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Exploring Systems Thinking Competence of Finns in Fostering Sustainable Transformation

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Abstract: Systems thinking competence is one of the key sustainability competences to make the future more sustainable by focusing on individuals' capability to analyse sustainability problems across different sectors and scales. The other competencies to foster systems thinking are futures thinking competence, values and critical thinking competence, action-oriented competence, and collaboration competence. In this study, we examined Finnish people's systems thinking competence and its connections to sustainable transformation. The survey data collected from Finns (n = 2006) were analysed using principal component analysis (PCA) and hierarchical regression analysis. The study showed that the sustainability component loaded reliably into principal components. In particular, the Cronbach's alpha (0.91) and Spearman–Brown (0.90) were high for systems thinking competence. The hierarchical regression analysis showed that Finns' values, critical thinking, and individual action-oriented competence predict their systems thinking competence. The results indicate that Finns' ideas of climate change and biodiversity loss mitigation arise from their individual values and opinions that actions are implemented in an ethically just way.

Keywords: sustainability competence; systems thinking competence; futures thinking competence; values and critical thinking competence; action-oriented competence and collaboration competence

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1. Introduction

The Intergovernmental Panel on Climate Change (IPCC) has emphasised that global warming should be limited to 1.5 degrees Celsius compared to pre-industrial times. There are less than 10 years left to complete the implementation of the climate action to achieve the global carbon targets [1]. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [2] pointed out that nature and its vital contributions to people, which together embody biodiversity and ecosystem functions and services, are vulnerable. We must ensure nature conservation and sustainability while other global societal goals are simultaneously met through urgent and concerted efforts fostering transformative change. To disseminate transformative education on climate change and biodiversity loss, school education alone will not be sufficient to reach the IPCC and IPBES targets. We must educate and engage citizens meaningfully and actively to respond to the current sustainability urgency. Despite the widespread realization of the unsustainability of the modern way of life and the urgency of mitigating sustainability issues, people face significant difficulties in making the necessary decisions and taking action. The reasons for these difficulties are complex and related to the complexity of the global issue itself, but some difficulties derive from shortages of individual and sustainability competencies. Individuals are involved in the process of rethinking future possibilities, how values are actualized, and how to build a sustainable way of living [3]. Therefore, sustainability education requires new values and modes of thoughts and actions that foster individuals' sustainability competences.

Accordingly, the OECD's [4] learning framework promotes the need for futures thinking by suggesting that the required competencies for engaging with the world are to be learned in a sequenced process of reflection, anticipation, and action. We define competence as a combination of skills, knowledge, and attitudes that enable a particular task to be performed or a problem to be solved [5–7]. In this study, we examined and analysed the following sustainability competences: systems thinking competence, futures thinking competence, values thinking competence, strategic thinking competence, and collaboration competence [7,8].

Sustainability is a normative concept meaning an ideal state of being in which humans are able to flourish within the ecological thresholds of the planet alongside other living entities for permanency [9]. There are two underlying beliefs of sustainability change: (1) the most important sustainability beliefs are that the world operates as a complex system and (2) that humans operate based on care rather than needs [9]. From a systems perspective, sustainability is the ability of systems to persist, adapt, transform, or transition under varying conditions [10]. In this study, systems thinking competence refers to an individual's capability to analyse sustainability problems across different sectors and scales and systems thinking characteristics. [11]. Individuals are capable of applying systems concepts, such as systems ontologies, features of systems elements, the interaction of elements, feedback loops, and structuration, including sustainable issues. In the perception and construction of knowledge related to phenomena, emergence is a core concept of systems thinking [12,13]. The law of emergence is as follows: when a large number of factors interact with events at the same time, and emergence is the result of lower-level interactions when the system is pushed out of equilibrium. For example, the interaction of forestry measures and natural processes produces properties that would not be possible on their own. Second, in systems thinking interconnectedness, social, economic, and ecological systems are important to recognise, and they are critical to achieving sustainability [14,15]. Individuals are also able to describe the need for systemic thinking in sustainability problem solving, such as for anticipating future trajectories from a systems perspective and for analysing sustainability transition strategies. Third, in this analysis, the understanding of interactions with feedback, nonlinearity, dynamics, and the emergence of complex behaviours over time is essential to systems thinking. Moreover, understanding feedback as an underlying governance mechanism can inform decision making [16]. Fourth, in systems thinking, the ability of an individual to maintain the basic structure and to manage resilience represents the adaptive capacity of the system [12,17]. It has been observed that when individuals adapt to systems thinking, competitiveness, resilience, and survival are improved [14]. Individuals may also build an adaptive capacity by engaging in transformative learning processes [18–20]. Sterling [20] pointed out 'that not only do current ways of thinking, perceiving and doing need to change in response to critical systemic conditions of uncertainty, complexity and unsustainability, but that old paradigms are the root of these conditions'. Therefore, transformative learning processes should include learning to deal with sustainability change, enhancing diversity, systems level learning, and creating conditions for self-organisation to emerge. Self-organisation is the fifth core concept of systems thinking. Williams et al. [10] pointed out that self-organising systems develop their own structure and behaviour spontaneously without being guided from the top down, therefore making systems thinking challenging. For example, for individuals, it would be difficult to outline the big picture of climate change and to find solutions in their own lifestyles because climate systems' internal structure and/or functions can change in response to many external circumstances. Transformative learning can create opportunities for self-organising processes towards sustainability [19].

In this sub-study of the broader study, we focused on the assessment of Finnish people's systems thinking competence and its connections between the other sustainability competences. Research shows that systems thinking is one of the key foundations of sustainability thinking [10,21–23]. Systems thinking has become increasingly popular because it provides a 'new way of thinking' to understand and manage complex problems,

whether they rest within a local or a global context. As Redman et al. [24] pointed out, the assessment of sustainability competence has not been a primary research interest. The assessment tools are not well-developed and are often inappropriately used. Thus, we focus here on moving forward to develop sustainability competence measuring for a larger audience, Finnish citizens, by further developing the theory and measurement related to sustainability competence [7,23,25,26].

The other sustainability competences are based on Wiek et al.'s [7,8] and Brundiers et al.'s [27] foundations. First, futures thinking competency is the 'ability to collectively analyse, evaluate, and craft rich "pictures" of the future related to sustainability issues and sustainability problem-solving frameworks' [7] (pp. 208–209). Here, we scrutinise Finnish people's ability to anticipate how sustainability problems might evolve or occur over time (scenarios), considering inertia, path dependencies, and triggering events. Moreover, we examine how Finns create sustainable and desirable future visions considering evidence-supported alternative development pathways and how they are also able to describe the need for informing strategy building, including prevention, mitigation, and adaptation responses, i.e., responding to scenarios. Second, values thinking competency is the 'ability to collectively map, specify, apply, reconcile, and negotiate sustainability values, principles, goals, and targets' [7] (p. 209). We focus on how Finns are also able to describe the need for values thinking in sustainability problem solving, such as for providing normative orientations to problem analyses, including the carbon footprint estimations and futures thinking activities, such as technological innovation and strategy building, for economic growth thinking. From an ethical point of view, we were also interested in Finnish people's ability to assess the sustainability impact and other activities to make a sustainable future. Third, collaborative competency is the 'ability to motivate, enable, and facilitate collaborative and participatory sustainability research and problem solving' [7] (p. 211). Therefore, we studied how Finns are able to initiate, facilitate, and support different types of collaboration, including teamwork and stakeholder engagement, in sustainability efforts. We describe collaboration as the ability to be aware of one's own feelings, desires, thoughts, behaviours, and personality, as the ability to regulate, motivate, and develop oneself for sustainability issues collaboratively with others. Fourth, in this study, we defined action-oriented competence, which integrates strategic thinking competency and integrated problem-solving competency. Wiek et al. [7] (p. 210) defined strategic thinking competence as follows: the 'ability to collectively design and implement interventions, transitions, and transformative governance strategies toward sustainability'. Integrated problem-solving competency means the ability 'to apply different problem-solving frameworks to complex sustainability problems and develop viable solution options' to 'meaningfully integrate problem analysis, sustainability assessment, visioning and strategy building [8] (p. 251). In the present study, we focused on how Finns are able to use transformational actions and transition strategies towards sustainability, such as actions to mitigate sustainability problems and make progress towards sustainability visions.

2. Aims

Based on previous studies, we know that Finns' average knowledge about climate change is rather good, and they can make realistic assessments of their own level of knowledge [28]; however, knowledge moves slowly from words to deeds [29]. Tackling sustainability crises requires enormous systems level changes in the energy sector, housing sector, and food sector [30]. It is important to note that individuals make changes, but we need more knowledge regarding how to develop solutions. Recognising and integrating multiple kinds of systems competence knowledge and know-how, we can help boundary spanning people, organisations, and tools to make easier to solve the sustainability crisis. We postulate that transitioning to sustainability requires transformative change. Therefore, we focus on how systems competences contribute to sustainability transfor-

mation and how they can be explained through the development of futures thinking competence, collaboration competence, action-oriented competence, and values and critical thinking competence. Thus, we developed the following research question:

- How does Finns' systems competence interact with other sustainability competencies?

3. Materials and Methods

Brundiers et al. [27] further developed Wiek et al.'s [7,8] model of sustainability competence. In this study, we considered these new ideas. In our questionnaire, the competencies to be added to the original model [7] were an integrated problem-solving competency that included the utilisation of combinations of the competencies in the model. Our questionnaire was used to identify and leverage the necessary problem-solving skills. Another competence to be added was intrapersonal competence. This is described as the ability to be aware of one's own feelings, desires, thoughts, behaviours, and personality as well as the ability to regulate, motivate, and develop oneself. The third modified competence in our questionnaire was solution competence, which refers to the collective ability to put plans and visions into practice and to understand the long-term and iterative nature of sustainable development projects.

3.1. Procedure and Participation

The target group consisted of 2006 Finnish people living in Finland, Åland excluded. Åland is a Swedish-speaking autonomous region belonging to Finland. The survey was only in Finnish, so Åland was excluded from the survey. The average age was 47.8 years, and the sample was composed of 52.1% females and 47.5% males. Nine respondents (0.4%) did not want to express their gender. We did not perform any statistical comparisons based on the respondents' background data. There were no missing data because answering the questionnaire required an expression of opinion for each question. The data collection was carried out as a web survey tool developed by Feedback Group. Web consumer research panels of the Cint Panel Exchange (CPX) network were used for the target group's definition. Respondents were selected from several different research panels, thus preventing a possible panel-specific structural skew. Respondents were recruited from various web panels using a registration form that asks the panellist about background information. Based on these backgrounds, respondents can be queried and quota-selected. Upon registration, the panellist also agreed that research invitations may be sent to his or her email. Thus, at the beginning of an individual study, consent to the study is no longer specifically requested as the panellist has already given his or her consent. Respondents were selected at the sampling stage based on the demographic structure of Finland. E-mail invitations to the survey were sent to all panellists who participated in the target group selection. During data collection, additional invitations and reminders were sent to those who did not respond. Each response was rated on a five-point Likert scale: strongly disagree = 1, disagree = 2, no disagreement or agreement = 3, agree = 4, or strongly agree = 5.

3.2. Measurements and Statistical Tests

To measure Finns' systems competence, the participants were asked to evaluate their skills related to climate change and nature loss using a systems point of view. Ten possible responses were provided (Table 1). A principal component analysis (PCA) was conducted for the calculation of the principal scores using a regression method. The Kaiser–Meyer–Olkin (KMO) value of 0.94 showed that the sample was suitable for performing the PCA. The principal component solution accounted for 55.8% of the total variance, and the factor loadings were satisfactory (0.50 or greater), $\alpha = 0.91$, Spearman–Brown = 0.90.

Table 1. Finnish people's systems competence (n = 2006).

	Systems
I can outline the big picture of climate change and find solutions to it in my everyday life and lifestyle.	0.797
I can solve the climate crisis in terms of reducing the environmental impact of my lifestyle, such as my own consumption.	0.771
I recognise which climate measures will significantly reduce my own carbon footprint in terms of Finland's carbon neutrality goal.	0.770
I can take ecological, cultural, and economic considerations into account when dealing with natural disasters.	0.766
I can look at the connections of the products I buy to the world economy.	0.743
I can reduce my own environmental impact by starting with the most effective reduction measures.	0.735
I like to solve environmental issues based on the overall picture they form.	0.732
I can determine the industry with the most urgent and effective means to tackle climate change.	0.731
I can put different systems (transport, housing, eating) in order of magnitude in terms of their environmental impact.	0.715
I recognise how different forestry activities in Finland affect biodiversity.	0.706
Eigenvalue	*5.584*
Exp. of total variance %	55.8

To measure Finns' futures thinking competence, the participants were asked to evaluate their anticipatory competence, and nine possible responses were provided (Table 2). The PCA was conducted for the calculation of the principal scores using a regression method. The KMO value was 0.847, and a varimax rotation method was chosen. The total explanation of variance was 61.4%, and the factor loadings were satisfactory (0.50 or greater) (Table 2). Finally, two scales were created: structural skills (α = 0.81, Spearman–Brown = 0.84) and dynamic skills (α = 0.83, Spearman–Brown = 0.84).

Table 2. Finnish people's futures thinking competence (n = 2006).

	Structural Skills	**Dynamic Skills**
I believe that in the future, diets must be changed globally to avoid a serious sustainability crisis.	*0.801*	0.114
I am ready to vote for decision makers who want to promote solutions that support sustainable living.	*0.782*	0.152
I believe that the climate and sustainability crisis will be resolved in the near future through significant changes in housing, eating, and traveling.	*0.756*	0.147
I believe that material consumption will have to be restricted in the future by legal means.	*0.761*	0.138
I trust that the climate and sustainability crisis is largely solvable in the future if we are able to change linear economic thinking (raw material > waste) to the circular economy.	*0.543*	0.240
I can interpret different climate scenarios, and I know the most effective climate measures.	0.074	*0.863*
I can evaluate how different climate measures affect the future of the Finnish climate system.	0.126	*0.844*
I can evaluate how current global land use will accelerate environmental degradation in the future.	0.210	*0.748*
I can imagine what global food production that sustains biodiversity looks like.	0.306	*0.718*
Eigenvalue	*3.869*	*1.654*
Exp. of total variance %	43.0	18.4

To measure Finns' values and critical thinking competence, the participants were asked to evaluate their competence, and 10 possible responses were provided (Table 3). The PCA was conducted for the calculation of the principal scores using a regression method. The KMO value was 0.91, and a varimax rotation method was chosen. The total explanation of variance was 58.6%, and the factor loadings were satisfactory (0.50 or greater), (Table 3). Finally, two scales were created: criticality (α = 0.82, Spearman–Brown = 0.85) and responsibility (α = 0.80, Spearman–Brown = 0.80).

Table 3. Finnish people's values and critical thinking competence (n = 2006).

	Criticality	Responsibility
I can also assess climate and sustainability issues in terms of social justice.	*0.792*	0.183
I recognise and know how to equally solve issues related to climate change mitigation.	*0.769*	0.105
I can critically present perspectives of material economic growth.	*0.736*	0.048
If necessary, I would critically examine Finland's carbon footprint and relate my own climate impact to other Finns' greenhouse gas emissions.	*0.702*	0.330
I can credibly justify how economic growth thinking like today needs to be radically transformed into a solution to the sustainability crisis.	*0.665*	0.297
I raise even the difficult issues and problems of climate change.	*0.660*	0.284
I can take part in building an environmentally friendly society.	*0.613*	0.381
I feel that we Finns have a moral responsibility to reduce our own consumption to solve the sustainability crisis.	0.195	*0.844*
I feel that Finns have a responsibility to preserve biodiversity.	0.164	*0.841*
I think it would be fair to pay higher taxes on environmentally harmful activities.	0.178	*0.757*
I understand that technological innovation alone will make it impossible to solve the sustainability crisis in the long run.	0.249	*0.567*
Eigenvalue	*4.970*	*1.480*
Exp. of total variance %	45.2	13.5

To measure Finns' action-oriented competence, the participants were asked to evaluate their sustainability actions, and 16 possible responses were provided (Table 4). The PCA was conducted for the calculation of the principal scores using a regression method. The KMO value was 0.90, and a varimax rotation method was chosen. The total explanation of variance was 55.0%, and the factor loadings were satisfactory (0.50 or greater), (Table 4). Finally, three scales were created: society (α = 0.82, Spearman–Brown = 0.80), individual (α = 0.81, Spearman–Brown = 0.83) and no car (α = 0.79, Spearman–Brown = 0.84).

Table 4. Finnish people's action-oriented competence (n = 2006).

	Society	Individual	No Car
I am prepared to pay more environmental taxes in the future.	*0.719*	0.241	0.249
I have taken part in climate demonstrations.	*0.709*	−0.130	0.280
I am prepared to reduce my own salary if I know for sure that the money saved will be used to repair the damage that we have caused to nature.	*0.713*	0.185	0.209
I have donated money to protect the environment.	*0.658*	0.204	0.119
I will get an electric car as soon as their operating distance is over 500 km.	*0.583*	0.184	−0.138
I am ready to move into a smaller apartment.	*0.572*	0.178	0.109
I voted for an environmental candidate in the last parliamentary elections.	*0.531*	0.184	0.177
I sort and recycle all my waste.	−0.051	*0.697*	0.037
I have reduced my own consumption to reduce the risk of a sustainability crisis.	0.421	*0.652*	0.147
I have increased the proportion of vegetarian food in my diet.	0.413	*0.633*	0.147
I am not flying or I am ready to reduce my air travel to at least half of my current status.	0.087	*0.591*	0.157
I have reduced the use of meat products.	0.439	*0.583*	0.267
I have lowered the temperature in my apartment.	0.227	*0.582*	0.091
I do not use/own a car anymore.	0.189	0.075	*0.861*
I have replaced almost all commutes by car with public transport.	0.250	0.152	*0.825*
I walk or cycle almost all trips less than 3 km.	0.055	0.339	*0.681*
Eigenvalue	*5.925*	*1.460*	*1.413*
Exp. of total variance %	37.0	9.1	8.8

Finally, to measure Finns' collaboration competence, the participants were asked to evaluate their collaboration skills, and eight possible responses were provided (Table 4). The PCA was conducted for the calculation of the principal scores using a regression method. The KMO value was 0.91, and a varimax rotation method was chosen. The total

explanation of variance was 57.1%, α =.89, Spearman–Brown = 0.86, and the factor loadings were satisfactory (0.50 or greater), (Table 5).

Table 5. Finnish people's collaboration competence (n = 2006).

	Interaction
I can look at and solve the problems of climate change mitigation and adaptation easily with other people.	0.830
I recognize the seriousness of natural loss and my ability to discuss its solutions proactively and constructively.	0.810
I can guide the discussion on climate change mitigation and adaptation to core issues related to consumption and use of natural resources.	0.809
I can participate constructively and be solution-oriented on the social climate debate.	0.798
I can think about the effects of human activities on nature.	0.789
I can justify on a scientific basis which industries have a key role to play in resolving the climate and sustainability crisis.	0.713
I can motivate other people to reduce their consumption of materials and energy to achieve significant environmental goals.	0.696
I can listen to and respect the opinions and values of others about climate change.	0.561
Eigenvalue	*4.564*
Exp. of total variance %	57.1

4. Results

The principal component scores were calculated using regression methods. These scores were used for the hierarchical regression analysis. As shown in Table 6, taken in the first step, action-oriented competence individual actions alone were a significant predictor (β = 0.394, p < 0.001), (Table 6). For example, sorting and recycling waste are small-scale systems changes (0.697), but reducing consumption (0.652), the use of meat products (0.583), and air travel (0.591) are remarkable systems change that loaded rather strongly to the individual component (Table 4). It seems evident that society-related actions predict Finns' systems competence quite well (β = 0.318, p < 0.001), (Table 6). In particular, Finns' willingness to pay environmental taxes (0.719) and reduce their own salaries (0.713) loaded well into the society component (Table 4). Purchasing an electric car (0.583) and moving to a smaller apartment (0.572) were also considered a societal issue as they quite strongly loaded to the society component. Instead, avoiding cars predicted a low systems competence (β = 0.131, p < 0.001), (Table 6).

Table 6. Hierarchical regression analysis of Finns' systems competence.

	Systems Competence			
	Step 1	***Step 2***	***Step 3***	***Step 4***
	β	***β***	***β***	***β***
Societal	0.318 ***	0.083 ***	-	-
Individual	0.394 ***	0.203 ***	0.170 ***	0.136 ***
No car	0.131 ***	-	-	-
Criticality		0.637 ***	0.323 ***	0.275 ***
Responsibility		0.137 ***	0.127 ***	0.82 ***
Structural skills			0.088 ***	-
Dynamic skills			0.378 ***	0.308 ***
Collaboration				0.266 ***
R^2	0.273 ***	0.596 ***	0.669 ***	0.697 ***
Adjusted R^2	0.272 ***	0.595 ***	0.668 ***	0.695 ***
ΔR	0.273 ***	0.332 ***	0.073 ***	0.028 ***

*** p < 0.001.

In step two of the model, values and critical thinking competences were entered in the model, and this step increased the explanation of the regression model by 33%. Finns' critical sustainability competence predicted their systems competence well (β = 0.637, p <

0.001) (Table 6). In particular, Finns' skills in assessing the social justice of sustainability issues (0.792) and their recognition of equality issues (0.769) loaded strongly to the criticality component (Table 3). Critical thinking toward economic growth (0.736) and raising the difficult issues and problems related to climate change (0.702) strongly predicted Finns' systems competence as well (Table 3). The other values and critical thinking competence predicted Finns' systems competence ($\beta = 0.137$, $p < 0.001$) (Table 6). The moral responsibility to reduce one's consumption to solve the sustainability crisis (0.844) and the responsibility to preserve biodiversity (0.841) loaded strongly to the responsibility component (Table 3). Overall, Finns' values and critical thinking competence explained their systems competence well. Finnish people's responses to the interactions between different system elements, included, for example, consumption and the world economy. The regression coefficient and the 33 % ΔR for the explanation of the model means that normative issues are clearly related to Finns' systems competence.

In step three, futures thinking was inserted, increasing the explanation of the regression model by 7% (Table 6). These skills consist of structural skills and dynamical skills. According to Levrini et al. [31], structural skills refer to learners' abilities to recognise temporal, logical, and causal relationships and to develop systemic views. Dynamical skills refer to learners' abilities to navigate scenarios, relating local details to global views, past to present and future, and individual to collective actions. Based on the aforementioned definition for this study, structural skills represent the respondent's confidence that the future will be better if sustainability actions are implemented at the systems level. Dynamic skills describe respondents' personal opinions towards the means or skills to make the future better.

Finns' dynamic skills predicted their systems competence well ($\beta = 0.378$, $p < 0.001$), (Table 6). In particular, Finns' beliefs based on different climate scenarios and their knowledge of the most effective climate measures loaded strongly to the dynamic skills components (0.863), (Table 2). Similarly, Finns' skills in evaluating how different climate measures affect the future of the Finnish climate system loaded well to the dynamic skills component (0.844), (Table 2). Overall, Finns' personal opinions towards the means or skills to make the future better seem to predict their systems competence well. Because structural skills did not strongly predict Finns' systems competence ($\beta = 0.088$, $p < 0.001$), there is evidence that Finns' own beliefs were more strongly associated than their systems-level trust to making sustainability changes in their systems competence; however, it is noteworthy that the eigenvalue of structural skills was higher than that of dynamic skills (Table 2).

In this final step, individual action-oriented competence, critical competence, dynamic futures skills, and collaboration competence were all significant predictors of systems competence. The final step only increased the explanation of the model by 3% (Table 6). The proportion of variance accounted for by the full model was 70% of the variance, $F(8, 1997) = 573.081$; $p < 0.001$. A closer examination of collaboration competence indicated that it predicted Finns' systems competence well ($\beta = 0.226$, $p < 0.001$), (Table 5). Finns' beliefs that they can solve the problems related to climate change mitigation and adaptation with others strongly loaded to the interaction component (0.830). Finns' ability to discuss solutions proactively and constructively (0.810) and to guide discussions on climate change mitigation and adaptation related to consumption and the use of natural resources (0.809) and their constructive and solution-oriented participation in the social climate debate (0.809) loaded strongly to the interaction component.

5. Discussion

This study is part of larger project aiming to develop measurements for sustainability competence. To analyse the structure of the data collected through the scale, a PCA was conducted. Here, PCAs were used to explore the data and find the theory of Finns' sustainability competence. Later, when the theory is known, confirmatory factor analysis (CFA) and Structural Equation Modelling (SEM) can be carried out. However, the findings

of PCA showed that the data are suitable for analysing sustainability competence. The validation of the measurements could be further analysed by CFA and SEM and they can be used to perform an extensive investigation into variables' relationship [32].

As systems competence is one of the key competences related to sustainability, we focused on Finns' systems competence interactions with their other sustainability competences. Developing a measurement that considers systems thinking and the complexity of the climate and nature crisis is crucial. Based on the Cronbach's alpha and Spearman–Brown coefficients, the instrument used to measure systems competence had a high reliability. Systems thinking is embedded in many of the existing theories, ontologies, concepts, and tools that are currently being used by different disciplines to address the importance of the transition to a sustainable future. Therefore, the systems thinking measurements should be developed as context- and case-specific. Ben-Zvi Assaraf and Orion pointed out [11] (p. 523) that there are eight characteristics in systems thinking. Here, we focused on Finns' ability to identify the components of a system and processes within the system, the ability to identify relationships among the systems components, the ability to organise the systems' components and processes within a framework of relationships by understanding the hidden dimensions of the system, and the ability to make generalisations. The recently published Greencomp [33] includes systems thinking as the core concept of sustainability competence. This study is an example of how systems competence related to sustainability issues can be measured.

The hierarchical regression analysis revealed that normative critical values thinking predicted Finns' systems competence related to sustainability. The result is similar to previous studies for which critical thinking addressed a core competency, and normative dialogue was a key competency crucial to the success of multi-stakeholder sustainability projects [34,35]. Based on Finns' futures thinking, there is evidence that Finns' individual smaller scale actions for a more sustainable future better predict their systems competence than their ideas of large-scale systems changes, such as changes in global diets. Aarnio-Linnanvuori [36] pointed out that small actions for the environment are possible for young people, but young people's involvement in society is generally viewed as a minor or future issue. The present study showed that similar thinking is notable for adults as well. Heimlich and Ardoin [37] found many challenges to analysing changing environmental behaviours, such as social learning theories, as we more fully consider the practice in which the behaviour will be used in a larger community. In this study, somewhat surprisingly, the action-oriented competence of Finns and their collaboration competence did not significantly increase the explanatory power of the regression model related to the systems competence of sustainability thinking. Ajzen's [38] Theory of Planned Behaviour (TPB) has led to the theory of reasoned action [37], which suggests that human behaviour is influenced by three belief constructs: (1) beliefs about consequences, (2) expectations of important others, and (3) things that may support or prevent the behaviour. More recently, Holdsworth et al. [39] found that sustainability education can be effective in establishing both the knowledge of sustainability and the will to act on these principles in workplaces. In the context of sustainability competence, the TPB should be studied in more detail in the future.

Sustainability competences have mainly been studied in the context of higher education [3,7]. In the era of a sustainability crisis, there is a need to consider sustainability issues in a broader context than only the education sector. Finland has set a goal to be climate-neutral by 2035 [40]. Attention has also been paid to halting the loss of nature, which is crucial to biodiversity and forestry [41]. From the global perspective, this study reveals how individuals' sustainability competences can also be studied in the context of the 2030 Agenda [42]. Sustainability development goals are fundamental issues in order to achieve real and effective sustainable development. Without sustainability competences (from all its perspectives), individuals are unable to address the complexity of the sustainability problems. This study showed that systemic competence is a challenging skill to develop,

which should be addressed in the education of citizens, in particular to improve their understanding of the large-scale of environmental actions and the uncertainties associated with them [20]. In addition, it seems to be evident that looking critically at social sustainability issues, it may potentially reduce some of the uncertainty related to the solution of sustainability issues. As Berry et al. [43] pointed out, systems thinking is capable for organizing and interpreting the large and diverse body of information relevant to climate change and its factors and their causal linkages. Based on the present study, however, generalisation of results to global citizens is difficult to make but such a topic would be a very relevant subject of further study. In the future, it would be useful to use a similar survey approach to determine whether the answers would be different for other countries. The comparative results could be used to prevent problems in addressing sustainability issues, such as by developing sustainability workshops in the workplace that address the learning problems to make sustainable change.

6. Conclusions

The present study is one of the few studies in which sustainability competence has been examined in a fairly large population sample (n = 2006). The results showed that in the Finnish context, tackling climate change and biodiversity loss issues at the systems level arise from Finns' individual values and that actions are carried out in an ethically just way. Comparisons with other studies are difficult to make because similar sustainability competences have not been measured in this context. Based on our results, we have determined that three different tasks could enable people to improve their sustainability competences: (1) involvement in real-world problems that require critical thinking, (2) focusing on systems thinking competence, and (3) consideration of large-scale futures thinking for sustainability problems. The Finnish people's responses strengthen Ehrenfeld's [9] ideas that sustainability change requires knowing that the world operates as a complex system. Moreover, the idea that humans operate out of a care—not needs—was observed in the ethical responses of Finns.

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