Teacher Sustainable Development Competencies: from Policy to the State of Empirical Research and Practical Implications

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Abstract

This paper aimed to review empirical evidence concerning how teachers perceive and integrate sustainability principles into their teaching in the context of emerging global and national development and educational policies embracing the concept of sustainability. These advancements have positioned teachers as key figures in realising education for sustainable development. A comprehensive literature search was conducted using Web of Science, Elsevier Scopus, and ERIC databases and a total of 32 peer-reviewed English articles were analysed. The articles were analysed against a survey of the following categories: bibliographic information, the theoretical framework, the topic of the study, the research approaches and methods, the instruments used, and the main findings, which were also analysed for common themes. These studies encompassed a wide range of topics related to teacher knowledge and sustainability, employing diverse research approaches and methodologies. The findings revealed the variability and multifacetedness in teacher competencies, the influencing factors, and highlighted the need for holistic and interdisciplinary sustainability education encompassing global citizenship. The studies also underscore the importance of instilling sustainability awareness and behaviours since primary education, emphasizing teacher professional development and empowerment, with intervention studies showcasing positive impact on teacher and student competencies. Overall, this research contributes valuable insights into the complex landscape of sustainability education, providing recommendations for researchers, teachers, teacher educators, and policymakers in their efforts of teacher training and professional development to promote sustainability education in schools.

Keywords: Teachers, Sustainability Competencies, Systematic Literature Review.

1. Introduction

Sustainability has become a prominent element in global educational policies, leading to the emergence of environmental and sustainable education as a distinct field of research (Barth & Rieckmann, 2016; Wals, 2015). Teachers play a crucial role in promoting Sustainable Development (UNESCO, 2021), necessitating a focus on teacher competencies for Education for Sustainable

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Development (ESD). While some frameworks for teacher competencies have been proposed, there is a need to review the empirical evidence, particularly regarding how the concept is embedded in teacher education and how teachers perceive it and integrate it.

1.1. Background

1.1.1. Sustainable Development in Policy: Historical Highlights

The concept of sustainable development gained prominence with the 1987 Brundtland Commission's report, "Our Common Future," which outlined a global agenda for addressing environmental and sustainability challenges (World Commission on Environment and Development, 1987). It emphasized the interconnection between development and environmental issues, laying the foundation for subsequent international agreements, including the United Nations Conference on Environment and Development (UNCED) or Earth Summit in 1992.

The Earth Summits focused on global challenges such as poverty, health, and the environment, resulting in agreements like the Rio Declaration and Agenda 21 (United Nations, 1992a, 1992b; Johannesburg Declaration on Sustainable Development, The World Summit on Sustainable Development, 2002). These summits recognized the role of education in changing attitudes and behaviours towards the environment and sustainable development.

In 2015, the United Nations General Assembly adopted the Agenda for Sustainable Development, comprising 17 Sustainable Development Goals (SDGs) with 169 targets to be achieved by 2030 (United Nations General Assembly, 2015). This agenda acknowledges the critical role of education in achieving sustainable development, as well as targeting education itself through Goal 4, "Quality in Education".

1.1.2 Education for Sustainable Development and Sustainable Development Goals (SDGs)

Education for Sustainable Development (ESD) aims to integrate sustainable development principles into all aspects of education and learning, promoting responsible global citizenship (UNESCO, 2012, 2017). The United Nations Decade on Education for Sustainable Development (DESD) from 2005 to 2014 encouraged countries to incorporate sustainable development into education systems and curricula (UNESCO Education Sector, 2005). ESD emphasizes both

environmental and social aspects, including climate change, poverty reduction, and gender equality.

The 2030 Agenda, which succeeded the DESD, further underscores the role of education in achieving the SDGs. Sustainable Development Goal 4 focuses on ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all. Target 4.7 aims to ensure that "*by 2030 all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development"* (United Nations General Assembly, 2015, p.17). The target is understood as an important means to achieve all the other 16 SDGs. The Global Action programme (UNESCO, 2018) has five 'priority action areas', two of which are transforming learning and training environments, and building capacities of educators and trainers. For example, integrating ESD into pre-service and in-service teacher education programmes is one proposed action.

1.1.3 Teacher Education and Training for Sustainable Development

Given the pivotal role of education in sustainable development, teacher education and training have been a global focus, with UNESCO launching capacity-building programs and guidelines for teacher educators (Wals, 2012). National initiatives, like Germany's and Japan's strategies for ESD and teacher training, have also emerged (Federal Ministry of Education and Research, 2005; Ministry of Foreign Affairs, 2009). Despite progress, studies indicate that many teachers still lack the knowledge and skills to effectively integrate ESD into their teaching (Barth & Rieckmann, 2016).

Educators are expected to understand the global ESD discourse, challenges, and the integration of sustainability across dimensions. ESD pedagogy is participatory, practice-oriented, learner-centred, and transformative; it encourages active student participation, collaboration, critical, anticipatory, and innovative thinking, self-awareness, and real-world action (Leicht et al., 2018). Teacher approaches should evaluate learners' development of cross-cutting sustainability competencies and sustainability-related learning outcomes (ibid, 2018).

1.2. Empirical Research on Teacher Knowledge and the Current Research

As national and international educational policy and practice is shifting, as well as theory and frameworks developing, it would be valuable to look at the empirical investigations of these initiatives (Barth & Rieckmann, 2016; Imara & Altinay, 2021) . Thus, the current study aims to review the empirical base of the last two years concerning teachers' understanding of sustainable development and education for sustainable development. The study aims to investigate the background against the studies conducted and their pertaining research approach and methodologies. In addition, the current study will present narrative synthesis of the main studies' findings on teacher knowledge of sustainable development themes.

2. Methodology

2.1. Data Collection and Analysis

The literature search was conducted during March 2023 through the Digital Library of the University of Ljubljana and focused on three major databases: Web of Science, Elsevier Scopus, and ERIC. These databases were chosen for their extensive coverage of social sciences and education-related literature. The research targeted peer-reviewed English journal articles published between 2020 and 2023, utilizing the following set of keywords: ("teacher knowledge" OR "teacher knowingness" OR "teacher Consciousness" OR "teacher views") AND ("sustainability" OR "sustainability education" OR "ecopedagogy" OR "education for sustainable development") AND ("primary education" OR "elementary education" OR "initial teacher education"). The keyword search extended beyond just titles and abstracts yielded a total of 366 articles.

The subsequent step involved an initial screening of titles and abstracts, applying predefined inclusion and exclusion criteria related to the study's focus, the context of the study, research type, and publication details. In the third phase, 55 remaining articles were subjected to a thorough examination of their full texts. This screening ensured that the selected articles were empirical studies targeting (pre-service) teachers, featuring a clear conceptualization and measurement of competencies within the context of sustainability and teacher education and primary education. 23 articles were removed because they were either duplicate, editorials, implemented at the secondary schools, explained the process of teaching but didn't measure any teacher attribute.

Ultimately, 32 articles met the criteria for inclusion in the data analysis stage. The data underwent processing and coding using an Excel database, capturing

bibliographic details, target audience, research approach and methods, utilized instruments, rationale, and findings. Common themes across the main findings of the papers were identified, culminating into a narrative synthesis of the main themes.

3. Results and Implications

3.1 Bibliographic Overview

In terms of publication frequency, it is evident that the years 2020 and 2021 saw a considerable surge in research output. Subsequently, the publication rate dropped in 2022 and 2023, with four and five papers, respectively. This may be attributed to various factors, including ongoing research projects or publication cycles.

Regionally, Europe emerged as the dominant context of sustainability education research (N=22), with Spain being particularly prominent (N=10). This geographical focus may be indicative of Europe's endeavours for integrating sustainability principles into its educational systems and curricula. Additionally, the Middle East (N=3) and North America (N=3) were also regions of research contributions, with Israel and the United States, respectively, being presented in the field. Sub-Saharan Africa (N=3), Oceania (N=1), and Southeast Asia (N=1), were also regionally presented. It is noteworthy that some publications, such as those involving multiple countries like Serbia, Croatia, Hungary, Spain, and Norway, exemplify collaborative efforts across regions to address sustainability and environmental education. This expansion underscores the global nature of the challenges posed by sustainability and highlights the importance of cross-border collaboration in finding solutions and promoting sustainable practices in education.

The papers include a notable distribution across various journals. Among these, the journal "Sustainability" featured prominently, with 11 papers, demonstrating its significance as a platform for research related to sustainability and environmental education. Additionally, "Environmental Education Research" and "Education Sciences" were also notable journals in this domain, publishing nine and five papers, respectively. This diversity of journals underscores the interdisciplinary nature of the field, as researchers engage with topics related to sustainability, environmental education, and global citizenship across various academic platforms.

3.2. Theoretical Framework in the Reviewed Studies

In the realm of theoretical foundations, the studies exhibit a diverse array of approaches. While only a few explicitly mention grounding their research in specific theories, several others draw upon pedagogical theories or rely on legislative and policy frameworks to underpin their work.

For instance, Pamuk and colleagues (2022) employ the Theory of Commitment to Environmental Education Teaching, influenced by Lewin's Field Theory. Their study explores the interplay between personal and environmental factors in shaping teachers' environmental education practices, examining how school facilities, teacher attitudes and knowledge influence educators' behaviours and attitudes towards sustainability. The concept of Significant Life Experiences is also used to understand the impact of past life experiences on environmental values. Moreno-pino et al. (2022), adopt the Theory of Objectification (TO) in the context of critical mathematics education which challenges individualistic models of thought and conceives mathematical knowledge as a historical-cultural entity. The TO emphasizes collaborative learning, ethical development, and reflective thinking, providing a framework to integrate sustainability competencies into mathematics teacher training.

Other studies, while not explicitly grounded in theories, reference pedagogical theories to inform their research. Jeong et al., (2021) employ the flipped classroom methodology, which draws from active instruction methods. This approach involves moving lectures and concepts out of the classroom, using diverse learning materials to support students and foster problem-solving, group discussion, and collaborative learning. Ferreira et al., (2020) make reference to critical pedagogy by Paulo Freire, advocating for a holistic perspective that recognizes humans as integral parts of nature. They argue for attitudinal changes and a comprehensive approach to sustainability that encompasses economic, social, political, cultural, and environmental dimensions.

Most of the studies incorporate legislative, policy, and educational frameworks into their theoretical background such as the United Nations' 2030 Sustainable Development Agenda, Sustainable Development Goals (SDGs), and national or regional educational policies. These studies emphasize the importance of aligning educational practices with policy directives and legal frameworks.

The literature review of the studies under investigation of this current study encompassed several topics. These include higher education courses, primary education implementation, teacher competence and professional development, global citizenship, environmental and sustainability education in general, specific sustainability issues such as climate change or waste management, well-being and health, national contexts, and methodologies. Many studies span multiple categories, exploring various facets also within each domain.

Studies focusing on higher education underscore the role of universities in advancing sustainability education and environmental awareness. They showcase graduate-level courses and cross-curricular interventions aimed at equipping prospective educators with the necessary skills and knowledge to effectively integrate sustainability into their teaching. Other studies delve into sustainability education in teacher education and for in-service teachers, aligning with the need for curriculum adaptation, competency assessment, and tailored teacher training. These studies emphasize that sustainability, climate change, and global citizenship education should be core components of mandatory curricula, with teacher preparation aligning with educational policies and regional needs.

In addition, the reviewed studies cover a diverse range of sustainability topics, offering insights into teacher experiences and competencies related to socioscientific issues, food education, waste management, health, renewables, climate change, outdoor education, cultural sustainability, global citizenship, and education for sustainable development. This comprehensive exploration provides valuable insights into the multifaceted dimensions of sustainability education.

3.3. Methodology of Studies

The methodology employed in the reviewed studies reflects the diverse and multidisciplinary nature of sustainability education research, encompassing a wide array of research approaches and methods. These approaches range from qualitative explorations to quantitative assessments and innovative problem-solving methodologies.

Several studies (e.g. Brandt et al., 2022; Jeong et al., 2021; Laitinen et al., 2023; Macalalag et al., 2020; Mandrikas, 2020; Morote & Hernández, 2020; Oliveira et al., 2021; Solís-Espallargas & Morón-Monge, 2020) employed intervention-based approaches. These studies implemented educational interventions or programs focused on sustainability and subsequently evaluated their impact using various methods. Pre- and post-test questionnaires were commonly used (Jeong et al., 2021; Solís-Espallargas & Morón-Monge, 2020), complemented by the triangulation of data sources, including interviews, reflective diaries, and video/photographic records (Brandt et al., 2022; Laitinen et al., 2023; Macalalag et al., 2020; Mandrikas, 2020). In addition to these methods, some studies employed problem-solving approaches like action research and design thinking, engaging different stakeholders in idea generation and solution experimentation (Al-Thani et al., 2021; Evans & Ferreira, 2020; Niens & Bögeholz, 2021; Pérez-Guilarte et al., 2022).

Other studies adopted comparative research approaches to examine variables across different national contexts (Borsos et al., 2022; Brandt et al., 2022; Sjöblom et al., 2021; van Werven et al., 2023). These studies sought to understand how sustainability education varied in different regions and the factors influencing these variations.

Qualitative research methods featured in-depth interviews and focus groups to gain profound insights into teachers' experiences, perspectives, and identities within the realm of sustainability education (e.g., Da Silva-Branco & Woods-McConney, 2021; Parejo et al., 2022; Timm & Barth, 2020; Zaradez et al., 2020). On the other hand, quantitative methodologies employed validated questionnaires to measure variables such as teacher efficiency (Imara & Altinay, 2021; Vukelić, 2022). Some studies mixed-methods studies combined open-ended questions with opinion surveys, multiple-choice questions, and Likert scale items to offer a more comprehensive understanding of their research topics (e.g. Demant-Poort & Berger, 2021; Martínez-Borreguero et al., 2020; Molina-Torres & Ortiz-Urbano, 2020; Nguyen et al., 2022; van Werven et al., 2023).

3.4. Main Findings of the Studies

3.4.1. Challenges in Implementing Sustainability Education and Influencing Factors in Developing Teacher Competencies

Challenges in implementing sustainability education and factors influencing teacher competencies are multifaceted, with teachers often lacking necessary support and competencies to address sustainability effectively in education (Al-Thani et al., 2021; J.-A. Ferreira et al., 2019; Pérez-Guilarte et al., 2022). This gap may lead to misconceptions about sustainability topics (Demant-Poort & Berger, 2021; Jeong et al., 2021), exacerbated by teachers' struggles to identify strongly with their roles as environmental educators due to broader perceptions (Zaradez et al., 2020). Variation in teachers' concerns and competencies, influenced by factors like national development and personal traits ((Timm & Barth, 2020), highlights the complexity of sustainability education. What's more, factors affecting teacher challenges can overlap and depend on specific contexts (Niens & Bögeholz, 2021).

Studies of University education and training programmes have reported positive impacts of these programmes in developing teachers' competencies. Developing teachers' competencies is important as it might help overcome some of the challenges. For instance, outdoor studies (Borsos et al., 2022; Sjöblom et al., 2021) have highlighted the multifaceted factors influencing teachers' commitment to sustainability education. Finnish and Norwegian student teachers of this study (Sjöblom et al., 2021) reported positive views of outdoor education,

emphasizing its benefits, such as active and experiential learning, improved motivation, and environmental consciousness. However, they also expressed concerns about issues like safety, challenging weather conditions, planning requirements, parental resistance, and classroom management challenges. Norwegian student teachers exhibited a more favourable perception of outdoor teaching, likely influenced by their curriculum's emphasis on outdoor activities. However, the authors maintain that enhancing student teachers' confidence in outdoor teaching may help overcome some of the obstacles (Borsos et al., 2022; Sjöblom et al., 2021).

Intervention studies with pre-service and in-service teachers reveal their significant impact on teacher competencies and sustainability education. These interventions positively contribute to the development of teachers' competencies in addressing sustainability in their teaching practices. For instance, Vukelić, (2022) reports that student teachers who had attended ESD courses expressed higher levels of intention to implement ESD and higher self-efficacy for ESD. The number of attended ESD courses was positively correlated with readiness to implement ESD. Next, Macalalag et al., (2020) found that discussing real-life socioscientific issues as part of university courses expanded teachers' understanding and their ability to integrate STEM content into relevant contexts. Similarly, Jeong et al., (2021) demonstrated that an active and flipped classroom intervention improved teachers' awareness of climate change. However, the lack of prior training and support contributes to teachers' limited knowledge in sustainability-related areas (Morote & Hernández, 2020).

Other studies report on other strategies for competencies development. For instance, both Brandt and colleagues 2022, and Kerr, 2019 reported that social interactions and feedback in teaching environments contribute to pedagogical content knowledge development. Knowledge forms the basis for cultivating positive attitudes, which in turn is reported a determining factor in implementing practices related to sustainable development (Pamuk et al., 2022). Cascade learning, coteaching, and enhancing self-efficacy are also suggested strategies to equip teacher in addressing challenges in sustainability education and generally increasing sustainability awareness (Ada, 2020; Antón-Peset et al., 2021; Baena-Morales et al., 2020; Borsos et al., 2022; Sjöblom et al., 2021).

Overall, studies emphasize the need for tailored and comprehensive training programs, including participatory and practice-oriented methodologies, to equip teachers equally with knowledge and practical skills for sustainability education (Marcos-Merino et al., 2020; Nguyen et al., 2022; Pamuk et al., 2022)

3.4.2. Need for Holistic and Interdisciplinary Sustainability Education

Overall, the studies underscore the necessity for an interdisciplinary, holistic, and ecological approach to sustainability education. However, this comprehensive approach is often underrepresented in teacher education programmes as well as in primary education (Pérez-Guilarte et al., 2022; Solís-Espallargas & Morón-Monge, 2020). While sustainability encompasses the environmental, social, and economic dimensions, there is a tendency among teachers and students to associate socio-environmental problems predominantly with issues like climate change and environmental pollution, rather than recognizing also the broader social aspects of sustainability, such as poverty and gender equality. Consequently, a disconnect exists between societal and environmental dimensions in their understanding of sustainability (Pérez-Guilarte et al., 2022). Moreover, sustainability topics tend to be confined to science classes, with a consensus among teachers that they should also be integrated into humanities and social subjects (Demant-Poort & Berger, 2021; Morote & Hernández, 2020; Pérez-Guilarte et al., 2022). Nonetheless, studies reveal a potential for simultaneously emphasizing science concepts, particularly within the Science as a Human Endeavor strand, alongside the sustainability cross-curriculum priority (Da Silva-Branco & Woods-McConney, 2021).

3.4.3. Shifting to an Ecological Perspective and Embodying Indigenous Knowledge and Global Citizenship Education

While teachers seem to acknowledge that human activities contribute to climate change (Demant-Poort & Berger, 2021), the current framework of Education for Sustainable Development (ESD) remains predominantly anthropocentric, focusing on preserving the planet for future human generations. Teachers also seem to often avoid incorporating political content into their teaching, deeming it inappropriate (Brandt et al., 2022; Pérez-Guilarte et al., 2022). Consequently, there is a need to explore alternative educational approaches, such as ecological citizenship and ecopedagogy, which foster complex thinking, social creativity, civil ethics, and critical ethical reflection, promoting a broader perspective on sustainability and critical thinking about power imbalances (Brandt et al., 2022; Moreno-pino et al., 2022; Oliveira et al., 2021; Parejo et al., 2022; Pérez-Guilarte et al., 2022).

Oliveira et al., (2021) conducted a study in Guinea-Bissau that highlights the importance of incorporating indigenous knowledge and community values into sustainability education. Their research reveals that among the activities within the Scientific-educational Kit developed by teachers, those promoting inquiry

and community engagement garnered the most relevance. Parejo et al., (2022) explore Global Citizenship Education (GCE) in sustainability education, promoting civic engagement in addressing global environmental, economic, and social issues. They note initial neocolonial orientations among GCE teachers, but recognize the potential for reorienting GCE content to address local issues effectively. This shift aligns with findings from Molina-Torres & Ortiz-Urbano, (2020), highlighting teachers' interest in active learning methodologies and citizenship skills development. Meanwhile, Iris M. van Werven and colleagues identify various GCE typologies among teachers and teacher educators, including moral and cultural global citizenship. They also emphasize advocacy-based GCE elements and teacher competencies, which was reflected in teaching practices such as cooperative learning, critical thinking development, and caring for the environment. The study highlights a shift towards adding active teacher competencies and practical GCE implementation, such as tailoring communication with parents and collaborating with the school community.

3.4..4. Fostering Sustainability Education in Primary Education

The studies reviewed underscore the critical need for addressing sustainability since primary education, emphasizing its significance in instilling awareness and sustainable behaviours (Morote & Hernández, 2020; Oliveira et al., 2021). Teachers, while expressing genuine interest in delivering sustainability-related subjects, often require access to essential resources and specialized training programs to effectively meet this educational demand (Evans & Ferreira, 2020; Macalalag et al., 2020; Molina-Torres & Ortiz-Urbano, 2020; Oliveira et al., 2021). This implies the vital role of teachers as drivers of sustainability implementation, necessitating continuous support from educational institutions and active leadership engagement to seamlessly integrate sustainability principles into the education system (Da Silva-Branco & Woods-McConney, 2021; Zaradez et al., 2020).

4. Conclusion

This paper summarizes the findings from studies conducted over the past two years that investigate teacher competencies related to sustainability education. The research indicates that initiatives in both university and primary education settings, aimed at enhancing the competencies of both pre-service and in-service teachers, have generally been successful. These studies reveal a complex interplay of factors that impact professional development and the implementation of sustainability education, and there is considerable

variability in teachers' competencies in this regard. While frameworks for teacher competencies exist, the majority of the reviewed studies emphasize the importance of assessing teacher competencies, creating tailored teacher training programs, and evaluating the effectiveness of integrating Education for Sustainable Development (ESD). The paper also underlines the need to address sustainability education comprehensively, with an interdisciplinary and holistic approach, considering national contexts and adapting content to local community challenges. International policy initiatives have stimulated both educational practice and research, which is evident in the theoretical foundations of most of the reviewed studies. The diverse research methodologies and the global representation of these studies underscore the growing recognition of education's global, complex and pivotal role in achieving sustainable development and well-being worldwide. This study can further inform the interrelation between research, policy, and practice in developing teacher competencies for sustainability education.

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