Education for Sustainable Development in Teacher Education

Subjects: Environmental Sciences

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Teachers play a crucial role in supporting the development of students' environmental knowledge and skills for responding to environmental change. Education for sustainable development (ESD) involves holistic, transformational and lifelong learning processes that aim to enhance the cognitive, social, emotional and behavioural dimensions of learning.

climate change | environmental issues | subject student teachers | sustainable development

1. Introduction

The role of human beings in environmental and sustainability problems, such as climate change and the reduction in biodiversity, has been reported as increasing [1]. As the world's population has grown, the effects of these changes have expanded from the local to the regional and global levels. The formation of global ecological, social and economic challenges cannot be addressed by individuals working alone or solely using local efforts [2]. With the help of global development guiding the sustainable development (SD) paradigm, the aim is to find ways to overcome threats to ecology and human health by looking for new forms of interactions between society and nature [3]. Effectively combating environmental problems requires people to acquire new knowledge, skills and ways of thinking and acting. The education system must respond to this need with appropriate teaching content and teaching methods [4].

Education for sustainable development (ESD) involves holistic, transformational and lifelong learning processes that aim to enhance the cognitive, social, emotional and behavioural dimensions of learning [5]. ESD seeks to balance human and economic wellbeing while taking into account cultural traditions and the sustainable use of the earth's natural resources [6]. It emphasizes the expansion of social learning and responsibility thinking from the individual level to communities and social institutions [7]. Key issues in ESD include globalization, the rise of the information society and the knowledge society, the use of diversity and the need for the inclusion of marginalized groups and perspectives [6][8]. The main goal is to educate students to be cooperative, active members of society who see environmental problems as solvable, know how to draw up plans to promote sustainable development (SD) and are ready to act in accordance with those plans [5][9]. This goal is also noted in the curricula of Finnish basic and upper secondary education [10][11]. Comprehensive knowledge and socio-emotional and practical skills serve as the basis for promoting SD [5][12].

In general, students entering teacher training programs already have some sense of the subjects they are studying. However, their knowledge can be partial, illogical or simply wrong; these “alternative conceptions”, as the field describes them, make it difficult to learn new concepts and theories for several reasons [13]. First, students usually do not know that their information is wrong. In addition, they interpret new experiences through these incorrect understandings, with their old “knowledge” interfering with the better understanding offered by new knowledge. Misconceptions can also take root in the students’ thinking and make learning difficult because learning requires replacing or reshaping their old knowledge [13]. Learning requires a conceptual change, without which a student cannot effectively learn new knowledge and skills. In order for teachers to support learning, they must know their students’ alternative conceptions. Thus, in order to teach SD, they must know their students’ previous perceptions of SD and environmental challenges, their interest in adopting new ideas about SD and their desire to act on behalf of the environment.

2. The Environment and Environmental Problems

The meaning of the term “environment” has changed significantly over the last few decades. Previously, it was associated with the natural environment and the pollution thereof. Today, it covers the full range of living environments and activities. Thus, it is often presented in accordance with the concept of SD as three-dimensional in two ways, with environmental, social and economic dimensions on the one hand and the three transverse dimensions of needs, long-term consideration or future generations and institutional aspects or governance on the other hand [14]. In the present research, this more nuanced concept of “environment” is applied.

The state of the environment and environmental problems have been extensively studied in recent years. According to the Intergovernmental Panel on Climate Change (IPCC), the most urgent environmental problem is climate change. Human-caused climate change has already been connected with extreme weather events across the globe. This has adversely affected food and water security, human health, economies and whole societies, leading to damage to nature and economic losses [15]. In Finland, as elsewhere, climate change is one of the most serious environmental problems affecting humanity. It is linked to the impoverishment of biodiversity and unsustainable consumption and production methods [16]. The IPCC has set the goal of shifting development pathways to increase sustainability and mitigate climate change [2]. A climate-neutral Europe by 2050 is the goal of the European Union (EU). Particular attention is being paid to the development of the circular economy, the central functions of which are waste reduction, reuse and recycling to promote economic wellbeing and environmental protection [17].

From the perspective of environmental protection, the enormous diversity and sheer scale of the environment poses challenges, as the environment is seen as the indirect responsibility of everyone but the direct responsibility of no one [1]. The socially constructed nature of environmental problems also poses challenges. Although statistically verifiable data are used to identify environmental problems, the selection and definition of those data are socially constructed. This can lead to disagreements about environmental problems, as some may feel that a given definition conflicts with their interests [18]. Due to the multidimensional nature of the environment and environmental problems, it is challenging to find an objective truth to define these terms, to assess the severity of

environmental problems and to identify cause-and-effect relationships [1][18]. Based on the multidimensional nature of environmental issues and the diffuse responsibility for the environment, local, regional and global environmental problems and who is expected to solve them are the focus of the present research.

The results and conclusions of environmental reports have been based mainly on information provided by decision makers' [19] and citizens' perceptions of environmental problems and behaviours [20]. By interviewing local decision makers and environmental experts, Rousval [21] and Rousval and Maurin [22] created a hierarchy of the environment and related goals that were based on environmental problems (**Table 1**).

Table 1. Hierarchy of objectives in the environmental field [21][22].

Objectives on Global Levels	Objectives on Local Levels
Preserving the environment for human life	*Concerning the natural environment*
Limit the greenhouse effect	Limit the degeneration
Limit climate change	Protect fauna
Protect the ozone layer	Protect flora
	Preserve landscapes
Preserving natural resources	Limit excessive use of concrete
Limit the extinction of natural species	
Limit the extinction of the natural environment	*Concerning the human environment*
Limit energy consumption	*Concerning public health*
Limit the maritime pollution	Limit the effects of air pollution
Limit the production of non-recyclable waste	Limit the health impacts of noise

Objectives on Global Levels	Objectives on Local Levels
	Concerning quality of life
	Limit disturbing noises
	Limit disturbing fumes
	Limit disturbing odours
	Improve townscapes
	Preserving cultural legacies
	Respect an area's villages
	Prevent habitats from being spoiled [23]

onmental [24]

3. Students' Perceptions of Environmental Problems

Finnish university students have been shown to regard climate change to be the most serious environmental problem, with decreasing biodiversity second and the lack of clean water third [25]. The main goals in teaching climate change, according to the perceptions of Finnish university students, are increasing and structuring knowledge, developing thinking skills and encouraging action, with raising hope and triggering emotions regarded as less important [26]. The findings of Kukkonen et al. [25] support previous research [24] in which teacher candidates were reported to consider the most important environmental problem to be global warming, with climate change coming second. Salīte et al. [27] found that student teachers did note the serious effects of climate change but regarded other issues as more serious, especially pollution. That finding partially diverges from Elshof's report [28] that technology teachers perceived biodiversity and global warming as the least important sustainability issues. Kukkonen et al. [25] found that arts, social sciences, mathematics and natural sciences students considered the lack of clean water to be a serious environmental problem more often than education students, with female students regarding climate change as the most serious environmental problem more than male students. This finding is in line with those of Svetina et al. [29] about a gender difference in appreciating sustainability. Some international studies conducted at universities have mapped students' awareness of waste minimization, collection,

reuse and recycling problems [30][31][32]. These studies and others [19][33] show that environmental issues are very important for students.

Finnish university students have also been shown to be aware of the existence of local, regional and global ecological, economic and environmental problems [33]. Of local problems, they consider air pollution, private motor vehicles and littering to be big issues in particular. Regional problems included ineffective local transportation, overconsumption and the use of energy. Globally, they showed awareness of climate change, deterioration in water quality and low levels of recycling. However, they did not consider social disadvantage to be a SD issue. This finding differs from another study [34], where Spanish student teachers rated social problems as more important than other environmental problems.

4. Sustainability, SD and Environmental Issues

The heart of sustainability lies in ethical issues related to three concepts: continuity, orientation and relationships [35]. From the perspective of continuity, the concept of sustainability involves stability over time and the inherent ability of systems (e.g., ecosystems, economic systems), entities (e.g., species, buildings, capitals) and processes (e.g., evolution, activities) to survive, with or without human intervention, in a context of rapid change. The concept of “orientation” refers to the idea that sustainability is the main goal that should guide the actions of individuals and communities [33], while “relationship” is the core idea in the Brundtland Report [36], which clearly emphasizes the link between the environment and development and the importance of the human dimension in all decisions concerning environmentally sound development [37]. Thus, sustainability has often been divided into weak and strong forms [38]. The former emphasizes the quantitative aspect of growth [39]; the idea is that weakening one dimension of SD could be mitigated by strengthening another [38]. For example, a lack of ecological sustainability could be managed by technological advances. In this case, the danger is an overestimation of nature’s carrying capacity and an inability to recognize the need to protect nature and change our current behaviours. From a strong sustainability perspective, the dimensions of sustainability complement one another [40], and the importance of the green economy and environmental protection is emphasized [38].

Sachs [41] (p. xiii) has stated that SD “is both a way of looking at the world, with a focus on the interlinkages of economic, social, and environmental change, and a way of describing our shared aspirations for a decent life, combining economic development, social inclusion, and environmental sustainability. It is in short both an analytic theory and a ‘normative’ or ethical framework”. Thus, SD is a socio-economic issue that not only helps meet short-term human needs but also contributes to long-term progress towards wellbeing and a better quality of life within realistic environmental constraints [42]. At its core, it has three principles: eco-efficiency, inter- and intra-generational social justice and participation in decision making [36]. Eco-efficiency strives to create more goods and services with fewer resources and creating less waste and pollution in the process. Inter- and intra-generational social justice and the possibility of participating in decision making depend on different aspects, including inter- and intra-generational equity, the distribution of power and resources, education and freedom [43].

The concept of SD derives from the triple bottom line framework, which implies a balance between the three dimensions of sustainability: ecological, social and economic SD [44]. The broad perspective of the concept of environment, where cause-and-effect relationships of phenomena related to the environment are also examined socially and culturally, is also clearly visible in the SD concept [45].

Ecological SD focuses on maintaining the level of environmental protection necessary for carrying out economic activities and enhancing people's quality of life [38]. Human–environment interactions and their impacts belong to the ecological dimension. Social SD strives to ensure human rights and equality, the preservation of cultural identities and respect for cultural diversity, race and religion [46]. At the core of the social dimension are social equity and the sustainability of communities. Economic SD involves creating and maintaining the natural, social and human capital required for income and living standards [47]. It concerns organizations' impacts on the economic conditions of their stakeholders and on economic systems at the local, national and global levels. These three dimensions are also integrated in a complex manner: for example, the political aspect is mainly a part of the economic dimension but also affects the other two dimensions [37].

The importance of ecological SD lies in the fact that society and the economy depend on the integrity of the biosphere and the ecological processes taking place within it. Consequently, people should maintain their social, cultural and economic wellbeing without overly depleting natural resources or overloading nature's delicate balance. SD cannot be achieved solely with technical solutions, political regulation or financial instruments; it also requires high-quality education and learning for SD [5].

In the early years of environmental education, teaching was often based on a resource-oriented and reductionist approach that avoided social, environmental and political issues. Instead, it emphasized protecting fauna, flora and natural resources. It was often also connected with the idea of the ability of science and technology to find solutions to environmental problems. Later, the focus shifted to the responsibility of the authorities and of every citizen to protect, revitalize and improve the environment not only in the ecological but also in the social and economic areas [48]. These perspectives are reflected in the environmental knowledge and skills of today's university students.

According to Khalid [49], prospective American science teachers had several misconceptions about the causes, consequences and interactions of the greenhouse effect, ozone depletion and acid rain. Teksoz et al. [50] concluded that Turkish pre-service teachers did not possess an acceptable degree of knowledge; they could barely identify, analyse, investigate and evaluate environmental problems and issues or the interrelationships between natural and social systems. Kopnina and Cocis [51] showed that Dutch higher education students discussed social and economic SD as the cornerstones of SD without realizing that human wellbeing and economic stability depend on the availability of natural resources. For some students, social justice and economic equality were even more important than environmental issues. Yavetz et al. [23] reported that attitudes of future teachers in Israel did not necessarily translate into environmentally responsible behaviours. These examples show that environmental problems are intricately related not only to ecological but also to economic and social issues and that teaching

them using interdisciplinary approaches that integrate ecological science with social and economic issues and in-depth knowledge are necessary.

Environmental knowledge can be classified into system knowledge, action knowledge and effective knowledge [52]. System knowledge refers to the natural characteristics of environmental and ecological systems regarding the relationship between organisms and ecosystem functions. Understanding the causes of environmental problems requires system knowledge and thinking concerning, for example, why carbon dioxide is a problem, where groundwater comes from, why the ozone layer is important and how long it would take for the ozone layer to completely regenerate [53].

Moreover, according to Díaz-Siefer et al. [54], the knowledge of the local environment in relation to global environmental problems supports students' pro-environmental behaviour. Kollmuss and Agyeman [55] (p. 240) defined pro-environmental behaviour as consciously seeking "to minimize the negative effects of one's own actions on the natural and built environment (e.g., minimizing resource and energy consumption, using non-toxic substances, reducing waste production)". Action knowledge is needed when selecting activities and minimizing and eliminating environmental problems [55]. Effective knowledge supports the kind of environmental activity or behaviour that can achieve the greatest environmental benefit [52]. According to Barber et al. [56], in-depth information about the environment and the causes of environmental problems increases people's motivation and actions to confront environmental problems; conversely, insufficient or contradictory information limits participation in environmental activities [57]. However, information on the relationship between environmental knowledge and pro-environmental behaviour is conflicting. Laroche et al. [58] found no significant relationship between environmental knowledge and pro-environmental behaviour. One reason for these conflicting results is that having an environmental understanding is not easily transformed into a feeling that generates action. Kollmuss and Agyeman [55] list several obstacles to the transformation of knowledge into feeling. The first is the "non-immediacy of many ecological problems" (p. 253), the second is that the deterioration or even destruction of the environment occurs gradually, and the third is the complexity of environmental problems.

5. ESD in Teacher Education and Teachers' Attitudes towards ESD

ESD is a transformative and holistic education that addresses learning objectives, content and outcomes and pedagogy and the learning environment [6]. The goal of ESD is to provide learners with the information they need to undertake responsible environmental action by supporting the values, knowledge, understanding and multidisciplinary practical, cognitive and socio-emotional skills needed for sustainable environmental management, the promotion of social justice and the eradication of poverty [5]. ESD is also useful in encouraging people to participate in SD actions to promote social, economic and political change and to modify their own behaviours. ESD aims to develop competence so that individuals are able to look at their own actions, taking into account current and future social, cultural, economic and environmental impacts from both local and global perspectives [6]. Individuals should also be empowered to act sustainably in complex situations, which may require them to participate in socio-political processes and help direct their societies towards SD [59]. In this case, the ability to work

with actors with different value systems and to find meaningful compromises to resolve conflicts between stakeholder goals are essential. Environmental problems and their solutions are a key part of SD, so being aware of them and understanding their interactions can also be considered SD skills [60].

The problems faced when integrating SD into teacher education are the conflict between the multidisciplinary nature of SD and the differentiation of university disciplines, a lack of time and a shortage of competent staff [37][61].

The attitudes of both teachers and student teachers towards teaching SD and their experiences of their own competence vary, and research on the subject is partly contradictory. Previous studies have found that teachers have a positive attitude towards SD and perceive their own SD competence to be moderately good [62][63]. Student teachers have also been found to consider teaching SD as part of teacher training important, but they feel that the amount of teaching is insufficient [64]. On the other hand, teachers and student teachers have also been shown to have indifferent or even negative attitudes towards SD and to feel that SD content does not belong in their teaching, even though it has been included in basic education curricula since the beginning of the millennium [65].

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