Climate Change Education in Finland

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The climate change education (CCE) is understood as a component of environmental education and education for sustainable development. Its core concept is CC literacy, which means that students understand the scientific concepts related to CC and the relationships between them, as well as the effects of CC and their own activities on the environment. CCE is multidisciplinary and interdisciplinary. Multidisciplinarity means that knowledge of various individual sciences is needed. Interdisciplinarity, on the other hand, incorporates elements from a variety of disciplines and also integrates environmental, economic, social and political issues.

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1. Specific Features of Climate Change Education (CCE)

For over a decade, the United Nations (UN) and the Education for Sustainable Development (ESD) program of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) have played prominent roles in promoting sustainable development [1][2]. In sustainable development and education of sustainability, several different concepts (e.g., sustainable education, sustainability education, and education for sustainable development) have been and continue to be used. These terms contain similar ideas, but they do not mean the same thing [3]. Sterling [4] defined the term sustainable education as âa change of educational culture, one which develops and embodies the theory and practice of sustainability in a way which is critically aware. It is therefore a transformative paradigm which values, sustains and realises human potential in relation to the need to attain and sustain social, economic and ecological well-being, recognising that they must be part of the same dynamicâ.

The concept of sustainable education thus refers to finding sustainable solutions to environmental, social, and economic problems through education [5]. It is a concept that challenges both formal and non-formal educational sectors to actively participate in the creation of economic, social, and environmental programs that improve the quality of life, increase the empowerment of students to perform as active citizens, and respect interdependence [6].

Sustainability education is an interdisciplinary, collaborative, experiential, and potentially transformative process of creating a space for inquiry, dialogue, reflection, and action about the values and goals of sustainability [7]. Again, education for sustainable development is a holistic and transformational lifelong learning process which aims to enhance the cognitive, social, emotional, and behavioral dimensions of learning [8].

Climate change is an ecological phenomenon. CCE therefore requires a transformative education based on an ecological vision, with holistic, systemic, and multi- and interdisciplinary planning and

implementation at its core. Sustainable education is built on this view, which is why it can be considered useful in the context of CCE.

The notion that CCE is crucial to redirecting teaching and learning in the face of the contemporary climate emergency is now widely established and accepted [9][10][11][12]. In this context, universities [13][14] and teacher education departments [15] are of great importance in CCE.

According to Kagawa and Selby [16] (p. 4), the aim of CCE is to reflect in depth on what is very important and to envision future perspectives together. Education should increase holistic understanding of CC causes, consequences, and mitigation and adaptation measures [16] (pp. 241â243). To achieve this, critical and systemic as well as strategic thinking are needed. Critical thinking is a key skill on which systemic thinking is based [17]. Systemic thinking refers to the ability to understand the world as a complex system in which everything is connected to everything else [18]. This is an essential part of eco-social civilization, especially in identifying interdependencies and outlining causal relationships between ecological, social, and economic realities and their local and global dimensions [19]. Strategic thinking is crucial when creating viable strategies to implement solutions to environmental problems. It unites the knowledge, skills, and abilities needed to identify opportunities and formulate a vision on how to use those opportunities to solve a problem [20].

Increased knowledge of CC threats and other pertinent information concerning CC phenomena about the causes, processes, and consequences have caused young people to feel helplessness and environmental anxiety [20][21][22][23][24]. As in environmental education [25], the importance of emotional processing is also emphasized in CCE [26]. Through communality and working together [16] (pp. 241â243), CCE can foster feelings of empowerment and promote the development of action skills, providing opportunities for participation [27][28]. In addition, cooperation with individuals or groups outside the school or educational institution increases the effectiveness of CCE [29]. Climate-friendly behavior on the part of school or university leaders has also been found to strengthen the motivation and commitment of other members of the work community to achieve the goals of CCE [30]. In the literature, many authors [31][32][33] consider all types of behavior to be included in climate-friendly behavior. In CCE, from the perspective of the development of climate change mitigation behaviors, it would be important to discuss how the behavior of individuals would cause less change in global weather patterns. Issues to be discussed could be, for instance, energy conservation behavior, willingness to use or to select (or willingness to pay more) renewable energy, usage of environmentally friendly transportation, and the purchase of green products [34].

2. Challenges of Climate Change Education (CCE)

The challenges of CCE are affected by social, political, and educational perceptions. An example of those could be Unescoâs 17 SDGs, which are politically drafted, may not always be the same, and are appreciated in all school and research societies. Societal value choices and the ways in which the media deal with conflicts between political interests and environmental problems impact the perceptions, attitudes, and values of both teachers and students, as well as perceptions about the division of responsibilities for action against the challenges posed by CC in the context of CCE [27].

From an educational perspective, the ever-increasing amount of knowledge and the inconsistencies between different data sources make it difficult to stay up-to-date and increase suspicion concerning research data related to CC [35]. Previous research has shown that teachersâ and student teachersâ knowledge of CC is incomplete, fragmented, and narrow, with many misunderstandings [36][29][27][28][37][38]. The multidisciplinary nature of CCE is also often perceived as challenging and even intimidating [29][39]. The implementation of CCE is often the responsibility of individual teachers [29][30]. Increasing multidisciplinarity is hampered by challenges in teaching

staff collaboration, such as the epistemic starting points and the pedagogical perspectives of teachers in different subjects, which are not always easy to combine [38]. Addressing controversial issues such as CC can arouse strong opinions and feelings in both teachers and students and can therefore be an unpleasant experience for teachers especially [37][38][39][40]. Teaching topics about CC is also hindered by the lack of appropriate teaching methods [29][14] and teaching materials considered appropriate and functional [39]. One key challenge is that very little attention is still paid in teacher education to the development of CCE and teachersâ competences in sustainability education, such as integrated problem solving, transformative learning, and learning or proactive competences [15][26].

Achieving the goals of CCE is obstructed not only by the challenges and obstacles associated with teachers and teaching but also by various factors affecting students and learning. Studentsâ knowledge of CC has been found to be incomplete and to contain many misconceptions about, for example, the link between CC and other environmental problems, such as ozone depletion and environmental pollution [36][29][27][28][41]. Learning science-based knowledge is important to alleviate CC anxiety [25]. Studentsâ feelings and attitudes related to CC also pose challenges to CCE. Unaddressed negative emotions can manifest as, for instance, denial of CC, anxiety, apathy, or hopelessness, making it difficult to address climate issues [42][39][41]. Ratinen and Uusiautti [43] found that mitigation knowledge of CC among Finnish female upper secondary students was better than among Finnish male upper secondary students. Yli-Panula, Laakkonen, and Vauras [44] showed with Finnish upper secondary students that the ability to learn about and solve CC issues is linked not only to topic knowledge but also to peopleâs beliefs regarding the topic, a result congruent with those generated by Leiserowitz [45] and Poortinga et al. [46]. The research by Yli-Panula et al. [44] also revealed that upper secondary school studentsâ academic achievements are influenced by the structure and certainty of knowledge, as well as by the justification of knowing studied in relation to CC, which are results that are in line with those of Cano [47] and Mason et al. [48].

The nature of CC also poses its own challenges for CCE. Compared with many other environmental problems, the effects of CC are broader, less directly visible, and much more gradual, which makes it difficult to perceive the problematic nature of CC [42][27]. Because of the holistic and multidimensional nature of CC, students can perceive the empowerment of the individual to be very limited [27][39]. In addition, the huge amount of information and contradictions related to CC can confuse and frustrate students [29][27][39].

Community action by schools and educational establishments is essential for the development of CCE. This includes climate-responsible and climate-friendly activities and engagement by learners in shared goals [29][28][51][52]. Of particular importance is the development of critical thinking skills and the perception of the need to change attitudes, beliefs, values, and practices that are detrimental to the climate. Future education and future visions are considered essential for the empowerment of individuals. The inclusion of the principles of CCE in teacher education is important, as is the development of teaching methods that will better support different students. In addition, it is important to increase cooperation between various sciences and other disciplines.

3. Climate Change (CC) in Finnish Upper Secondary Education

In the Finnish school system, basic education (primary and lower secondary education) and upper secondary education follow the national core curricula and quality requirements [53][54]. These curricula form a continuum. Thus, education in one level is built on the previous level. The respondents are also targeting different levels of education in their teacher studies. Some of them will be class teachers in primary schools, and some will be subject teachers in the lower or upper secondary schools.

The institutions providing education (mostly public, some private, and all free and accessible) and the individual teachers have, however, wide pedagogical freedom to choose the teaching methods and materials and to emphasize certain topics. However, all topics taught, including the foundations of CCE, should be constructed as a continuation from basic education to upper secondary education. In basic education, climate change is addressed from the perspective of building a sustainable future by looking at oneâs own activities [49] (p. 242). In upper secondary education, CC is part of the transversal competence themes, and it is mentioned in both the common goals and guidelines for upper secondary education and in connection to the specific subject aims and objectives [50][55][56]. CC is brought up in shared values of education: âStudents understand the importance of their own activities and global responsibility. in mitigating climate change.â [55] (p. 17). It is also mentioned in connection to the topic âSustainable Lifestyle and Global Responsibilityâ, where âthe student knows the factors influencing climate change and they are aware of the significance for the environment and human activitiesâ [55] (pp. 60â64). For individual subjects, CC has been mentioned in the main contents of biological âEcology and Environmentâ studies, which states the ecological effects of CC [50] (p. 142), and geographical âWorld in Changeâ studies, according to which the lessons dealt with CC [50] (p. 148) already in the previous curricula, published in 2015. Before that, CC was already mentioned in the geography contents in the upper secondary curriculum published in 2003 [57]. In the most recent curriculum document [55], CC is connected to an increased number of subjects (multidisciplinary), such as language studies, natural science subjects, philosophy, and ethics.

For teachers, two models are designed to facilitate the planning of CC-related teaching: the so-called bicycle model [51] and the problem-centered process model [43]. The bicycle model outlines CC in all its dimensions and as a whole, but in order to function and stay in motion, the CC âbicycleâ must actively incorporate every component and requires an active user. In this model, the essential aspects of CCE are described in a simple but comprehensive way: knowledge and thinking skills (wheels); identity, values, and worldviews (frame); action to curb CC (chains and pedals), motivation and participation (saddle); operational barriers (brakes); hope and other emotions (lamp light); and future orientation (handlebars). The problem-centered process model concerning CC, introduced by Ratinen et al. [43], supports teachers in outlining the wide multidimensionality and comprehensiveness of CCE, which in turn facilitates the integration of different aspects of CC into education [36]. In these models, knowledge and thinking skills form the basis for CCE. The bicycle model especially [51] pays attention to other educational views, such as values, motivation, identity, emotions, actions, anticipatory hope, and worldviews.

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