frontiers | Frontiers in Education

ORIGINAL RESEARCH
published: 13 April 2022
doi: 10.3389/feduc.2022.838005

The Connection of Finns' Environmental Awareness to Their Anticipatory Competence

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Knowledge of people's abilities must be adapted to a new, sustainable society. Through sustainability competences, the necessary changes in people's behavior in the pursuit of a sustainable society can be intensified. In this study, Finns (n = 2006) express their knowledge of climate change and biodiversity loss and evaluate their own anticipatory competence. The connection between their environmental awareness and the future's orientation toward a society of sustainable actions will be studied by statistical analysis. The study discusses how learning sustainability competences can be promoted in science education and reveals the gap between females and males in their objectives for a sustainable future. Finns with higher education have greater environmental awareness than those with lower education. The connection between Finns' environmental awareness and their structural skills for making a more sustainable future is quite clear.

Keywords: environmental awareness, anticipatory competence, science education, Finns, climate change, biodiversity

OPEN ACCESS

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Specialty section:
This article was submitted to STEM Education, a section of the journal Frontiers in Education

Received: *17 December 2021*
Accepted: *24 February 2022*
Published: *13 April 2022*

Citation:
Ratinen I and Linnanen L (2022) The Connection of Finns' Environmental Awareness to Their Anticipatory Competence. Front. Educ. 7:838005. doi: 10.3389/feduc.2022.838005

INTRODUCTION

To make modern society more sustainable in the future, we need well-educated citizens to take the necessary actions to make changes. This does not merely require enhancing their knowledge; their awareness and commitment to solving these problems must be developed as well. The awareness concept is ultimately a stimulus, and the driving force to acquire knowledge is the need to solve problems. Environmental awareness is one of the prerequisites for an environmental attitude and pro-environmental behavior. Many studies have confirmed that behavioral change may be caused by activities with the objective of raising awareness (Halady and Rao, 2010; Swaim et al., 2014; Ojala and Bengtsson, 2019). Quite a long time ago, Hungerford and Volk (1990) pointed out that environmental education would create awareness and foster the necessary attitudes and behaviors for change. Here, we can assume, based on earlier research (e.g., Kollmuss and Agyeman, 2002; Zsóka et al., 2013; Ratinen and Uusiautti, 2020), that changes in behavior are brought about by increasing scientific knowledge through raising awareness regarding climate change and biodiversity loss and by fostering an appropriate attitude toward the future. Moreover, we propose that individuals review their knowledge and anticipatory competence and then decide whether they have enough knowledge and awareness in the first place.

We need to prepare learners for their future and consider how we can support them in creating a more sustainable future instead of an uncertain future. For this purpose, Wiek et al. (2011) defined key competencies in sustainability and synthesized the substantive contributions in a coherent framework of sustainability research and problem-solving competence: system thinking competence, anticipatory competence, normative competence, strategic competence, and interpersonal competence.

In this study, we focus on anticipatory competence and define that competence as learners' ability to collectively analyze, evaluate, and illustrate the future as it is related to sustainability issues and sustainability problem-solving frameworks. Anticipatory competence includes comparative skills related to estimating the "state of the art," including concepts such as time, uncertainty, and scenarios. It is well known that without appropriate knowledge, learners are not capable of undertaking meaningful and effective environmental actions that increase their hope for the future (Ratinen, 2021). Therefore, we also focus on environmental awareness based on Finns' knowledge of climate change and biodiversity issues.

Science education is one of the keys to helping humankind solve the environmental problems, such as climate change and loss of biodiversity, that we are facing today. Science education focuses primarily on teaching knowledge and skills. Although socio-scientific issues (SSI) (Mogensen and Schnack, 2010) and responsible research (RRI) (Heras and Ruiz-Mallén, 2017) have been developed to foster the learning of environmental issues, it is more common that environmental education stresses the incorporation of values and changing behaviors in education (Wals et al., 2014). Responsible science education needs to support learners' meaning-making coping strategies and thus prevent their environmental anxiety (Ojala and Bengtsson, 2019). In science education, there is a need to consider the means to make science classes more meaningful for learners and bring examples of their everyday lives near—both now and in the future. Science education across the globe holds the responsibility for shaping Students' environmental awareness and changing their attitudes toward the importance of preserving the environment.

Science education has recently focused more on Students' future thinking (Branchetti et al., 2018). Levrini et al. (2021) found that environmentally oriented science education can support learners' future—scaffolding skills. These skills consist of structural skills and dynamical skills. Structural skills refer to learners' abilities to recognize temporal, logical, and causal relationships and build systemic views. Dynamical skills are, in turn, learners' abilities to navigate scenarios, relating local details to global views, past to present and future, and individual to collective actions. Science education helps people to perceive future global multiple scenarios that they can influence and shape in the present while using that knowledge for the future (Rickards et al., 2014). This anticipatory competence leans on interdisciplinary future studies, which typically involves disciplines but also scholars and practitioners from the arts, social sciences, natural sciences, technology, and engineering to orient actions in the present that can influence and create preferable or desirable futures. Levrini et al. (2021) incorporated future thinking skills into school science, including scenario thinking, systems thinking, thinking beyond the realm of possibilities, action competence, and skills to manage uncertainty and complexity, and thus brought future thinking close to the principles of sustainability thinking (Wiek et al., 2011; Sterling, 2021).

ENVIRONMENTAL AWARENESS AND ANTICIPATORY COMPETENCE AMONG FINNS

Learning sustainable development competencies requires a systematic focus on the concepts, methods, and skills of each competence (Brundiers et al., 2021). In addition, competence learning should focus on teaching staff so that awareness and understanding of competencies can be brought into general education for sustainable development. In Finland, sustainability competencies are not well known from the point of view of science education, although environmental crises have been known for a long time. Vuorio et al. (2021) found that university teachers in chemistry evaluated the learning of critical thinking skills as important in teaching. Moreover, promoting the competencies of sustainable development was evaluated as important. Tolppanen and Kärkkäinen (2021a) found that few pre-service teachers seem to examine climate change mitigation through a systems-thinking approach. Pre-service teachers did not internalize that individuals, governments, and businesses all play a role in climate change mitigation.

According to Lehtonen et al. (2020), Finns' average knowledge about climate change is rather good, and they can make a realistic assessment of their own level of knowledge. Most Finnish people believe estimate that climate change is mainly due to increased carbon dioxide in the atmosphere. Finns are also able to link the increased amount of carbon dioxide to the use of fossil fuels. However, there is also misunderstanding of the causes of sustainability issues among Finnish people (Lehtonen et al., 2020). Namely, only about half know that deforestation is not the main cause of climate change and that climate change is not caused by ozone depletion. A closer look at the results of Lehtonen et al. (2020) reveals that 57% of men and 42% of women have good or very good knowledge of climate issues based on knowledge-based questions. The differences between age groups are not large. The knowledge of climate change issues of those under the age of 50 is better than that of older age groups. However, the knowledge of those under 30 is no different from that of others under 50.

Finns' environmental awareness is relatively high, but knowledge moves slowly from words to deeds (Hyry, 2017). More recently, Finns expressed that recycling is the most effective way to reduce one's own emissions, even though its impact is actually quite small (Lehtonen et al., 2020). Therefore, there are shortcomings in Finns' basic information. In Finland, women's attitudes toward the environment are more positive than men's. The general environmental attitudes of young people appear to be more negative than those of older respondents (Hyry, 2017). The general environmental attitudes of respondents who are dissatisfied with their lives or who do not perceive their lives as valuable are clearly more negative than those respondents who say they are happy with their current lives or feel their lives are valuable.

Finns' anticipatory competence related to sustainability issues is not well known. Heikkilä et al. (2017) found that some young people criticize the Western consumption-oriented lifestyle and express a desire for fairness in income and lifestyle in the future. Working together and communality come to the fore as important issues for these individuals. On the technology side, young people being connected in advocating for and promoting environmentally friendly and sustainable energy solutions is expected to become more common. Adults' anticipatory competence is also unknown. Eurobarometer (2021) revealed that climate change and environmental issues are one of the EU's main challenges for the future among European people, but our opinions varied significantly across EU member states.

AIMS

Wiek et al. (2011) and colleagues believe that defining the key competencies required for sustainable development is important to profile and assess the right kind of competence. Although we know about Finns' environmental expertise, we still have gaps in our knowledge of how Finns' knowledge is combined with their anticipatory competence and how that knowledge could be used in the development of science education. This study is based on the following research questions:

- How does Finns' knowledge of climate change and biodiversity loss depict their environmental awareness?
- How is Finns' environmental awareness associated with their anticipatory competence?

The purpose of the present article is to increase our understanding of the relationship between Finns' environmental awareness and their anticipatory competence. Based on the results, novel and more effective ways to respond to sustainability challenges in science education are presented.

MATERIALS AND METHODS

Procedure and Participation

The target group consisted of 2,006 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 (**Table 1**). There was no missing data because answering the questionnaire required an expression of opinion on each question. However, two participants did not inform their age and 24 participants their education as well. Nine participants did not identify their gender. All those missing participants were excluded in the analysis because the small number does not allow for comparisons with the rest of the participants. The data collection was carried out as a web survey tool developed by Feedback Group. Web consumer research panels of the CPX (Cint Panel Exchange) network were used for the target group definition. Respondents were selected from several different research panels, thus preventing a possible panel-specific structural skew. Respondents are recruited to various web panels using a registration form that asks the panelist their background information. Based on these backgrounds, respondents can be queried and quota-selected. Upon registration, the panelist also agrees 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 panelist has already given his or her consent once. Respondents were determined at the sampling stage based on the demographic structure of Finland. E-mail invitations to the survey were sent to all panelists who participated in the target group selection. During the data collection, additional invitations and reminders were sent to those who did not respond.

TABLE 1 | Respondents' backgrounds.

Gender	Frequency	%
Female	1,045	52.1
Male	952	47.5
No answer	9	0.4
Age		
16–24	156	7.8
25–34	342	17.0
35–44	390	19.4
45–54	311	15.5
55–65	431	21.5
65–	374	18.6
No answer	2	0.1
Education		
Basic school	150	7.5
Vocation school	471	23.5
High school	228	11.4
College	366	18.2
Uni. of applied science	311	15.5
University, bachelor	151	7.5
University, master	305	15.2
No answer	24	1.2

Measures and Statistical Tests

To measure Finns' environmental awareness, the participants were asked to evaluate climate change and biodiversity issues, and 10 possible responses were provided (**Table 2**). Each response could be rated on a five−point Likert scale: strongly disagree = 1, disagree = 2, no disagreement or agreement = 3, agree = 4, or strongly agree = 5. Analysis of variance (ANOVA) was used to look for differences between groups by age and education level and *t*-test for gender. Principal component analysis (PCA) was conducted for the calculation of the principal scores using a regression method. The Kaiser–Meyer–Olkin (KMO) value of 0.861 showed that the sample was suitable for performing PCA, and a varimax rotation method was chosen. The principal component solution accounted for 56.8% of the total variance,

TABLE 2 | Finnish people's environmental awareness (n = 2006).

	Totally disagree	Disagree	Neither disagree nor agree	Agree	Totally agree	Statistics
Climate change is caused by greenhouse gases, such as carbon dioxide methane and nitrous oxide, increasing in the atmosphere.	2.1	3.9	20.0	50.8	23.1	Age: no Gender: $t_{(1,915)} = 3.848$, $p < 0.000$ Edu: $F_{(6,1,975)} = 12.746$, $p < 0.000$
Greenhouse gases decrease the atmosphere (the ozone layer), which causes the Earth to get more heat radiation.	3.8	4.9	20.2	48.9	22.2	Age: no Gender: $t_{(1,811)} = 7.554$, $p < 0.000$ Edu: no
The increase in palm oil consumption has reduced biodiversity.	1.5	5.6	35.7	37.5	19.7	Age: no Gender: $t_{(1,995)} = 2.410$, $p < 0.02$ Edu: $F_{(6,1,975)} = 4.531$, $p < 0.000$
Climate change is natural, as, e.g., volcanoes and water vapor affect current climate change more directly than humans' greenhouse gases.	14.1	34.9	29.0	16.3	5.7	Age: no Gender: $t_{(1,995)} = -5.531$, $p < 0.000$ Edu: $F_{(6,1,975)} = 6.945$, $p < 0.000$
The loss of biodiversity is a result of the current exploitation of nature by humans that occupy the space of nature.	0.9	2.8	16.0	45.1	35.1	Age: no Gender: $t_{(1,995)} = 4.139$, $p < 0.000$ Edu: $F_{(6,1,975)} = 10.515$, $p < 0.000$
Scientists are sure that people are definitely the reason for the current rapid climate change.	2.4	6.4	22.4	42.5	26.3	Age: no Gender: $t_{(1,878)} = 4.116$, $p < 0.000$ Edu: B-$F_{(6,\ 1,569)} = 2.563$ $p < 0.02$
The decrease in the number of species is natural and people are unable to significantly affect the number of species.	20.0	38.9	22.9	14.9	3.2	Age: no Gender: $t(1,954) = -4.710$, $p < 0.000$ Edu: $F_{(6,1975)} = 6.512$, $p < 0.000$
Combustion of fossil fuels releases carbon dioxide into the atmosphere, which binds heat and causes climate change.	1.9	5.0	23.9	49.9	19.3	Age: no Gender: no Edu: [F-$B_{(6,1,611)} = 12.492$, $p < 0.000$]
The main reason for biodiversity loss is that we do not recognize the environmental impact of production chains (manufacturing, distribution, and disposal) adequately.	2.2	11.7	33.6	41.6	10.8	Age: no Gender: $t_{(1,934)} = 4.705$ $p < 0.000$ Edu: F-$B_{(6,\ 1,508)} = 3.864$, $p < 0.001$
Even if we, as individuals, were to significantly reduce material consumption, it would have no effect on biodiversity.	12.0	37.7	26.0	18.6	5.7	Age: $F_{(5,\ 1,956)} = 3.940$, $p < 0.001$ Gender: $t_{(1,940)} = -5.578$, $p < 0.000$ Edu: $F_{(6,1975)} = 5.851$, $p < 0.000$

and the factor loadings were satisfactory (0.50 or greater) (**Table 3**). Finally, two scales were created: understanding (α = 0.79) and misunderstanding (α = 0.76). The principal component scores were calculated using regression methods. These scores were used for the calculation of Pearson correlation coefficients.

In this study, 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 (Baartman et al., 2007; Wiek et al., 2011; Voogt and Roblin, 2012). Brundiers et al. (2021) updated Wiek et al. (2011) model. In our questionnaire, the competencies to be added to the original model were an integrated problem-solving competency that included the utilization of combinations of the competencies in the model. Our questionnaire involved identifying and leveraging 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, behaviors, 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.

To measure Finns' anticipatory competence, the participants were asked to evaluate their anticipatory competence, and nine possible responses were provided (**Table 4**). Each response could be rated on a five−point Likert scale: strongly disagree = 1, disagree = 2, no disagreement or agreement = 3, agree = 4, or strongly agree = 5. Principal component analysis (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 4**). Finally, two scales were created: structural skills (α = 0.81) and dynamic skills (α = 0.83). The principal component scores were calculated using regression methods. These scores were used for the calculation of Pearson correlation coefficients.

RESULTS

In Finland, citizens' environmental awareness seems to be relatively high (**Table 2**). Both the understanding of the main cause of climate change as greenhouse gases (73.9% agree or totally agree with the statement) and the main roots of biodiversity loss, namely our large-scale exploitation of nature

TABLE 3 | Finnish people's awareness of environmental issues (*n* = 2006).

	Understanding	Misunderstanding
Burning fossil fuels releases carbon dioxide into the atmosphere, which binds heat and causes climate change	0.714	
The main reason for the decline in biodiversity is that we do not recognize the environmental impact of product production chains (manufacturing-distribution-disposal) well enough	0.671	
Climate change is caused by greenhouse gases such as carbon dioxide, which increase the amount of methane and nitrous oxide in the atmosphere	0.664	
The loss of biodiversity is the result of humanity's current exploitation of nature, which takes over the living space from nature	0.650	
The increase in palm oil consumption has reduced biodiversity	0.635	
Scientists are sure that people are definitely the cause of the current rapid climate change	0.611	
The decline in the number of species is natural and humans are not able to influence the number of species in a significant way		0.806
Climate change is a natural thing, for, e.g., volcanoes and water vapor have a greater impact on current climate change than anthropogenic greenhouse gases		0.799
Even if, as individuals, we significantly reduced material consumption, it would have no impact on biodiversity		0.766
Eigenvalue	3.874	1.232
Exp. of total variance %	43.1	13.7

TABLE 4 | Finnish people's anticipatory competence (*n* = 2006).

	Structural skills	Dynamic skills
I am ready to vote for decision makers who want to promote solutions that support sustainable living	0.782	
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	
I believe that material consumption will have to be restricted in the future by legal means	0.761	
I have confidence 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 a circular economy	0.543	
I can interpret different climate scenarios, and I know what the most effective climate measures are		0.863
I am able to assess how different climate measures affect the future of the Finnish climate system		0.844
I can assess how current global land use will accelerate the worsening of nature loss in the future		0.748
I can imagine what global food production that sustains biodiversity looks like		0.718
Eigenvalue	3.869	1.654
Exp. of total variance %	43.0	18.4

(80.2%), are scientifically correct. The Finns' ideas that CO_2 emissions are released from burning fossil fuels (70.2%) and that nature loss is caused by the environmental impact of production chains (62.4%) indicate high environmental awareness. Finnish people are also confident that scientists are sure that people are the reason for climate change (68.8%). However, this study, like earlier studies (Ratinen, 2016; Lehtonen et al., 2020), shows that 71.1% of respondents confused climate change with the depletion of the ozone layer. Scientifically, the connection between climate change and ozone depletion is not strong (IPCC, 2007). It is also interesting that many Finns (24.3%) think that even if we, as individuals, were to significantly reduce material consumption, it would have no effect on biodiversity.

According to ANOVA, only one variable— even if we, as individuals, were to significantly reduce material consumption, it would have no effect on biodiversity—differed statistically significantly by age [$F_{(5,\ 1{,}956)} = 3.940$, $p < 0.001$, $\eta^2 = 0.01$]. The effect size for this analysis ($\eta^2 = 0.01$) was found to approach Cohen's (1988) convention for a small effect. A *post-hoc* test (Bonferroni) revealed that the groups from 55 to 65 ($p < 0.003$) and over 65 ($p < 0.05$) years old believed more than 16–24-year-olds that individuals can minimize biodiversity loss by de-creasing consumption.

Gender was a clear distinguishing factor in environmental awareness (**Table 2**). A *t*-test revealed that females had significantly different ideas about how climate change is caused by greenhouse gases [$t_{(1{,}915)} = 3.848$, $p < 0.000$, $d = 0.18$] and palm oil consumption has reduced biodiversity [$t_{(1{,}995)} = 2.410$, $p < 0.02$, $d = 0.11$], and they also confused climate change and ozone depletion more often [$t_{(1{,}811)} = 7.554$, $p < 0.000$, $d = 0.36$]. Moreover, females more often believe that the loss of biodiversity is a result of the current exploitation of nature [$t_{(1{,}995)} = 4.139$, $p < 0.000$, $d = 0.19$] and believe in scientists' evidence for rapid climate change [$t_{(1{,}878)} = 4.116$, $p < 0.000$, $d = 0.19$]. Males more often believe that climate change is natural [$t_{(1{,}995)} = -5.531$, $p < 0.000$, $d = 0.25$], individuals' consumption reduction does not affect biodiversity [$t_{(1{,}940)} = -5.578$, $p < 0.000$, $d = 0.25$], and people are unable to significantly affect the number of species [$t_{(1{,}954)} = -4.710$, $p < 0.000$, $d = 0.21$]. The effect size for this analysis (Cohen's d) was found to approach Cohen's (1988) convention for a small effect < 0.50.

The level of education affected respondents' environmental awareness, but the effect size for this analysis (η^2 = 0.01–0.04) was found to approach Cohen's (1988) convention for a small effect: "climate change is caused by greenhouse gases" [$F_{(6,1,975)}$ = 12.746, p < 0.000, η^2 = 0.04], "the increase of palm oil consumption" [$F_{(6,1,975)}$ = 4.531, p < 0.000, η^2 = 0.01], "climate change is natural" [$F_{(6,1,975)}$ = 6.945, p < 0.000, η^2 = 0.02], "the loss of biodiversity" [$F_{(6,1,975)}$ = 10.515, p < 0.000, η^2 = 0.03], "scientists are sure that people" [$F_{(6,1,569)}$ = 2.563 p < 0.02, η^2 = 0.01], "the decrease in the number of species" [$F_{(6,1,975)}$ = 6.512, p < 0.000, η^2 = 0.02], "combustion of fossil fuels releases carbon dioxide" [F-$B_{(6,1,611)}$ = 12.492, p < 0.000, η^2 = 0.04]," the main reason for biodiversity loss" [F-$B_{(6, 1,508)}$ = 3.864, p < 0.001, η^2 = 0.01], and "even if we as individuals..." [$F_{(6,1,975)}$ = 5.851, p < 0.000, η^2 = 0.02].

For more detailed knowledge about how education affects environmental awareness, the PCA was generated (**Table 3**). The principal component of understanding represents higher environmental awareness, i.e., the scientific view of climate change and biodiversity loss, but misunderstanding does not do so. The *post-hoc* test (Bonferroni) indicates that those with bachelor's (p < 0.008) and master's degrees who graduated from university (p < 0.000) ex-pressed a greater understanding of climate change and biodiversity than people in or who graduated from only basic school education. Similarly, bachelor's (p < 0.001) and master's (p < 0.000) recipients who graduated from university or college (p < 0.01) expressed greater environmental awareness than respondents who graduated from vocational school. Moreover, master's recipients from the university (p < 0.003) exemplified greater awareness than bachelor's recipients who graduated from the university of applied sciences. People graduating with a master's at university had less misunderstanding related to climate change and biodiversity loss than people in or who graduated from only basic school education (p < 0.002) or vocational school (p < 0.000), people who graduated from college (p < 0.002), or people who graduated from a university of applied sciences.

The connection between Finns' environmental awareness and their anticipatory competence was studied using Pearson's correlation analysis. Before the analysis, two principal components were generated. Structural skills represent the respondent's confidence that the future will be better if actions are implemented (see Levrini et al., 2021). Dynamic skills describe respondents' personal opinions toward the means or skills to make the better future.

The present study indicates a fairly clear connection between environmental awareness and structural skills for making a more sustainable future. The result of Pearson's correlation explains the connection between Finns' environmental awareness and their anticipatory competence. Finns' scientifically accurate knowledge of the reasons for climate change and nature loss (awareness) correlated rather strongly with their structural skill that climate change and biodiversity loss can be tackled through active measures, such as legislation (r = 0.446, p < 0.000, R^2 = 0.20). Instead, Finns' misunderstanding of environmental issues negatively correlated with their structural skills for solving environmental crises in the future (r = −0.375, p < 0.000, R^2 = 0.14).

However, the result becomes unclear when compared to Finns' personal anticipatory skills in interpreting or assessing climate change and nature loss in the future. Finns' awareness of climate change and biodiversity weakly correlated with their dynamic skills (r = 0.104, p < 0.000, R^2 = 0.01). Surprisingly, Finns' lower environmental awareness also correlates weakly with their dynamic skills (r = 0.100, p < 0.000, R^2 = 0.01). The result suggests that Finns' environmental awareness is not obviously associated with their dynamic skills for building a more sustainable future. However, the R^2-values indicate that only 1% of the variance in dynamic skills is shared with the variations of environmental awareness. The small effect sizes reveal that the correlation is unimportant.

CONCLUSION

According to the present study, environmental awareness among Finns seems to be quite high. Compared to previous studies, climate change awareness is similar (Lehtonen et al., 2020). Finns understand quite well the increase in the concentration of greenhouse gases in the atmosphere caused by climate change. The right information will help mitigate climate change mitigation measures. The most significant misunderstanding is that ozone depletion is causally linked to climate change. This result is very similar to previous studies (Tobler et al., 2012; Ratinen, 2016; Besel et al., 2017; Lehtonen et al., 2020). The understanding of biodiversity is also at a relatively high level. However, the results show that diversity is somewhat more unfamiliar to Finns than climate change, as the percentages of responses in the right direction were slightly lower. The result is similar to that of Lindemann-Matthies and Bose (2008), and they pointed out that limited knowledge of the public about biodiversity might explain why, in surveys, the loss of species is considered only a minor environmental problem.

From the point of view of developing the teaching of science, it is interesting to look at Finns' environmental awareness. Based on the results, it seems obvious that higher education increases environmental awareness. Those who attend primary and vocational school have a lower level of environmental education than those with higher education. However, the effect sizes between the groups remained small. Moreover, Dimante et al. (2016) found that teaching changed some undergraduate Students' household chemical consumption patterns, indicating the ambiguous impact of education on environmental awareness. Based on this study, it can be stated that age and education do not have a very significant effect on Finns' environmental awareness. The environmental awareness of women was somewhat higher than that of men, but for all variables, the effect size remained small.

The results suggest that Finnish primary school teaches students quite well about climate change and biodiversity, or that those who have attended primary school are quite environmentally conscious with information obtained elsewhere. Based on the results, it is worth paying attention to the causes of climate change and emphasizing the human impact on current climate change. In the context of biodiversity, it is worth highlighting the impact of production systems and consumption on biodiversity loss. Because climate change and biodiversity are complex, interrelated issues, it would be worthwhile to look at them simultaneously in teaching. However, as Barelli et al. (2018) indicated, the task is not easy because adults are not very comfortable dealing with scientific and epistemological concepts related to complex systems.

There is a clear link between Finns' environmental awareness and anticipatory structural skills. Conversely, the present research suggests that there is a partly contradictory connection between Finns' more personal dynamic skills and their environmental awareness. It would seem obvious that with an emphasis on future skills in science teaching, attention should be paid to ways to improve individuals' abilities to assess environmental issues from a more sustainable future perspective. As Tolppanen and Kärkkäinen (2021b) pointed out, the task of making education more sustainable is not simple: student teachers seem to have reluctance to make lifestyle changes that could significantly reduce their carbon emissions. This study suggests that Finns think broadly in the same way as Finnish student teachers. Teacher education is needed to foster student teachers' action competence, and thereby their competence to support their Students' and future citizens' action competence (Tolppanen and Kärkkäinen, 2021b). If teachers' own skills and will to make the future more sustainable are uncertain, it is unlikely that they will be able to guide their students toward a sustainable lifestyle.

Based on the results of the present study, it would be worth considering how sustainability education could be extended beyond education to the world of work. Finland is well-known for its education and this study shows the positive impact of Finnish higher education on citizens' environmental awareness. We still need more knowledge how awareness at the work places will lead sustainable environmental measures. The gap between females and males in their objectives for a sustainable future is also revealed, pointing out areas that deserve attention by science education. The better understanding for the results of the present study outside of Finland would be significant if the study was implemented in other countries.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

IR contributed to conception and design of the study, performed the statistical analysis, and wrote the first draft of the manuscript. IR and LL organized the database. Both authors contributed to manuscript revision, read, and approved the submitted version.

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