'This is not going to change in the short term'–Finnish and Spanish primary school student teachers' views on competencies for promoting sustainability education

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Abstract
In the contest of UNESCO's eight teacher competencies for sustainable development, this survey study aimed to investigate Finnish (n = 190) and Spanish (n = 170) primary school student teachers' views on competencies related to sustainability education and the ability to act as sustainability educators. The student teachers' answers to a questionnaire were investigated using qualitative content analysis. The most common competencies that appeared in the answers were strategic thinking, collaboration and integrated problem-solving. Most often, strategic thinking was reflected in responses related to global, regional and local problems. Normative, critical and systems thinking were the rarest competencies, and self-awareness competency was not detected in the student teachers' answers. In general, only one or two competencies were found in each answer, and no competency at all was found in the majority of the student teachers' answers. The educational implications of these results and the implications for initial teacher education are discussed.

Keywords: primary school student teacher, sustainability education, sustainability competencies, UNESCO's teacher competencies

INTRODUCTION

Sustainability education (SE) plays a key role in promoting a paradigm shift towards more sustainable behavior (Barth & Rieckmann, 2016; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2017) and supports the enlargement of sustainable development (SD) knowledge, skills and attitudes (Vesterinen & Ratinen, 2024). Recent studies have shown that education professionals are not committed to SE (Redman et al., 2018), and the biggest obstacle to the promotion of SE (Vare et al., 2019) and the inclusion of SD in curricula (United Nations Economic Commission for Europe [UNECE], 2012) is educators' lack of competency in sustainability. Competency in sustainability embraces the knowledge, skills and attitudes needed to successfully perform tasks and solve problems in relation to real life (Wiek et al., 2011).

Among teachers, positive attitudes towards SE prevail during their initial training, but they are more pessimistic during their teaching work (García-Fortes et al., 2024). Therefore, student teachers should be encouraged to acquire competency in sustainability to create suitable learning situations in the classroom (Rieckmann, 2018). According to Solís-Espallargas and Morón-Monge (2020), it is important that primary school teachers feel prepared and empowered so as to promote competencies in sustainability in their teaching activities. The acquisition of competencies is recognized as a complex and contested area. Barth et al. (2007) argue that individualized informal and formal contexts may shape the nature of competency development and suggest that inter- and trans-disciplinary spaces may support personal and professional reflection.

Many studies on SE have examined student teachers' attitudes and beliefs or their perceptions of sustainability

Contribution to the literature

- Previous studies have scarcely addressed the acquisition in sustainability of teachers and student teachers, and there are only a few studies on the inherent competencies of classroom teachers in sustainability.
- This study responds to this research gap by examining key competencies for sustainability education among student teachers in the dimensions of sustainable developments based on their spontaneous written answers.
- Study results show that sustainable development competencies and useful teaching methods to teach these skills should be accurately described in the teacher education curricula for fostering student teachers' thinking skills that are essential for understanding sustainable development.

(Vega-Marcote et al., 2015), but very few studies have employed a competency framework (García et al., 2017; Vare et al., 2019). According to Cebrián and Juyent (2015), further research is needed on achievement in teachers' and student teachers' acquisition of competencies in sustainability. Basic research is also missing on primary school student teachers' spontaneously appearing existing competencies so called existing inherent competencies in sustainability. Responding to this research gap, this study examines the key competencies for SE among student teachers in the ecological, social, cultural and economic dimensions of SD (Cebrián & Junyent, 2015; Yli-Panula et al., 2021).

The study describes the views of primary student teachers (PSTs) on competencies in sustainability based on their spontaneous written responses without systematic previous teaching and training on competencies in sustainability. The results identify the existing competencies among second-year PSTs. These findings could guide teachers to pay attention to which competencies should be strengthened during PSTs' studies. Although there is a lack of evidence on how various pedagogies succeed in developing competencies (Mindt & Rieckmann, 2017), some suggestions based on the literature are presented.

The goal of this survey is to make visible the existence of competencies in sustainability and to encourage educators to consider the practice of competencies in sustainability in their teaching. This information offers approaches for educators to enhance their student teachers' competency in sustainability.

THEORETICAL BACKGROUND

Education for Sustainable Development and Sustainability Education

Definitions of *sustainability-related education* often overlap, but there are also differences in goals and content. In all definitions, the goals of education are emphasized in the cognitive, skillful and affective dimensions to promote SD. The often-used definitions 'education for sustainable development' (ESD) and 'sustainability education' differ, as the former is considered a traditional approach at the individual level, whereas the latter focuses more on sustainability

changes in organizations and in local, national and global entities and their research. The goal of SE is to transform the world as we know it by 'inspiring different sets of values and practices' (Sterling, 2011, p. 23).

Both ESD and SE are future-oriented education approaches that emphasize the social and economic aspects of SD (Taylor et al., 2019). At the center of SE are humanistic and ecological values, a transformative way of thinking and the motivation to act for sustainability (Elegbede et al., 2023). It strives for sustainability in schools and communities with the aim of maintaining ecological, social, cultural and economic well-being by recognizing their interdependence (Sterling, 2004). In SE, students are also encouraged to visualize a variety of sustainable futures (Elegbede et al., 2023). Thus, SE is a useful approach for promoting a fundamental change in the educational paradigm (Sterling, 2004). This article adopts the concept of SE due to its broad coverage of sustainability issues, including the ideas of transformation and the sustainability crisis.

There are several perspectives on the implementation of SE in schools. For example, Sterling (2004) considers traditional teacher-centered and knowledge-transferring approaches as well as discipline-based approaches to be ineffective methods for teaching SD topics. Such teaching requires that teachers adopt new ways of thinking to approach the matter and cultivate new types of skills and competencies.

Competencies for Sustainability Education

In the past decade, increasing consideration has been given to the concept of competencies in sustainability as a means of supporting the theory and practice of SE (García-Fortes et al., 2024; Vare et al., 2019; Wiek et al., 2011). Definitions of competency include a combination of skills, knowledge, understanding, values and attitudes that enable a given task to be performed, and a problem solved (Crick, 2008; Wiek et al., 2012). In addition, it is important to highlight that these educational concepts are not limited by subject boundaries or specific content information (de Haan 2006; Juuti et al., 2021). Eight overarching competencies for sustainability presented by UNESCO (2017) can be used to coordinate both disciplinary and interdisciplinary aspects of the curriculum and in the

teaching of sustainability issues. The competencies for promoting SE provide a framework that guides students in acquiring the knowledge, skills and attitudes crucial to overcoming the global sustainability crisis (Olsson et al., 2020; UNESCO, 2017; Wiek et al., 2015).

Wiek et al. (2011) define competencies as a 'functionally linked complex of knowledge, skills and attitudes that enable successful task performance and problem solving' (p. 204). They suggest five key competencies in sustainability: systems thinking, normative or values thinking, anticipatory or futures thinking, strategic or action-oriented competency and collaboration or interpersonal thinking competency (Wiek et al., 2011). For its part, UNESCO (2017, p. 10) adds three other competencies from the perspective of teaching: critical thinking competency and self-awareness or intrapersonal competency. In addition, Redman and Wiek (2021) have recently suggested that implementation competency and integrated competency should be added to the sustainability competency framework. Implementation competency includes the idea that SE ought to prepare students for acting. Integrated competency means that all key competencies need to be integrated to advance sustainability transformations.

Systems thinking competency

Systems-thinking competency refers to higher-level thinking and methodological skills that enable human beings to analyze comprehensively complex systems across multiple environmental, societal, cultural and economic scales (Juuti et al., 2021; Wiek et al., 2011). Sustainability issues are exactly the kind of complex issues for which the importance of systems thinking is highlighted (Rieckmann, 2012). According to Alm et al. (2022), Swedish master's students agreed that sustainability must be viewed globally and that individuals have effects on SD. However, Spanish primary school student teachers exhibited difficulties when the environmental problems studied did not imply classic trophic relationships and required the management of the spatial scale in addition to the temporal one (Banos-González & Esteve, 2019). For their part, Tolppanen and Kärkkäinen (2021) found that only a few Finnish student teachers considered climate change mitigation using systems thinking. According to Palmberg et al. (2017), Nordic primary school student teachers' views on the relationships between the concepts of biological and SD were mainly at the basic level of systems thinking (recognizing interconnections and feedback, understanding dynamic behavior). According to Wiek et al. (2015), systems-thinking competency provides a sophisticated basis for strategic competency development and aims to influence the current state of the social-ecological system, whereas more sustainable lifestyles require normative thinking competency and anticipatory thinking competency.

Normative thinking competency

Normative thinking competency is connected to people's ability to define, apply, coordinate and negotiate in relation to sustainability values, goals and targets (Redman & Wiek, 2021). The overall goal of normative thinking is to develop a critical view and examine the sustainability of current and future states of social-ecological systems. In the study of Alm et al. (2022), the master's students rated themselves high in the normative competency, especially regarding the ecological aspects of sustainability; their views on taking responsibility for their work careers were also reflected in the normative competency.

Anticipatory thinking competency

Anticipatory thinking competency, by contrast, includes the skills to analyze, evaluate and create possible future images and predict future development in the framework of SD (de Haan, 2006; Wiek et al., 2011, 2015). It has been shown to be strongly related to master's students' views on the importance of educating students for a sustainable future (Alm et al., 2022).

Strategic thinking competency

Strategic thinking competency includes the 'ability to collectively design and implement interventions, transitions and transformative governance strategies toward sustainability' (Wiek et al. 2011, p. 210). Master's students scored it high in response to the question of working together at the organizational level to fulfil sustainability goals (Alm et al., 2022). Strategic thinking competency was generally recognizable in the responses of Finnish subject student teachers (FSSTs) when they were asked about environmental issues, such as forest logging, economic growth and equality, as well as about sociocultural sustainability, such as the responsibility of teachers regarding the equal treatment of their students (Yli-Panula et al., 2021). The implementation of strategic thinking in action requires the ability to apply other sustainability competencies, for example, systems thinking, anticipatory thinking and problem solving (Juuti et al., 2021).

Interpersonal competency

Interpersonal competency involves a student's ability 'to motivate, enable, and facilitate collaborative and participatory sustainability research and problem-solving' (Wiek et al., 2011, p. 211). Good communication, negotiation and collaboration skills are needed to work together to address sustainability issues (Wiek et al., 2011, 2015). Interpersonal competency seems to improve when children cooperate and participate in working together to achieve common goals. Collaboration competency appeared often in the answers of FSSTs, which is to be expected in regard to a teacher's basic skills (Metsäpelto et al., 2022; Yli-Panula et al., 2021).

Student teachers must develop an ability for outreach and collaboration with stakeholders. Additionally, interpersonal competency includes thinking and acting across cultural boundaries, thus strengthening trans-cultural thinking, facilitating diversity across cultures and valuing individuals and communities. Also, leadership (in oneself and others) is a skill that may be relevant for this. These skills are also necessary for the other four competencies mentioned above. Teaching interpersonal competency is complicated, as it involves all the other competencies, which may be challenging in the pedagogical setting. According to Alm et al. (2022) this competency was scored high by master students to the question to discuss sustainability and the ability to work in diverse groups.

Critical Thinking Competency

Critical thinking can be defined briefly as an ability to question norms, practices and opinions (UNESCO, 2017). A study by Vuorio et al. (2021) reveals that Finnish university teachers deemed critical thinking skills to be important in teaching. They can be enhanced by inquiry-based teaching and learning (Wongkam et al., 2014) and by using social network activities and cloud computing (Thaiposri & Wannapiroon, 2015). Teaching critical thinking competency and challenge-based learning can develop systems-thinking competency (Vesterinen & Ratinen, 2024). Bassachs et al. (2020) claim that primary school students reached a higher level of critical thinking development when interdisciplinary approaches were adopted. Yli-Panula et al. (2021), for their part, show that critical thinking was seldom connected to environmental and sociocultural problems in the views of FSSTs.

Integrated problem-solving competency

Students with integrated problem-solving competency know how to apply different problem-solving frameworks to solve complex SD problems and use them to develop diverse solution options. They are able to meaningfully analyze problems and evaluate solutions to build visions and strategies from an SD perspective (Wiek et al., 2015). This competency was found in FSSTs' responses in relation to environmental and sociocultural problems (Yli-Panula et al., 2021).

Self-awareness competency and intrapersonal competency

Many scholars have recently suggested that self-awareness and intrapersonal competencies should be added to the sustainability competency framework (Ayers, 2023; Redman & Wiek, 2021; Wiek et al., 2011). Brundiers et al. (2021) state that the concepts 'self-awareness competency' and 'intrapersonal competency' may be considered as synonyms, as both 'contribute significantly to sustainability problem-solving competency, do not overlap with any of the other

competencies, and keep the framework to a minimal set of competencies' (p. 24). According to Brundiers et al. (2021, p. 20), intrapersonal competency promotes 'the ability to be aware of one's own emotions, desires, thoughts, behaviors and personality, as well as to regulate, motivate, and continually improve oneself'. This competency was not found in FSSTs' answers in the study of Yli-Panula et al. (2021).

Other Aspects of Competencies for Sustainability Education

Focusing on learning outcomes, Brundiers et al. (2021) highlight the importance of Wiek et al.'s (2012) five key competencies in contemporary research. They refine and appraise them to show the hierarchy within the competencies (with values thinking underpinning other competencies) and add two other key competencies, intrapersonal and implementation. Brundiers et al. (2021) suggest combining the competencies within the possible methods of developing programs and course plans that will best promote the necessary learning outcomes in SD classes. According to UNESCO (2017), to achieve high-quality learning results, pedagogical approaches must be learner centered, activity centered and transformative. In SE, methods that promote SD skills through active learning should be preferred, such as collaborative real-world projects, vision-building exercises, science-fiction thinking (envisioning, e.g., future societies), analysis of complex systems and critical and reflective thinking (Rieckmann, 2018).

Research Questions

The main aim of this study was to analyze the appearance of the competencies in sustainability (UNESCO, 2017) in the answers of groups of PSTs from Finland and Spain. Therefore, our research question was: Which kinds of competency in sustainability can be identified in the Finnish and Spanish PSTs' answers?

MATERIAL AND METHODS

Participants

In total, 360 second-year PSTs participated in the survey as volunteers. The data were collected during the COVID-19 period in both Finland and Spain. These PSTs as yet had no teaching experience, only observational experiences from the first teaching practice period in schools. The study's participants comprised 190 Finnish primary student teachers (FPSTs) (codes 1-190) and 170 Spanish primary student teachers (SPSTs) (codes 191-360). The majority of the FPSTs and SPSTs were women (84% and 80%, respectively), and the vast majority were aged 19-24 years.

Table 1. Criteria for identifying the key competencies for teaching sustainability in the respondents' answers (adapted from UNESCO, 2017; Redman & Wiek, 2021; Yli-Panula et al., 2021)

Competency	Question	How the competency is identified
Systems-thinking competency	1, 3, & 4	The respondent identifies several dimensions of the problems and mentions cause-and-effect relationships (question 1). The respondent analyses complex situations across different dimensions (environmental, social, economic) and across different scales (local to global) (question 3). The respondent addresses various perspectives of the problem, including aspects from different disciplines. Instead of simple and direct solutions, more complex solutions are suggested (question 4).
Anticipatory competency	1 & 3	The respondent discusses the future and links together the causes and consequences of phenomena (question 1). The respondent anticipates future states of complex systems and sustainability problems (question 3).
Normative competency	1	The respondent analyses backgrounds and norms and applies sustainability values and principles (question 1).
Strategic competency	1 & 4	The respondent presents concrete proposals and means for promoting sustainable development (question 1). The respondent presents a (detailed) plan for an interdisciplinary educational module to address the problem of the school community they have designated (question 4).
Collaboration competency	2	The respondent expresses their intention to consult the person responsible for the excursion destination before making an independent decision or intends to seek advice (question 2).
Critical thinking competency	1 & 3	The respondent questions prevailing perceptions and discusses the norms in society (question 1 & question 3)
Self-awareness competency		This competency cannot be detected in the answers based on the design of the questions analyzed.
Integrated problem-solving competency	2 & 4	The respondent submits a specific proposal for resolving the situation other than cancelling the excursion or negotiating with the person responsible for the excursion destination (question 2). The respondent presents a (detailed) plan for an interdisciplinary educational module to address the problem of the school community described (question 4).

Instrument for Data Collection

The survey's questionnaire was developed as part of the OVET project (teacher student selection–proactive future work), which developed a conceptual framework for teaching quality in the form of a multidimensional adapted process model of teaching (Metsäpelto et al., 2022). The PSTs answered the questions spontaneously without any introduction to competencies. The questionnaire was web based (Webropol) and was approved by the ethics committee of the participating universities. It contained, among others, the following questions:

Q1. In your opinion, what are the most essential environmental problems? How would you try to solve these problems a) locally, b) regionally and c) globally?

Q2. You are taking pupils on a class excursion that accommodates only 12 students. The class you are responsible for has 36 students. You are informing the representative of the organizers at the destination. What would you tell them?

Q3. Mark whether the following statements are true or false and explain your responses. Justify your choice.

a. Continual economic growth is possible.

b. Economic equality between developed and developing countries will be achieved in the next few years.

Q4. What is something that can be a problem in the school community? Create an interdisciplinary study module for the class level of your choice to solve the problem you have identified.

The use of various types of questions on the questionnaire, such as open-ended questions and statements, increased the study's methodological reliability (De-Jaeghere et al., 2020; Elo et al., 2014).

Data Treatment

The PSTs' responses were analyzed using the inductive content analysis approach and on the basis on the multidimensional adapted process model of teaching (De-Jaeghere et al., 2020). The procedure for analyzing and categorizing the PSTs' responses was based on the study of Yli-Panula et al. (2021). Three of the researchers examined the responses to determine whether the competencies had been expressed in a given written answer. **Table 1** shows the competency-related criteria used to identify the competencies. A competency was scored as a single hit even when it was subsequently identified again in different parts of the response. When the researchers' interpretations of the answers' content
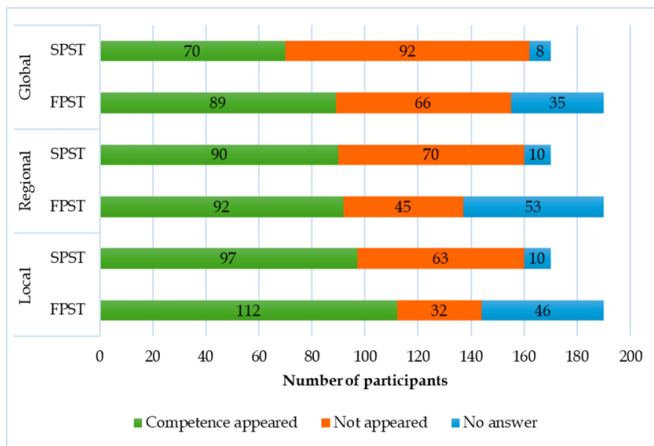
Figure 1. Number of appearances and no appearance of five sustainability competencies in the answers of FPSTs and SPSTs concerning environmental problems and their proposed solutions to the problems and number of no answers (Source: Authors' own elaboration)
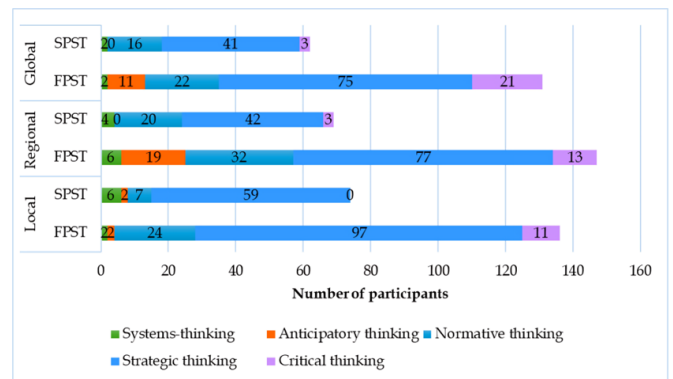

Figure 2. Percentage of the appearance of competencies in the answers of the FPSTs and SPSTs concerning local, regional and global environmental problems (the appearance of the competencies may be over 100%, as more than one competency may have appeared in a single answer and the per cent has been counted in relation to the number of answers received to the certain question) (Source: Authors' own elaboration)

differed, they discussed them until a common interpretation was reached. The final results of the analyses are therefore based on the common views and consensus of all three researchers.

The open-ended questions were prepared in such a way that the PSTs could choose their own answer path during the answering process without time limit, and some of the paths clearly permitted more indications of competency than others. Although the Finnish and Spanish results are presented separately, the main focus is the phenomenon, not comparing the results between countries. The focus of the study was not the frequency of occurrence of the mentioned competencies but the prevalence. The number of respondents and the four questions used in this study enabled the analysis of seven of eight competencies, so this study design can be considered reliable.

RESULTS

Competencies Regarding Environmental Problems (Q1)

In total, the PSTs gave 896 answers:
(a) locally (FPSTs 144, SPSTs 160 answers),
(b) regionally (137 and 150 answers, respectively) and
(c) globally (155 and 150 answers, respectively).

In the answers concerning local, regional and global environmental problems, five distinct competencies appeared. None of the PSTs' answers contained all five competencies, and usually only one or two competencies appeared in the analyzed answers. There were also several answers with no appearance of any of the competencies (**Figure 1**).

The five competencies appearing in the PSTs' answers were strategic, critical, normative, anticipatory and systems thinking (**Figure 2**). The most frequently

reflected competency at the three levels (local, regional and global) was **strategic competency** (in around 60% of both the FPSTs' and SPSTs' answers), as the respondents proposed concrete examples of environmental problems, such as waste production or air pollution due to an excessive number of vehicles, and they suggested concrete means for promoting SD, as in this example:

> 'One day of the week, certain streets should be pedestrianized so that cars cannot pass through them, thus reducing the amount of oil and gases emitted by vehicles' (SPST45).

Normative competency appeared in 14% of the FPSTs' answers and in nearly a quarter of the SPSTs' answers dealing with global problems. For example, the PSTs wrote,

> 'Together with international agreements such as the Paris Climate Agreement, everyone must commit to following the goal' (FPST34)

and

> 'The sheer amount of waste in the ocean is staggering. I would propose that people become aware of this problem through education … and I would penalize the companies that dump waste into the seas, to try to stop this disaster' (SPST281).

Systems-thinking, anticipatory and critical thinking competencies were barely observed. An example of the PSTs' answers representing anticipatory thinking competency regarding a local environmental problem is

> 'In my town, a chemical derivatives company has settled, and it does not stop pouring toxic gases into the atmosphere. This is compromising the
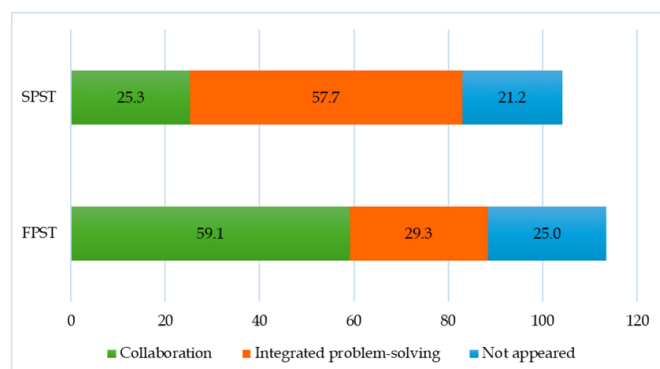
Figure 3. Percentages of the appearance of competencies in the answers of FPSTs and SPSTs concerning a school trip (the appearance of the competencies may be over 100%, as more than one competency may appear in a single answer and the per cent has been counted in relation to the number of answers received to the certain question) (Source: Authors' own elaboration)

health of citizens and the species … since there are many respiratory cancer cases in other towns with this kind of industry' (SPST83).

Regarding regional environmental problems, another wrote,

'Clear-cutting the forest and peat production. Biodiversity is declining, and Finland's natural landscapes and forests are disappearing' (FPST331).

In both countries, the most commonly appearing global environmental problem was climate change, whereas the most common regional problems were water eutrophication or similar issues in the Baltic Sea (among FPSTs) and the Mar Menor, an important coastal lagoon (among SPSTs). The most common local problems were waste and soil and air pollution.

Competencies Regarding a Class Excursion (Q2)

In total, the PTSs gave 334 answers (FPSTs 164, SPSTs 170 answers) regarding a class excursion. Two competencies, collaborative and integrated problem-solving, were in focus to be analyzed in these answers. Some participants gave several alternative solutions to the problem, so both competencies appeared in certain responses (**Figure 3**).

Among the PSTs, more than half the FPSTs showed a kind of **collaboration competency**, as they suggested that they would ask for advice or negotiate with the person who would take responsibility for the 12 students at the destination. This was the case of FPST138, who stated, 'I would arrange for another teacher to accompany me on the trip, and I would plan a "waiting activity" with the excursion destination. One of the teachers would stay to do the activity with those who couldn't fit in the trip yet, and then they would switch'.

Over a quarter of the SPSTs also showed this competency. For example, SPST324 wrote,

'I would talk to reach an agreement to be able to take all [the] students on the excursion … as all students have the right to go on this activity'.

Over half and one-third of the SPSTs and FPSTs, respectively, showed **problem-solving competency** in their answers, offering some kind of solution when facing this situation (other than cancelling the trip) as in the following example:

'I would see if they could welcome one group first and then another and another; if this is not possible, then look for another alternative where everyone can go and not only favor a few pupils' (SPST312).

The rest of the PSTs (n = 77) opted to cancel the trip, demonstrating neither of these two competencies. Most of them offered equality as their rationale for proposing this solution, such as SPST216:

'I would not go on the excursion, since we cannot discriminate so that some students go and not others, since we do not have exact criteria'.

Competencies Regarding Continual Economic Growth and Economic Equality Using Statement-Based Answers (Q3)

In total, the PSTs gave 699 answers to the two elements of Q3:

(a) continual economic growth (FPST 182, SPST 167 answers) and

(b) economic equality between developed and developing countries (FPST 182, SPST 168 answers).

The analysis of the PSTs' justifications for their statements revealed that **anticipatory competency** appeared often (in 35%-40% of the answers), whereas **systems-thinking and critical thinking competencies** scarcely appeared (less than 5% and 20%, respectively) (**Figure 4**).

Anticipatory competency appeared when the PSTs referred to potential events (new pandemics, wars, crises) that threaten development and affect economic growth. For example, SPST257 wrote,

'I don't think it is possible. New crises, wars or pandemics, such as the one of COVID-19, might occur, and this [economic growth] can rapidly curve [downward]'.

Systems-thinking competency appeared when the PSTs referred to various factors involved in economic growth in connection with the social and environmental dimensions of growth. **Critical thinking** was shown, for
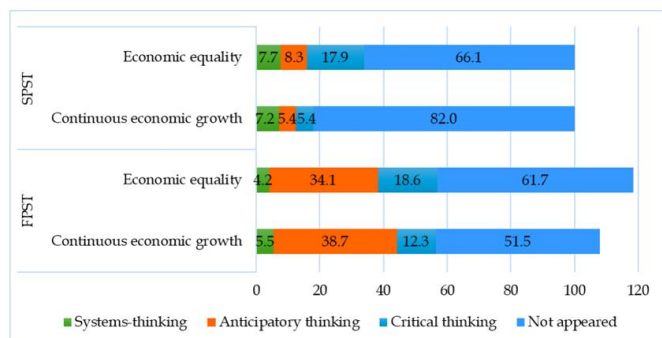
Figure 4. Percentage of appearance of competencies in the answers of the FPSTs and SPSTs in answers concerning economic equality and continual economic growth (the appearance of the competencies may be over 100%, as more than one competency may appear in a single answer and the per cent has been counted in relation to the number of answers received to the certain question) (Source: Authors' own elaboration)

Figure 5. Percentages of the appearance of competencies in the answers of the FPSTs and SPSTs concerning school community issues (the appearance of the competencies may be over 100%, as more than one competency may appear in a single answer and the per cent has been counted in relation to the number of answers received to the certain question) (Source: Authors' own elaboration)

example, when the PSTs criticized some actors (governments and industry) who, according to the PSTs' views, were focused on their own economic growth.

Concerning economic equality, **anticipatory competency** also appeared when the PSTs described their own vision of the future based on the current situation as well as **systems-thinking competency** when they referred to different dimensions (social, cultural and economic) to achieve equality between developed and developing countries. **Critical thinking competency** appeared when the PSTs questioned and were critical of the current situation of inequality, highlighting the interests of some actors in developed countries in maintaining and increasing these inequalities (the PSTs referred mainly to governments and big fortunes). For example, SPST277 wrote,

> 'Every day, there are more differences between various countries and inequalities within them as well, so it does not seem that this is going to change in the short term'.

Competencies Regarding a Possible Problem in the School Community and an Interdisciplinary Study Module (Q4)

Concerning school community issues, the PSTs described 284 problems and 252 study modules (FPSTs: 135 problems, 110 study modules; SPSTs: 149 and 142, respectively). The analyzed competencies found in the PSTs' answers regarding school community issues were **strategic thinking**, **integrated problem-solving** and **systems-thinking competency**. The PSTs were asked to describe a problem occurring at school and to develop a related solution via an interdisciplinary study module for the class. One-fourth of the FPSTs and three-fourths of the SPSTs identified problems and presented interdisciplinary study modules. The rest identified
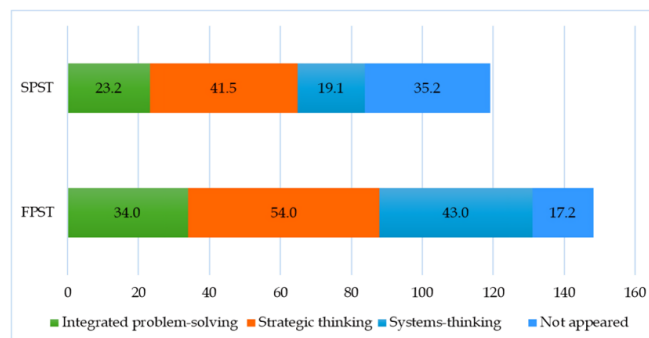
problems but did not come up with a plan or did not give any answers to the question (**Figure 5**).

More than two-thirds of the problems mentioned were of an environmental nature (e.g., pollution, recycling, indoor air problems, littering, and food waste); the rest varied from ones concerning the actual school building to matters of teaching and learning (e.g., lack of resources and lack of motivation for learning). A few respondents also mentioned social problems, such as bullying, loneliness or structural racism. In addition, issues such as superficial lifestyles, school lunches and locally sourced food offers were mentioned.

A closer look at the PTSs' answers showed that several included all the identified competencies. **Strategic thinking** was the most often detected (FPSTs 62, SPSTs 59), as the PSTs showed a certain ability to develop and execute measures facilitating SD. For example, FPST63 explained,

> 'We will compare vegetarian and meat-based dishes at school by tasting them for a week ... [with different flavoring processes] ... Then bringing the approach of SD into vegetarian food and together writing a plea for improving the taste of vegetarian food'.

The PSTs also exhibited the **integrated problem-solving competency** by presenting a plan on how to solve the mentioned problem by creating a multidisciplinary study entity for the pupils, trying to offer equitable and feasible options that promoted SD. For example, one PST described studies concerning how human activities affect the Mar Menor ecosystem, causing eutrophication. She proposed solving this problem by seeking and analyzing solutions based on nature, such as green filters or others related to the planning of the territory and the regulation of those activities that are most destructive to the Mar Menor, such as intensive agriculture or urban planning.

DISCUSSION

This study investigated the appearance of competencies to support SE among PSTs who had no systematic prior competency education. The PSTs' competencies in sustainability were examined based on their spontaneous written answers, but the level of their competency skills was not studied. Another potential limitation relates to the instrument for data collection, as the questions and their formulation may have influenced the type of answers the PSTs wrote. However, we sought to increase the reliability of the study by using several types of question as well as by independent parallel analyses carried out by three researchers.

The results indicate the existing competencies in sustainability among participating second-year PSTs and suggest how the acquisition of these competencies could be improved during their studies. Despite the present lack of evidence regarding how the various pedagogies succeed in developing the competencies (Mindt & Rieckmann, 2017), some suggestions based on the literature are discussed to address how to support learning the competencies in student teachers' initial training.

All five key competencies in sustainability shared by Wiek et al. (2011) and UNESCO (2017) (systems-thinking, normative or values thinking, anticipatory or futures thinking, strategic or action-oriented competency and collaboration or interpersonal thinking competency) were found in the responses of the Finnish and Spanish PSTs along with two competencies added by UNESCO (2017) (critical thinking and self-awareness or intrapersonal competency). Furthermore, the integrated problem-solving competency appeared. However, about half the PSTs exhibited none of the competencies in their responses. Strategic and normative thinking appeared most often in the responses regarding environmental problems, and anticipatory thinking was the most common in the question regarding economic equality and continual growth. Strategic thinking competency appeared in connection to environmental problems and issues that need to be solved in the future; however, self-awareness competency could not be detected in their answers. These results are in line with those of subject student teachers (Yli-Panula et al., 2021).

Collaboration competency was one of the three most frequently appearing competencies in the PSTs' responses, and it has been shown to be connected to interaction skills and empathy. According to Metsäpelto et al. (2022), interaction constitutes an essential skill for all teachers along with empathy, which is considered an important part of social interaction (Hétu et al., 2012). In our study, empathy was reflected via the PSTs' written answers. Collaboration competency was particularly visible in the responses of the PSTs when presented with a school trip in which the teacher takes responsibility for a student group and behaves equally towards them.

Cincera et al. (2021) found that supporting primary school teachers' collaboration competency in a residential outdoor environmental education program benefitted their teaching; when the teacher and student acted together, the collaboration was shown to support the students in developing their collaboration competency.

Strategic thinking was common in the PSTs' answers, most often appearing in responses related to global, regional and local problems. According to Bassachs et al. (2020), the development of strategic or action-oriented competency is possible via an interdisciplinary educational approach and multidisciplinary learning concepts, and this can enhance transformative pedagogy. Strategic thinking together with collaborative competency is important in SE (Bertschy et al., 2013), and the results of this study reveal the existence of these competencies among student teachers. This finding supports the belief that PSTs have at least the constitutive understanding necessary for teaching SD.

Integrated problem-solving competency was one of the three most commonly appearing competencies in the PSTs' answers concerning the school trip and designing an interdisciplinary study module. These problems to be solved were posed in connection to work-integrated learning and real-life experiences, and such issues have been shown to enhance students' understanding of sustainability (Alm et al., 2022). Furthermore, sustainability issues are often connected to uncertainty, and the integrated problem-solving competency has been associated with the ability to cope with various kinds of uncertainty issues (Li et al., 2011).

Normative and systems thinking were the least frequent in the PSTs' answers. Normative or values thinking competency appeared in the answers regarding local, regional and global problems and solving them. The learning of normative thinking can be supported by dialogue between teachers and students, as shown by Hercz et al. (2020), whose results prove that active and project-oriented learning can teach universal human values.

By contrast, despite the fact that Bertschy et al. (2013) present systems thinking as a fundamental competency for SE, its appearance in the PSTs' answers was rare. It appeared more often in the responses concerning an interdisciplinary study module in response to a school problem than in the responses to global, regional and local environmental problems or economic equality and continual economic growth. It seems that offering PSTs an opportunity to design a work-integrated study module might enhance systems thinking (cf. Alm et al., 2022). Clark et al. (2017) contend that technology-enhanced learning can help students learn and remember content and understand larger systems, supporting systems-thinking competency. This is essential to be able to teach transformative views to

students. Interdisciplinary approaches and seeing sustainability as a framework can foster systems-thinking competency both among educators and students (García-Fortes et al., 2024), but this competency appeared only in seven or less per cent of the answers of the PSTs.

Anticipatory or futures thinking competency also appeared seldom in the PSTs' responses. To support PSTs' anticipatory thinking skills, Aitken et al. (2019) suggest that a back casting method of looking from a past perspective to the present and generating a desirable future can confirm and extend students' understanding of how to build a sustainable future.

Especially in higher education, critical thinking has been seen as an important educational goal. Critical thinking competency appeared in the PSTs' responses connected to environmental problems and their solution to issues connected with economic equality and continual economic growth. Thaiposri and Wannapiroon's (2015) results show that critical thinking happens during the individual construction of knowledge, but it seems that this competency should still be enhanced beginning with teachers' initial training. In this regard, Wongkam et al. (2014) show that students' critical thinking abilities are significantly higher when these skills are better taught through inquiry-based learning and learning enhanced by information and communications technology, even in a social learning environment, than via traditional teaching methods (Meepian & Wannapiroon, 2013). For some authors, information-seeking behaviors can be helpful in cultivating the critical thinking of higher education students, which 'also involves a reflexive approach to the social-environmental problem and to the relations between the different acting agents' (Varela-Losada et al., 2016, p. 410).

CONCLUSION

Education is on the frontline in promoting the goals of SD in society (Solís-Espallargas et al., 2020), and teacher education can equip teachers with the skills/competencies (Frisk & Larson, 2011) for understanding that they require to integrate SD and SE into their classes. The results of this study support current recommendation of using competency approaches to support SE (UNESCO, 2019). Strategic thinking, collaboration and integrated problem-solving were common in the PSTs' responses to global, regional and local problems. This shows that teaching these skills is well considered in teaching and learning processes. However normative, systems, critical and anticipatory thinking were barely observed in the PSTs' responses. They should be emphasized more than previously, as they are decisive in understanding 'the big picture' of SD. However, Wiek et al. (2011) stress that the teaching of competencies in sustainability should consider the

students' resources, because high-quality learning of all the competencies in sustainability is not possible at one time.

It is essential that teacher education recognizes that teachers are transformation agents (Bürgener & Barth, 2018). Students' ability to understand the mutual connection and influence of several aspects should be promoted, and teacher education should equip student teachers with competence in sustainability, which supports the promotion of SD goals and enables activities aimed at SD from the local to the global level.

Finally, the results of the study suggest that SD competencies and useful teaching methods to teach these skills should be accurately described in the teacher education curricula of both countries. Thus, PSTs could take them into account when planning and implementing teaching situations to provide opportunities for students to practice the thinking skills that are essential for understanding SD.

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