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Promoting sustainability competency and self-efficacy in class teacher education

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There is an urgent need for a global sustainability transition. This change needs to be cultural and transform both our actions and the values on which we base our decision-making. Sustainability transition requires concentrating on future generations as well as on the people teaching them because class teachers have an impact on their pupils' knowledge, skills, values, and attitudes. Therefore, class teachers need new competency to make sustainability transformation in schools happen. Teachers also need to possess a sufficient level of self-efficacy beliefs, as they strongly impact a teacher's ability to manage their job as a sustainability educator. This survey research studied Finnish class student teachers' (N = 166) perceptions about their sustainability competency and self-efficacy in education for sustainable development. Students' perceptions of their sustainability competency were clustered into one weighted sum variable. Three principal components were constructed with principal component analysis (PCA) to describe the students' self-efficacy beliefs in education for sustainable development. A PCA paired with linear hierarchical regression analysis was conducted to explain the variation in students' sustainability competency perceptions. The results indicated that the combined self-efficacy beliefs in teaching values and ethics and systems thinking explained 19.3% of the variation in class student teachers' sustainability competency. As a result, improving class student teachers' self-efficacy beliefs about teaching ethics and values and systems thinking in the Finnish context can improve their sustainability competency and vice versa. To promote the sustainability competency of class student teachers, it is necessary to be aware of this connection when developing class teacher education.

KEYWORDS

sustainability competency, teacher education, sustainability education, self-effiacy, sustainability transition

1. Introduction

Due to climate change, biodiversity loss, and overconsumption, we need a sustainability transition of a novel kind. This transformation needs to be systemic, societal, and cultural (Linnér and Wibeck, 2019). Researchers from multiple scientific fields have highlighted various sustainability problems, but these problems still lack sustainable solutions (Lotz-Sisitka et al., 2015). Class teachers have a huge impact on future generations (Evans, 2020), and to make an investment in our children's future, class teachers with sustainability competency are required. Therefore, it is essential that class teacher education provides student teachers with the necessary skills, knowledge, and competency to responsibly fulfill their job of promoting sustainable values and actions in primary

schools (Evans, 2020). For example, in Finland, the National Core Curriculum constructed by the Finnish National Board of Education requires teachers to support their pupils' growth toward a sustainable way of life (The Finnish National Board of Education, 2014). This goal is ambitious, important, and value-loaded. As a result, class student teachers need their education to provide them with a strong and coherent basis for a new competency: the knowledge, attitudes, and skills needed to solve sustainability-related problems (Evans, 2020) and help their pupils foster a sustainable lifestyle.

Competency is defined as a set of skills, attitudes, and knowledge that is needed for successful task-managing and problem-solving (Brundiers et al., 2021). A competency-based viewpoint of planning courses and curricula, especially in higher education, has recently been an issue of interest (Brundiers et al., 2021). Researchers and universities are working toward sustainability competency-based educational programs with standardized evaluation objectives and learning goals (Brundiers et al., 2021). Sustainability competency-based frameworks are present in multiple European countries, including Finland (e.g., GreenComp; Bianchi et al., 2022). The sustainability competency framework is studied generously in the higher education context. Still, sustainability competency is only briefly studied in primary schools and basic education contexts (Vesterinen and Ratinen, 2023). Also, there is some evidence that education for sustainable development at the university level is not fully achieving its' goals when it comes to the learning outcomes of the students (Sánchez-Carracedo et al., 2021). The focus on sustainability competency framework at the higher education level is not fully showing at the basic education level, which indicates that there is still a need to improve when it comes to class teacher education.

In planning, executing, and assessing education for sustainability, a set of five key competencies (Wiek et al., 2011, 2016) is often used. The sustainability competency, according to Wiek et al. (2011, 2016), includes different, interconnected competency clusters (Brundiers et al., 2021). In this study, systems thinking competency refers to an individual's capability to analyze sustainability problems across different sectors, scales, and systems thinking characteristics (Assaraf and Orion, 2005; Wiek et al., 2011). Futures thinking competency is the "ability to collectively analyze, evaluate, and craft rich 'pictures' of the future related to sustainability issues and sustainability problem-solving frameworks" (Wiek et al., 2011, p. 208–209). The values thinking competency is the "ability to collectively map, specify, apply, reconcile, and negotiate sustainability values, principles, goals, and targets" (Wiek et al., 2011, p. 209). Collaboration competency is the "ability to motivate, enable, and facilitate collaborative and participatory sustainability research and problem solving" (Wiek et al., 2011, p. 211). Lastly, we define action-oriented competency as an integration of strategic thinking and integrated problem-solving competencies. Wiek et al. (2011, p. 210) defined strategic thinking competency 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" (Wiek et al., 2016, p. 251).

Sustainability competency is needed to successfully perform sustainability-related tasks (Brundiers et al., 2021). Bandura's (1977) concept of self-efficacy is defined as confidence in one's abilities to plan, execute, and assess actions in order to, for instance, problem-solve or bring intentions to fruition. In the present research, we define teachers' self-efficacy beliefs about emotions, feelings, and empathy as a teachers' confidence that they are able to understand their own and others' emotions and feelings, express their emotions meaningfully, regulate their emotions and use their emotions productively (Sleurs, 2008). Teachers' sense of self-efficacy impacts, for example, the achievements of the students (Caprara et al., 2006). Similarly, every competency includes a set of dispositions that are crucial to completing a task (Brundiers et al., 2021). For example, to collaborate successfully (for collaboration competency, see: Wiek et al., 2011, 2016), one must learn how to speak, listen, motivate, affect, read body language, and sense the atmosphere of the conversation. Therefore, it is reasonable to consider the concepts of competency and self-efficacy simultaneously. Next, we will provide examples of how sustainability competency and self-efficacy beliefs have been connected and paired in previous research.

A scale called "An Education for Sustainable Development Self-Efficacy Scale for Primary Pre-Service Teachers" was constructed and validated by Malandrakis et al. (2018). Their findings illustrate that the correlation between perceived sustainability development knowledge and the perceived sense of self-efficacy in pre-service teachers is significant (Malandrakis et al., 2018). In addition, perceived knowledge explains a huge amount of the variance in the self-efficacy of pre-service teachers (Malandrakis et al., 2018). Moreover, it was found that the respondents' scores for the dimensions of "Values and ethics" and "Emotions, feelings, and empathy" were higher than the scores for systems thinking competency. Also, students had a high perception of themselves as environmental educators, which indicates that they may not yet have coherent ideas about the complexity of sustainability challenges or about all the methods for sustainability education that could be used in the classroom pedagogy (Malandrakis et al., 2018).

Another study by Ho (2021) showed that if high school students had not acquired useful knowledge about sustainability problems, they did not want to engage in problem-solving with a sense of citizenship, even if they had enhanced self-efficacy. Self-efficacy beliefs are connected to knowledge-acquisition more than a sense of citizenship, which self-efficacy beliefs do not enhance (Ho, 2021). Knowledge-acquisition relates to systems thinking and, more generally, to sustainability competency (Wiek et al., 2011, 2016), and the results recorded by Ho (2021) suggest that self-efficacy could positively impact sustainability competency through knowledge-acquisition. As a result, systems thinking and systemic understanding require the right knowledge about sustainability crises and how life-preserving mechanisms work.

Schutte and Bhullar (2017) studied the connection between self-efficacy and changeability beliefs in one's behavior related to motivating environmentally sustainable behavior. They found that participants with a high sense of self-efficacy for sustainable behavior and high self-efficacy in changeability also reported such behavior more often than those who had low self-efficacy in sustainable behavior and changeability. Moreover, Schutte and Bhullar (2017) designed interventions to promote self-efficacy beliefs for sustainable purchasing and the changeability of sustainability-related purchasing behavior. In their research, the promotion of self-efficacy beliefs related to making sustainable purchases had the most impact on intentions to make sustainable purchases. These findings suggest that self-efficacy beliefs play a role in strategic competency (Wiek et al., 2016).

Moreover, to solve sustainability-related problems, values thinking abilities are required (Warren et al., 2015). Education is considered to be ethical and values-based in nature (Sutrop, 2015). In education, sustainability problems and people's values are connected and should be considered simultaneously. Research has shown that values play an important role in sustainable behavior and action. Still, there seems to be a gap between environmental attitudes and behaviors; values do not automatically transform into action (Leiserowitz et al., 2004). Also, the links between the futures thinking competency and self-efficacy among potential entrepreneurs (Fuller et al., 2018), as well as connections between cooperative educational approaches and sustainability competency, are considered to be very important (Bassachs et al., 2020). Lastly, Akça (2019) found that pre-service teachers' self-efficacy beliefs significantly predict their ability to focus on solutions and beliefs about education for sustainable development (29%).

The self-efficacy of teachers has been widely studied (Alibakhshi et al., 2020). The results show, for example, that teachers with high self-efficacy beliefs are more likely to attempt challenging tasks (Hussain and Khan, 2022). Also, there has recently been increased interest in constructing and validating scales for teacher students' self-efficacy beliefs and abilities to conduct education for sustainable development (Malandrakis et al., 2018; Handtke et al., 2022). In previous literature, self-efficacy has been included in action-oriented competency (Olsson et al., 2020) or considered to be a part of the teachers' teaching profession with teachers' competency and attitudes toward the teaching profession (Yeşilyurt, 2014). Nonetheless, the connection between class student teachers' self-efficacy and sustainability competency is not only evident (e.g., Schutte and Bhullar, 2017; Ho, 2021) but also unclear (e.g., Malandrakis et al., 2018), and has not been studied in the Finnish context before. This study presents a novel way of combining Finnish class student teachers' perceptions of their sustainability competency and collecting information about the students' sense of self-efficacy in education for sustainable development. The aim is to increase an understanding of the connections between class student teachers' perceived sustainability competency and self-efficacy beliefs. This information is crucial, as we aim to develop class teacher education in Finland according to competency-based higher education pedagogy frameworks (Brundiers et al., 2021; Bianchi et al., 2022).

The research questions are as follows:

(1) What kind of connection exists between Finnish class student teachers' sustainability competency and self-efficacy?
(2) How does self-efficacy explain variation in their sustainability competency?

2. Materials and methods

The data were collected with an internet survey using the Google Forms platform. The target group consisted of 166 Finnish-speaking class student teacher volunteers from nine Finnish universities. The participants were first- and second-year class student teachers. Students were contacted through a nationwide teacher education department with access to the email addresses of university lecturers. Therefore, we cannot say how many students the lecturers who chose to participate in this research contacted or, how many of those students answered the questionnaire. As a result, we cannot report an exact response rate; therefore, the sample should be considered a convenience sample. Some participants answered the questionnaire in their free time, whereas others answered it as a part of their lecture at the university. University lecturers were instructed to guide students in following the instructions in the research form when responding to the survey. The data collection was fully anonymous, and the students had the opportunity to refuse to participate. The response time for the survey was 20–25 min. Data were collected in two different sections, spring and fall 2022. Of the respondents, 85.5% were female, 13.9% were male, and 0.6% did not want to express their gender. Most of the respondents ranged in age from 18 to 23 (76.5%). This survey had no missing data because the questionnaire required an answer to each statement.

The sustainability competency scale modified for use in this study was originally developed to measure Finns' sustainability competency (Ratinen and Linnanen, 2022). The self-efficacy scale created and used in this research is based on the Malandrakis et al. (2018) scale, which has proven useful in measuring the self-efficacy of pre-service teachers and has demonstrated strong reliability and validity, along with the impressive psychometric properties (Malandrakis et al., 2018). The questionnaire used in this research consisted of two parts: (1) class student teachers' sustainability competency (Table 1) and (2) class student teachers' self-efficacy components on education for sustainable development (Table 2). Questions in the first part were clustered according to five key sustainability competencies (Wiek et al., 2011, 2016), including questions about systems thinking competency, futures thinking competency, values thinking competency, action-oriented competency, and collaboration competency. The second part of the questionnaire included questions regarding participants' self-efficacy beliefs in teaching values and ethics, systems thinking, actions and emotions, feelings, and empathy. The 5-point Likert scale used in this study consisted of the following options, of which the respondents chose one for each statement: 1 = totally disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = totally agree.

2.1. Analysis and statistical tests

To analyze the data, IBM SPSS software (version 28.0.0.0) was used. The number of items included in the sum variable of sustainability competency was calculated by principal component analysis (PCA), which is useful for reducing the number of variables while retaining the most information in the data (Jolliffe and Cadima, 2016). Some items were excluded (principal component loading < 0.600, KMO < 0.500), and the sum variable of the sustainability competency total consisted of 20 variables, including items regarding systems thinking competency, futures thinking competency, values thinking competency, action-oriented competency, and collaboration competency. The normality of the distribution of variables used in the sum variable was checked graphically (Frees, 2010). The properties of the items included in the sum variable are presented in Table 1. The weighted sum variable was used in the hierarchical regression analysis. The equation of the weighted sustainability competency was calculated as follows:

$$\bar{x} = \frac{\sum_{i=1}^{n}(x_i * w_i)}{\sum_{i=1}^{n} w_i}$$

where x_i = the mean value for each sustainability competency item, and w_i = the corresponding weight as the number of each sustainability item.

The second section of the questionnaire included questions about respondents' self-efficacy for education for sustainable development. This section was suitable for PCA (e.g., Malandrakis et al., 2018), excluding the dimension of actions (KMO < 0.600, Cronbach's α < 0.600). In total, three components were formed. The varimax rotation method was used. The properties of the self-efficacy components used to explain the variation in students' sustainability competency are presented in Table 2. Testing the assumptions of the multicollinearity of predictor variables was essential before running the hierarchical regression analysis. There was no significant collinearity (VIF) between the independent predictor variables. The VIF values of the components in the multicollinearity analysis ranged from 1.00 to 1.830. The correlation coefficients of the predictor variables ranged from r = 0.512 to r = 0.598.

2.2. Ethics approval statement

Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

3. Results

3.1. The sum variable of sustainability competency

The sum variable of sustainability competency consisted of 20 variables (Table 1). The Cronbach's alpha for the sustainability competency sum variable was 0.881. When it comes to systems thinking competency, respondents had quite low confidence that they could identify the factor causing a major turning point in a particular sustainability crisis (only 27.1% agreed and totally agreed, M = 2.86). Also, only 36.1% of the respondents felt that they liked to tackle environmental issues by looking at the big picture (M = 3.13). On the contrary, 66.2% of the respondents agreed and totally agreed that they could analyze the links between the products they buy and the global economy (M = 3.59). Cronbach's alpha for the systems thinking competency was 0.809.

All three agreement percentages and mean values were moderately high within the futures thinking competency (74.7%–84.4% agree and totally agree, M = 3.89–4.20). Respondents were nearly unanimous in voting for sustainable-driven decision-makers (84.4% agree and totally agree, M = 4.20) and renewing the educational agenda in schools (82.5% agree and totally agree, M = 4.14) Interestingly, there seem to be multiple opinions about whether the sustainability crisis will affect the participants' security in the future (SD = 1.045). Cronbach's alpha for the futures thinking competency was 0.704. Within the collaboration competency, 70.5% of the respondents agreed and totally agreed that they could take a constructive and solution-oriented stance in the societal climate debate (M = 3.75). However, the respondents seem to lack scientific knowledge or confidence: only 43.3% of the respondents agreed and totally agreed that they could make science-based arguments about which sectors are crucial to solving the climate and sustainability crisis and biodiversity loss (M = 3.22). Cronbach's alpha for the collaboration competency was 0.700.

Of the respondents, 82.6% agreed and totally agreed that they could assess climate and sustainability issues from the perspective of children's rights and human rights (M = 3.93). These numbers were slightly higher than for the item "I can also assess climate and sustainability issues from a social justice perspective" (M = 3.62, 61.4% agree and totally agree). Cronbach's alpha of the values thinking competency was 0.703. Within the action-oriented competency, 92.2% of the respondents reported that they agree and totally agree that they understand the link between their consumption and the environmental crisis (M =4.16). Moreover, respondents were quite unanimous (SD = 0.616). Still, only 52.4% of the respondents reported that they had reduced the use of animal-based commodities during the last year (M = 3.26), and surprisingly, they were not unanimous about reducing the usage of animal-based commodities (SD = 1.330). Also, only 56.1% agreed or totally agreed that they had reduced their intake of dairy and meat-based products (M = 3.31). For the action-oriented competency, Cronbach's alpha was 0.830.

TABLE 1 The sum variable of class student teachers' sustainability competency.

The sum variable of sustainability competency (Cronbach's $\alpha = 0.881$)	Mean (SD)	Agree and totally agree (%)
Systems thinking competency (Cronbach's $\alpha = 0.809$)	–	–
I can rank social systems (e.g., mobility, housing, food, energy production, consumption, recycling...) in terms of their environmental impact	3.11 (0.950)	40.9
I can analyze the links between the products I buy and the global economy	3.59 (0.928)	66.2
I can consider ecological, cultural, social, and economic aspects when solving biodiversity loss	3.37 (0.869)	51.2
I like to tackle environmental issues by looking at the big picture	3.13 (0.969)	36,1
I can identify which factor is causing a major turning point in a particular sustainability crisis	2.86 (0.929)	27.1
I can build cause-and-effect models of sustainability problems in my mind	3.50 (0.858)	61.4
Futures thinking competency (Cronbach's $\alpha = 0.704$)	–	–
I see a renewal of the educational agenda of the school as necessary to achieve a more ecological future	4.14 (0.793)	82.5
I want to vote for decision-makers whose actions contribute to sustainable development	4.20 (0.835)	84.4
I feel that the climate crisis and biodiversity loss will affect my security now and in the future	3.89 (1.045)	74.7
Collaboration competency (Cronbach's $\alpha = 0.700$)	–	–
I can take a constructive and solution-oriented stance in the societal climate debate	3.75 (0.836)	70.5
I can make science-based arguments about which sectors are crucial to solving the climate and sustainability crisis and biodiversity loss	3.22 (0.943)	43.3
I recognize the seriousness of climate change and biodiversity loss, and I can discuss their solutions and adaptation aspects in a proactive and constructive way	3.66 (0.791)	65.6
Values thinking competency (Cronbach's $\alpha = 0.703$)	–	–
I can assess climate and sustainability issues from a social justice perspective	3.62 (0.842)	61.4
I can assess climate and sustainability issues from the perspective of children's rights and human rights	3.93 (0.647)	82.6
Action-oriented competency (Cronbach's $\alpha = 0.830$)	–	–
I feel that my choices and actions have a role to play in solving the climate crisis and biodiversity loss	3.81 (0.934)	74.7
I understand how my own consumption is linked to the climate crisis and biodiversity loss	4.16 (0.616)	92.2
I understand the link between my eating habits, the climate crisis, and biodiversity loss	4.13 (0.684)	89.1
I have reduced my consumption of animal-based commodities	3.26 (1.330)	52.4
I have reduced my intake of dairy- and meat-based products	3.31 (1.296)	56.1
I have increased the proportion of plant-based foods in my diet	3.78 (1.274)	73.5

3.2. The class student teachers' education for sustainable development self-efficacy scale

The PCA facilitated the creation of three principal components that represent the class student teachers' self-efficacy beliefs. These components were (1) self-efficacy in teaching values and ethics, (2) self-efficacy in teaching systems thinking, and (3) self-efficacy in teaching emotions, feelings, and empathy. The Kaiser–Mayer–Olkin (KMO) value of the values and ethics self-efficacy principal component was 0.778, and Cronbach's alpha was 0.835. The total explanation of variance was 67.2%, and the loadings of the principal components were satisfactory (>0.600). The KMO value in the systems thinking self-efficacy principal component was 0.754, and Cronbach's alpha was 0.784. The total explanation of variance in this principal

TABLE 2 Class student teachers' self-efficacy components on education for sustainable development.

	Mean (SD)	Agree and totally agree (%)	Component loading
Self-efficacy in teaching values and ethics (Cronbach's $\alpha = 0.835$, KMO = 778)	–	–	–
I feel confident that I can consider pupils' values related to sustainable development in my teaching	3.88 (0.703)	75.3	0.810
I feel confident that I can develop pupils' ethics and ethical reflection skills related to sustainable development	3.86 (0.732)	76.5	0.823
I feel confident that I can develop pupils' ability to express their own opinion about sustainable development	3.93 (0.653)	80.8	0.853
I feel confident that I can develop students' positive attitudes toward sustainable development	4.03 (0.597)	88.0	0.792
Eigenvalue	–	–	2.688
Exp. of total variance %	–	–	67.2
Self-efficacy in teaching systems thinking (Cronbach's $\alpha = 0.784$, KMO = 0.754)	–	–	–
I feel confident that I can develop pupils' ability to consider an issue from multiple perspectives	4.04 (0.678)	85.6	0.790
I feel confident that I can develop pupils' ability to realize the interrelations among different factors or issues	3.84 (0.669)	74.1	0.816
I feel confident that I can develop pupils' ability to think using models	3.48 (0.836)	53.6	0.748
I feel confident that I can develop pupils' ability to act in a systemic way to achieve goals	3.63 (0.734)	60.8	0.778
Eigenvalue	–	–	2.454
Exp. of total variance %	–	–	61.3
Self-efficacy in teaching emotions, feelings, and empathy (Cronbach's $\alpha = 0.755$, KMO = 0.734)	–	–	–
I feel confident that I can understand and consider pupils' sustainability crisis-related feelings in my teaching	4.13 (0.644)	89.2	0.700
I feel confident that I can guide my pupils to tolerate uncertainty	3.71 (0.763)	68.0	0.690
I feel confident that I can help my pupils to process their feelings	4.13 (0.692)	87.3	0.855
I feel confident that I can empower my pupils and develop their own sense of self-efficacy	3.99 (0.730)	81.9	0.795
Eigenvalue	–	–	2.329
Exp. of total variance %	–	–	58.2

component was 61.3%, and the loadings of the principal components were satisfactory (>0.600). The KMO of the emotions, feelings, and empathy self-efficacy principal component was 0.734, and Cronbach's alpha was 0.755. The total explanation of variance was 58.2%, and component loadings were also satisfactory (>0.600).

Starting with self-efficacy beliefs about teaching values and ethics, most of the respondents (89.2%) reported that they agreed and totally agreed that they could understand and consider pupils' sustainability crisis-related feelings in their teaching ($M = 3.88$). Also, 88% of the respondents agreed and totally agreed that they felt confident they could help their students develop positive attitudes toward sustainable development ($M = 4.03$), and they were almost unanimous (SD = 0.597). Within the self-efficacy of values and ethics teaching, the mean values and the agreement and total agreement percentages were high (75.3%−88% agree and totally agree, $M = 3.86$–4.03). Within the component of self-efficacy in teaching systems thinking, only 53.6% of the respondents felt confident that they could help pupils to think with models ($M = 3.48$). Still, 85.6% of the participants agreed and totally agreed that they felt confident that they can develop pupils' ability to consider an issue from multiple perspectives ($M = 4.04$). The respondents were also quite unanimous (SD = 0.678). When it comes to self-efficacy in teaching emotions, feelings, and empathy,

only 68% of the respondents felt confident that they could guide pupils to tolerate uncertainty ($M = 3.71$), and the respondents were quite unanimous (SD = 0.763). On the contrary, 89.2% of the respondents agreed and totally agreed that they felt confident that they could understand and take into account pupils' sustainability crisis-related feelings in their teaching ($M = 4.13$), and they were nearly unanimous (SD = 0.644).

3.3. Links between self-efficacy beliefs in education for sustainable development and the variation in the sustainability competency of Finnish class student teachers

Hierarchical regression analysis was conducted to explain the variation in class student teachers' sustainability competency with the order of the following components: self-efficacy beliefs of teaching (1) values and ethics (Malandrakis et al., 2018), (2) systems thinking (Ratinen and Linnanen, 2022), and (3) emotions, feelings, and empathy (Malandrakis et al., 2018).

In the first step, self-efficacy beliefs of teaching values and ethics effectively predicted the respondents' perceptions of sustainability competency ($\beta = 0.413$, $p < 0.001$) and explained 17% ($R^2 = 0.170$) of the variation in students' sustainability competency perceptions (see Table 3). In the second step, the self-efficacy beliefs of teaching systems thinking were inserted into the model. Self-efficacy beliefs of teaching values and ethics combined with systems thinking self-efficacy beliefs explained 19.3% of the variation in students' sustainability competency ($R^2 = 0.193$). Adding systems thinking self-efficacy beliefs into the regression model improved its explanatory power by 2.3% (19.3%−17% = 2.3%). Steps one and two together predicted the perceptions of respondents' sustainability competency ($\beta = 0.299$ and $p < 0.001$; $\beta = 190$ and $p < 0.05$; see Table 3). In the third step, the self-efficacy component of teaching emotions, feelings, and empathy was inserted into the model. This step increased the explanatory power of the regression model only marginally ($R^2 = 0.194$), and the combination of the previous two steps and the self-efficacy component of teaching emotions, feelings, and empathy did not predict participants' sustainability competency ($\beta = 0.309$ and $p < 0.01$; $\beta = 0.196$ and $p < 0.05$; $\beta = -0.024$ and $p > 0.05$; see Table 3). In summation, the third step did not explain the variation in the participants' sustainability competency, whereas steps one and two did explain the variation by 17 and 19.3%, respectively.

4. Discussion

Societal sustainability transition requires systemic actions in all societal sectors (Linnér and Wibeck, 2019). Primary school teachers can enhance the sustainability transition through their work, as class teachers can variously affect pupils' thinking, knowledge, skills, attitudes, and values related to sustainability. Therefore, class teacher education in Finland must provide students with sustainability competency because students will need updated skills, knowledge, and attitudes in their future jobs (Evans, 2020). To develop class teacher education effectively in Finland, research about class student teachers' sustainability competency and self-efficacy in education for sustainable development is crucial. In the present study, we have clarified the connection between Finnish class student teachers' sustainability competency and self-efficacy beliefs.

4.1. The connection between Finnish class student teachers' sustainability competency and their self-efficacy beliefs

The results of the present study indicate that there is a connection between class student teachers' sustainability competency and their self-efficacy beliefs. In our research, students' self-efficacy beliefs of teaching values and ethics explained 17% of the variation in students' sustainability competency in the hierarchical regression model. Moreover, students' values and ethics self-efficacy beliefs combined with their systems thinking self-efficacy beliefs explained a total of 19.3% of that variation. After adding emotions, feelings, and empathy self-efficacy beliefs into the model, the explanatory power of the model did not increase. It needs to be highlighted though, that even if the emotions, feelings, and empathy component did not explain the participants' sustainability competency in our research, the role of emotions, feelings, and empathy in learning and attention is evident and

TABLE 3 Connections between Finnish class student teachers' self-efficacy in education for sustainable development and the variation in their sustainability competency.

Sustainability competency			
–	Step 1 β (SE)	Step 2 β (SE)	Step 3 β (SE)
Values and ethics	0.413*** (0.037)	0.299***(0.045)	0.309** (0.049)
Systems thinking	–	0.190* (0.045)	0.196*(0.047)
Emotions, feelings, and empathy	–	–	−0.024 (0.046)
R^2	0.170	0.193	0.194
Adjusted R^2	0.165	0.184	0.179

***p < 0.001.
**p < 0.01.
*p < 0.05.

researched widely (e.g., Tyng et al., 2017). To conclude, our findings suggest that it might be possible to simultaneously enhance Finnish class student teachers' sustainability competency when increasing their self-efficacy beliefs related to teaching values and ethics and systems thinking. This connection can be utilized when developing class teacher education in Finland.

Due to the convenience sample used in this study, it is possible that students with strong self-efficacy beliefs were more likely to respond to the questionnaire than were those with lower self-efficacy beliefs, which may have distorted the results. However, this factor probably also relays some of the meaning of values and ethics in sustainability education. That is, students who had progressed far with their own values and ethics reflections would probably have considered it important to participate in this study, thereby affecting teacher education in Finland. Also, the action-oriented self-efficacy component was excluded from our regression model due to the PCA, and therefore, it is unknown how action-oriented self-efficacy might impact Finnish class student teachers' sustainability competency.

4.2. How does self-efficacy explain the variation in students' sustainability competency?

Systems thinking competency and self-efficacy have been linked in previous research (e.g., through knowledge-acquisition, see Ho, 2021). It has also been found that values do not automatically transform into sustainable actions, and there is a gap between peoples' beliefs and actions (Leiserowitz et al., 2004). These findings indicate that systems thinking competency, being a part of the sustainability competency (Wiek et al., 2011, 2016), supports our knowledge-acquisition process, whereas values have an important role in acting sustainably (Leiserowitz et al., 2004). Even though these research findings describe very different areas of sustainability, both are interconnected parts of the sustainability competency (Wiek et al., 2011, 2016). Therefore, it is important to consider them simultaneously.

Based on our study, class student teachers' self-efficacy in teaching sustainability values in schools explains 17% of the variation in their sustainability competency. The results of this study can be interpreted so that, on one hand, if students have a high self-efficacy belief about themselves as sustainability values educators, their self-evaluated sustainability competency is also high. It might be possible to increase class student teachers' sustainability competency by supporting their self-efficacy in teaching values and ethics. On the other hand, these results indicate that sustainability competency requires an awareness of one's values and ethical competency. In addition, earlier research has indicated that values can be taught through different values and ethics pedagogies (Sutrop, 2015). Values are always adopted (Gamage et al., 2021), and they are not immutable. Also, potential solutions for sustainability problems require values thinking (Warren et al., 2015). As a result, values and ethics self-efficacy can and should be taught as a part of teacher education programs to positively affect students' sustainability competency.

Moreover, in our study, students' self-efficacy beliefs in teaching values and ethics combined with self-efficacy beliefs in teaching systems thinking even better explain the variation in their sustainability competency (19.3%) than do self-efficacy beliefs in teaching values and ethics alone. Interestingly, suggestions have been made in the previous literature about the uniqueness of combining systems thinking with values and ethics: This combination might have a role in making implicit values visible in different systems and their levels (Silva et al., 2018). For example, it might be possible and worthwhile to study if students who have a high level of self-efficacy in teaching systems thinking and values and ethics become more easily aware of the hidden curriculum in the university (Bergenhenegouwen, 1987).

Whether the humanities can provide causal explanations for societal phenomena is a controversial question. Still, it is important that this humanities philosophy debate does not stop researchers from tackling societally and environmentally important issues and making causal assumptions within the limits of their data (Raatikainen, 2015). Although self-efficacy beliefs related to teaching values and ethics and systems thinking might not be the only predictors of class student teachers' sustainability competency, they seem to provide the strongest connection between sustainability competency and the self-efficacy of class student teachers in this research. Also, it is beneficial to note how comparable the findings of this study are to the previous research literature. For example, Alp et al. (2008) found similar results about the link between environmental affects and environmentally friendly behaviors among pupils. According to their research, environmental affects and behavioral intentions explained 49.8 and 6.8% of the variance in environmentally friendly behavior, respectively (Alp et al., 2008). They also suggested that environmental knowledge explains only 0.6% of environmentally friendly behaviors (Alp et al., 2008). Future research might focus on studying the values and ethics and systems thinking self-efficacy beliefs of class student teachers to find out the mechanisms through which self-efficacy builds the sustainability competency.

5. Conclusion

Our study suggests that there is a connection between Finnish class student teachers' sustainability competency and their self-efficacy beliefs. Class student teachers' self-efficacy in teaching values and ethics explained 17% of the variation in students' sustainability competency. Moreover, self-efficacy beliefs in teaching values and ethics combined with self-efficacy beliefs in teaching systems thinking together explained 19.3% of the variation in students' sustainability competency in our hierarchical regression model. The links between self-efficacy and sustainability competency should be studied more deeply in the future to gain a coherent understanding of the processes and relations between these different dimensions. Still, based on our results, it can be concluded that in developing class teacher education in Finland and striving to construct a higher education framework that builds sustainability competency, it is important to simultaneously consider self-efficacy beliefs in both teaching values and ethics and systems thinking. This present study shows that self-efficacy beliefs in values and ethics and systems thinking explain the variations

in Finnish class student teachers' sustainability competency. Class teacher education curricula development work could benefit from emphasizing especially these two self-efficacy dimensions even more.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

Conceptualization and methodology: RK and IR. Analysis and writing—original draft preparation: RK. Writing—review and editing: IR and UK. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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