sustainability [8]. The difference between ESD and sustainability competencies is that ESD competencies focus on the competencies that teachers and educators need to put in place in educational settings to promote sustainability competencies amongst their students. In this Special Issue, we accepted papers focusing on both ESD and sustainability competencies.

While no shared, common or validated framework exists in sustainability competencies, there is an academic agreement in the competencies that should facilitate individual and societal transformation towards sustainability being those of problem-solving, interpersonal competence, systems-thinking, future-thinking, strategic and normative competencies [9–11]. Generic sustainability competencies' frameworks have been developed [2,12], in conjunction with discipline-focused or specific frameworks, for example, for schoolchildren [13], higher education students [11,14,15], sustainability entrepreneurs [16], engineering [17], or pre-service teachers and educators [8,18–21]. One criticism of the recent literature is the lack of conceptual clarity and rich descriptions of the competencies' frameworks that have been proposed [6,22].

In addition, most of the articles published addressing sustainability competencies refer to higher education contexts, with only a few publications addressing early childhood, primary, secondary, or adult education [6]. There are practically no experiences that refer to non-formal, informal and community-based forms of learning and how these influence the development of sustainability competencies [23]. The lack of a widespread and validated lifelong learning competence framework for sustainability has led to the proliferation of many co-existing frameworks and definitions of what knowledge, skills, attitudes and values for sustainability are, failing to provide a clear and shared direction towards promoting sustainability competent citizens [24]. Developing sustainability competencies amongst all levels of education is particularly critical to the development of sustainability literacy and individuals becoming positive change agents in their workplace and personal lives [25]. However, to date, little evidence exists on the development, outcomes and impact that courses and educational initiatives introducing students to sustainability competencies have [11,15,26]. This has led to the emphasis on developing suitable paths and strategies to assess sustainability competencies in the recent literature in the field of ESD [4].

Thus, over the last years, the assessment of sustainability competencies using different tools, in different subject areas and contexts mainly focused on higher education, educators and pre-service teachers has become an emergent research area [4,27]. A diversification of assessment and its design and validation used in combination is needed for determining and monitoring students' sustainability performance [22,26].

The research efforts in the next years need to be put into operationalizing sustainability competencies and developing a diversity of tools to help measure and assess competencies' development amongst individuals in different education levels and contexts. This Special Issue "Competencies in Education for Sustainable Development II" responds to this need, covering ESD and sustainability competencies' conceptualisation and innovative pedagogical approaches to develop sustainability competencies in different educational settings and contexts.

During our working period as Special Issue editors, we received many submissions, which presented significant contributions for the main topics of interest of our Special

Issue. However, only 15 papers were accepted after three rounds of rigorous review (Contribution 1–Contribution 15). All accepted articles contribute to knowledge with recent developments in ESD or sustainability competencies addressing emerging topics and areas, such as sustainability entrepreneurship competencies, educators' ESD competencies, the role of study abroad programmes or indigenous knowledge. In particular, the accepted papers mainly focus on various perspectives: systematic literature reviews; development of conceptual models; pedagogical approaches and curriculum developments to embed sustainability competencies, which include the use of action research, serious games, augmented reality, multi-course project-based learning and group model building processes; the testing and validation of assessment tools and processes for sustainability competencies and the enhancement of these through quality assurance processes.

2. Systematic Literature Reviews and Conceptual Contributions

Two contributions in this Special Issue focus on systematic literature reviews and conceptual contributions on ESD to advance knowledge concerning sustainability entrepreneurship competencies that universities should promote amongst students and the sustainability competencies that educators should possess to promote ESD processes.

In Contribution 1, Foucrier and Wiek conducted a qualitative literature review on competencies for entrepreneurs, sustainability professionals, social entrepreneurs, and sustainability entrepreneurs. From this review, the authors develop a conceptual framework to link sustainability competencies to the processes associated with entrepreneurship and describe sustainability entrepreneurship competencies along with the entrepreneurial process model. The outcome is a process-oriented and literature-based framework of sustainability entrepreneurship competencies. It is intended to be used as a general vision for students, faculty, and entrepreneurs, as well as for the design of curricula, courses, and assessments. The generic and iterative process model developed by the authors is comprised of five entrepreneurship phases (Discovery–Planning–Start-up–Build-out–Consolidation) and serves as a reference tool. The authors indicate for each process phase the sustainability entrepreneurship main tasks, and the associated sustainability entrepreneurship competencies and sustainability competencies.

In Contribution 2, Corres, Rieckmann, Espasa and Ruiz-Mallén present a systematic review of the frameworks and models of sustainability competencies addressed to teachers and other educators. The main objective of the paper is to identify and analyse competencies' frameworks and models for ESD educators available in the literature, and to examine their relation to transformational perspectives. They analysed 14 papers out of an initial sample of 437. Most of them are based on the United Nations Economic Commission for Europe (UNECE) framework and its guiding ESD approach, and developed in formal education, particularly in higher education. The results show that the competencies which are more present across frameworks, predominantly address knowledge, skills, values and attitudes that have been identified as those that educators need to mobilize to address current sustainability challenges from a critical and transformative perspective, such as Critical Thinking, Connections and Participation in Community. However, other competencies, significantly associated with transformational education, such as Emotions Management, Futures-thinking and Achieving Transformation are less addressed and tend to receive less attention in terms of the pedagogical strategies needed to promote them. The authors discuss how the different ways of understanding and operationalizing sustainability and sustainability competencies can shape educators' transformational capacities in sustainability education. It is underlined that further studies should explore innovative ways to approach the emotional and more holistic competencies in practice and provide educators with practical and suitable tools for transformational education. Research should continue analysing the transformational potential of different frameworks and models of competencies, approaches and pedagogies, considering the specific role of the educators in sustainability education.

3. Pedagogical Approaches and Curriculum Developments

The exploration, implementation and evaluation of pedagogical innovative approaches and curriculum developments to foster sustainability competencies within different education contexts have become a growing interest within the research field of ESD. This is evidenced by the number of papers devoted to this matter in our Special Issue, a total of 7 papers out of 15.

In Contribution 3, Schweizer, Di Giulio and Burkhardt-Holm describe an action research approach adopted to redesign an elective study program focused on sustainable development. The article focuses on the scientific support provided by a team of external experts who facilitated a social learning process to enhance the quality of the program. The team promoted evidence-based decisions to redesign the curriculum and share with lecturers' common challenges and lessons learned from different study programmes. A workshop was facilitated to engage lecturers in rethinking current teaching practices and better align the new learning objectives with the implementation of courses. In addition, the redesign process involved a pilot and evaluation of the redesigned curriculum. The results of the paper illustrate the power of action research, social learning and scientific support to support the development of ESD competencies of university educators.

In Contribution 4, Peña, Corral and Mata present a research study aimed at determining what key professional sustainability skills (KPSS) must be developed through the serious game "The Island", to improve students' satisfaction from Business Accounting and Finances degrees. The data were collected using a questionnaire composed of dichotomous questions and a Likert scale (88 surveys). It was then analysed using linear regression models, with their inferences estimated through goodness of fit test and ANOVA. The first results indicated that the implementation of the "The Island" strengthened students' development of sustainability competencies, such as anticipation, systemic thinking, problem-solving and critical thinking. However, the data show that the serious game did not support the development of competencies related to strategic thinking, self-awareness and collaboration. Therefore, the authors conclude that students do not develop collectively sustainability competencies and, thus, do not perceive that they are developing strategic skills. In addition, the e-learning approach underpinning the game did not allow space for individual reflection, hindering the possibilities of developing self-awareness competencies. The authors recommend the development of further research that analyses the serious game through an active collaborative methodology and test it in different educational levels.

The study carried out by Ayers (Contribution 5) investigates the role of a study abroad program, the *Engineers without Borders Humanitarian Design Summit*, in promoting the acquisition of sustainability competencies in its students. An instrumental case study approach was undertaken in two research stages: (i) analysis of the program of study; and, (ii) written learning reflections of 137 student participants. The analysis showed that the program includes several concepts and methodologies associated to sustainability competencies: systems-thinking, anticipatory, normative, strategic, interpersonal. The study's findings suggest that students did acquire sustainability competencies during the program, but also that students may become competence-literate but context-lacking as they acquire competency skillsets without understanding their purpose for use as sustainability tools or to promote sustainability outcomes. As the authors suggest from the results of this study, educators should consider the role of a sustainability epistemic teacher as a guide to further contextualise competence learning, and student experience with "unsustainability" may play a role in further contextualisation and, importantly, the motivation of students to act towards sustainability as they develop a personal value set regarding sustainability.

Nigussie Demssie, Biemans, Wesselink and Mulder's article (Contribution 6) explores opportunities to embed indigenous knowledge systems in mainstream modern education in Ethiopia with a view of developing sustainability competencies. The authors organized a focus group with lecturers in three different state universities to discuss the current status of indigenous knowledge in education and identify potential actions for its inclusion in modern (westernized) education. In addition, they distributed an open-ended questionnaire to

different experts in the field. Five interrelated learning design principles are proposed: the definition of indigenous knowledge worldviews; the utilization of indigenous knowledge through, for example, considering traditional ecological knowledge; the need to build on students' local experiences; the engagement of the culturally diverse students in the learning process; and the use of sustainability-oriented pedagogies, such as operative, practice-based, place-based, field trip and real-world learning.

The work presented by Khandakar et al. (Contribution 7) focuses on a multi-course project-based learning (MPL) approach implemented in two electrical engineering inter-disciplinary undergraduate courses at Qatar University. The authors implemented this approach by proposing a design project to students, which allowed the assessment of engineering soft skills and project management skills related to sustainability. These skills include the ability to communicate effectively, to work collaboratively in a team, to think both critically and creatively and to manage projects efficiently with realistic constraints and standards. Through using student surveys, it was evidenced that the MPL approach used contributed to competencies' development including critical thinking and collaborative decision-making skills, and in increasing the average marks scored by students in the design project. The authors identify some challenges for implementing this approach such as the organization of pedagogical activities that are planned for each of the courses involved, the coordination of the materials delivered by each course, and the supervision of around 90 students per year performing the MPL method.

In Contribution 8, Waltz seeks to contribute to the existing discussion within ESD academics and practitioners about the most effective pedagogical methods and tools to help students develop the sustainability competencies of strategic planning and decision-making. The paper specifically analyses how group model building (GMB) could be used to foster learning that leads to competency for strategic sustainable development (SSD). Through analysing four existing cases, the author determines the potential of the GMB process' steps and associated modelling to foster learning for SSD. Theory on learning for sustainability and key sustainability competencies were linked to elements of a process for strategic planning toward sustainability within the framework for strategic sustainable development (FSSD) as a reference model.

The authors Huh et al. (Contribution 9) present a research study that sought to study how an Augmented Reality (AR)-based intervention helped enhance student awareness regarding fine dust in sustainable environments in Korea. To do so, the authors conducted a pre-post test study amongst 182 first-year high school students. Two hours of theoretical classes were conducted to provide knowledge and information on fine dust. A week later, another class was held for the same target students using fine dust educational content with AR technology. Surveys were conducted before and after the fine dust education to investigate changes in students' awareness and attitudes. The effect of using AR in experiential learning in fine dust environmental education showed enhanced results due to AR-based intervention, and a high level of satisfaction amongst the participating students. The authors highlight that the use of AR in classes is an effective tool in raising students' interest and promoting active participation for better engagement in learning activities.

4. Assessment of Competencies and Quality Assurance Processes

The need to further identify suitable assessment tools for sustainability competencies and connect these with employability and quality assurance processes was evident in this Special Issue. A total of 6 of the papers submitted and published have addressed this emerging research topic.

Gora, Stefan, Popa and Albu's paper (Contribution 10) explores the connections between quality assurance, the development of ESD competencies and employability through a student perspective. A structured questionnaire was used as the main data collection tool and was responded to by 496 undergraduate and masters' students from two higher education institutions in Romania. The survey included questions about quality criteria (incl. university's infrastructure and technical equipment, the content of the educational

process, teaching staff, teaching activities, research activities and practical activities); the development of knowledge, skills and competencies; and employability variables. The results highlight that students' sustainability competencies and their chance of employment in the labour market were positively and directly influenced by the quality criteria studied. They also highlight the importance of practical and research activities in the development of competencies which, in turn, has a positive in students' employability. The authors emphasise that future research should study the mismatch between the competencies developed by students and the competencies required in the world of work.

In Contribution 11, Estrada et al. conducted a study to explore how emotional intelligence, conceived as an essential dimension in the development and management of emotional competencies, was required to engage students meaningfully in sustainability and to build sustainable societies. The authors designed and distributed a questionnaire to 550 students from four higher education institutions and one secondary school in Spain. The results show that emotional intelligence is related to compassion and higher levels of student commitment, which ultimately has an impact on students' academic performance. The paper concludes that there is a need for introducing more subjects that involve students in reflecting on their values and emotions as well as developing academic staff's emotional intelligence skills.

In Contribution 12, Richter-Beuschel and Bögeholz, acknowledging the importance of teachers' sustainability competencies, conducted a study to (i) assess sustainable development-relevant knowledge on sustainable land use issues differentiating between situational, conceptual and procedural knowledge; (ii) find out via item response theory modelling how these theoretically distinguished knowledge types can be empirically supported, and; (iii) link the knowledge dimension(s) to related constructs. The findings showed that master students outperformed undergraduate students in situational/conceptual knowledge, but master students did not differ from undergraduate students regarding procedural knowledge. The study outlines student teachers' deficits in procedural knowledge, which can be attributed to the lack of specific ESD training and courses received. Therefore, the research concludes by stating that procedural knowledge in ESD needs to be embedded in teacher education programmes to promote the development of sustainability competencies in educators.

The study carried out by Renta-Davids, Camarero-Figuerola and Tierno-García (Contribution 13) aims at estimating pre-service educators' awareness of different challenges regarding SDG 4 and identifying the learning experiences that contribute the most to these students' awareness of quality education. The study drew on a sample of n = 202 first-year students pursuing education-related degrees at a Spanish university. The data were collected using a vignette survey and analysed using qualitative and quantitative techniques. The purpose of using the vignettes technique in this study was to capture the intended behaviour that students would adopt in the face of certain situations, reflecting their awareness of quality education. Four vignettes were created that succinctly describe specific educational situations related to the four selected challenges included in SDG 4. The results show a high degree of awareness within the context of most of the challenges posed by SDG 4 and, in the search for the factors that contributed to the degree of awareness in the students, personal interests and classes taken at the university stand out. Methodological implications of the use of the vignette approach in the assessment of students' awareness are also provided in his study. The study concludes by affirming that it would be interesting to extend its application to other universities to obtain a broader understanding of educators' degree of quality education awareness.

In Contribution 14, Ortiz-Marcos et al. present the results of the first part of the Tools for Enhancing and Assessing the Value of International Experience for Engineers (TA VIE) project and their framework of global competence for engineers. The authors suggest adopting OECD's global competence definition, which explicitly combines global awareness and intercultural communication competence with sustainability efforts, to inform higher education institutions. Based on research in five European countries (Spain, Italy, Sweden,

France and Hungary), this paper details the understanding, requirements and perceived skill gaps of companies hiring engineering graduates, the first step towards improved and assessable global competence education for engineering students. The authors emphasise that future research and practice needs to assess curricula and mobility programs taking into account the global competence; thus, the desired learning outcomes must be specified to help operationalize the competence.

In Contribution 15, Scherak and Rieckmann document an ESD professional development programme in teacher education at the University of Vechta which was designed using the 12 competencies developed as part of a European project titled "A Rounder Sense of Purpose (RSP)". During two consecutive years, a series of staff training sessions were organized at the university. At the end of this process, the researchers conducted a focus group with participants and developed a self-assessment survey to reflect on the development of ESD competencies of participants. The results indicate that the 12 RSP competencies are somehow interrelated and must be considered, but each competence needs to be discussed deeply to understand what it means. The findings also suggest that the development of ESD competencies is complex in this type of university training as participants need time and space to put them into practice and reflect on what they have learned. However, the training acted as an effective trigger to start thinking on and practising ESD.

5. A Final Reflection

The contributions in this Special Issue indicate that the conceptualisation, innovative pedagogical approaches, curriculum developments and design and implementation of assessment tools for sustainability competencies in the field of ESD have become trends and emerging issues in recent years. These contributions can inspire and reinforce other studies in this academic field. However, further research is still needed to operationalize sustainability competencies and design, test and develop assessment tools for determining competencies' development at different educational levels and in a diversity of educational contexts, including non-formal, formal and informal education settings.

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