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Research paper

Future physical education teachers' perceptions of sustainability

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ABSTRACT

The integration of the Sustainable Development Goals (SDGs) into the curriculum of prospective physical education (PE) teachers is limited. This research aims to analyze their knowledge and perceptions of the role of physical education in promoting the SDGs. The SDGs most related to physical education are health and well-being, quality education, gender equality and reducing inequalities. Participants felt that PE contributes to the development of values for sustainability and that the constraints to being future sustainable teachers were mainly educational. With this information, more reliable conclusions can be drawn on how to intervene in their training to promote relevant training.

1. Introduction

Humanity faces serious global issues such as poverty, hunger, climate change, environmental destruction, and inequality. These global challenges are the starting points of the 2030 Agenda, whose roadmap is based on a universal call to action grounded in global solidarity. The Agenda, approved in 2015 by the United Nations General Assembly and signed by 193 countries, is a global commitment to achieving a sustainable future. It is also defined as an action plan for people, the planet, and prosperity, intended to strengthen universal peace and access to justice (United Nations General Assembly, 2015). The Agenda has five fundamental principles (Shulla & Leal-Filho, 2023): universality (involving all countries); leaving no one behind (integrating all people); interconnection and indivisibility (the Sustainable Development Goals (SDGs) must be applied holistically); inclusion (engaging the whole society); and cooperation among stakeholders (partnerships for achieving the SDGs). The 2030 Agenda includes an ambitious framework for implementing 17 SDGs, 169 targets, and 244 indicators. However, although the SDGs are a proposal to be achieved in 15 years, some research has highlighted that the pace of achieving the SDGs is not as fast as expected (Baena-Morales & González-Víllora, 2022), as a balance between economic growth, respect for the environment, and social welfare has not yet been achieved.

In recent years, there has been an increase in the number of publications on sustainability; however, it remains an open concept with

innumerable interpretations, and the meaning and implications of the term need to be clarified (Purvis et al., 2019). What is certain is that sustainability is now understood to be dynamic in nature. It requires the interconnectedness of ecological, economic, and social systems (Linnér et al., 2020; Opstoel et al., 2020; Taylor et al., 2019; Thorpe et al., 2021), and includes the following key constructs: (1) long-term well-being maintenance: This involves taking measures to protect the environment in ways that are economically viable, beneficial for health and well-being, socially just, and long-term (United Nations, 2012); (2) local and global intervention of strategies: There is a need for local and global strategies to address the problems affecting people and the planet (Melo et al., 2021); (3) commitment and individual and social behavior change: It is important not to forget that sustainability is oriented towards individual change, but this also requires social change (Balsiger et al., 2017); and (4) it provides benefits to all individuals and society: They are of a global nature and universally applicable (Agbedahin, 2019). There is a strong synergy between the promotion of physical activity and the Sustainable Development Goals (SDGs) (Baena-Morales & Ferriz-Valero, 2023; Chen et al., 2019; Lindsey & Chapman, 2017; Lohmann et al., 2021; Salvo et al., 2021). Recent findings have revealed protective effects of physical activity on infectious diseases, including Covid-19 (Centers for Disease Control and Prevention, 2020; Chastin et al., 2021; Sallis et al., 2021). The significance of sports in social development has also been widely recognized by the United Nations (2017). This body maintains that sport is an enabler of sustainable

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development, recognizing its contribution to peace, tolerance, respect, women's empowerment, and social inclusion (Opstoel et al., 2020; UNESCO, 2015).

There is also emerging evidence supporting the use of large-scale physical activity strategies focusing on transport and mobility systems that prioritize walking and cycling, thereby promoting healthy cities (Corbett & Mellouli, 2017; Mercè et al., 2021; Salvo et al., 2021). This could positively influence the economy (Baena-Morales et al., 2021; Dudfield & Dingwall-Smith, 2015; Lynch, 2016; MINEPS VI, 2017) and people's well-being (SDG 3) due to increased physical activity and improved traffic. Similarly, the influence of sport on innovation/construction of new infrastructure (SDG 9), reduction of air pollution (SDG 11), equitable access to public transport and public open spaces (SDG 10 and SDG 11), and reduction of carbon emissions (SDG 13) has been shown. However, these synergies between physical activity and the SDGs have been underresearched by academia, leading to missed opportunities to improve the health and well-being of the world's population (Salvo et al., 2021).

Research related to university teachers' knowledge of the SDGs shows that a large proportion of them have not received training on this topic (Aleixo et al., 2018; Verhulst & Lambrechts, 2015). The situation is similar in the case of future teachers, who do not have sufficient knowledge or skills to conduct education for sustainable development (ESD) in the classroom (Albareda-Tiana et al., 2018; Ull, 2015; Vega-Marcote et al., 2015). Likewise, although a large majority understand the importance of education in this process, there is little personal commitment to getting involved in change because it requires sacrifices or inconveniences (Agirreazkuenaga, 2019). In a recent study, Baena-Morales et al. (2022) showed that PE teachers have little knowledge of the SDGs. In the same vein, Leal Filho et al. (2019), in research involving 167 university managers from 17 countries, concluded that the SDGs had a low level of implementation in teaching either as subject content in the curriculum or as part of assessment.

The gap in research about PE teachers' knowledge and their perceptions of the role of PE in the SDGs shows the need to investigate this

area. Therefore, starting to include the SDGs in PE teaching could contribute to achieving well-being (Frøberg & Lundvall, 2021), as PE promotes physical health and contributes to the development of social values, as well as to the protection of the environment (Nigg & Nigg, 2021; SDG Fund, 2018). Furthermore, it could be useful to question and change the traditional teaching-learning practices of PE for a holistic and pluralistic pedagogy that considers different perspectives and values, and encourages critical thinking (Baena-Morales et al. (2023); Sinakou et al., 2019; Waring & Herold, 2020) and the development of innovative classroom experiences (Ennis, 2015).

1.1. Theoretical framework

Unfortunately, to date, not many universities have strategically aligned their curricula with the SDGs, and this is due, among other factors, to little or no specific teacher training (Kopinina, 2018). Therefore, the integration of sustainability in education in general, and in PE in particular, requires changes in thinking and teaching practice (Iyer-Raniga & Myla-Andamon, 2016; Li et al., 2018). PE is a key subject for achieving the goals and objectives of the 2030 Agenda, because the strategies and methodologies used in the teaching of this subject, such as cooperative learning, and the personal and team responsibility model, may promote the development of sustainable behaviors and competencies in children and young people (García-Rico et al., 2021). However, not all SDGs can be integrated into this subject. Baena-Morales et al. (2021) conclude that of the 169 targets proposed by UNESCO, 24 can be developed in PE classes (Fig. 1). Despite this, few studies have evaluated the contribution of sport, PE, and physical activity to the SDGs, or educational policies that promote education for sustainable development (ESD) in future PE teachers.

The benefits of physical education (PE) encompass not only physical well-being and the acquisition of healthy habits but also cognitive, social, and affective domains (Frøberg & Lundvall, 2021; Opstoel et al., 2019). Therefore, given its enormous potential, integrating sustainability into PE can enhance the acquisition of attitudes, knowledge, and



Fig. 1. Suggested Specific SDG Goals Linked to physical education based on Baena-Morales et al. (2021).

behaviors related to the environmental, economic, and social dimensions of sustainable development (Baena-Morales & González-Víllora, 2022). From an environmental standpoint, PE promotes a sustainable lifestyle (Gard, 2021; Thorpe et al., 2021), for example, by encouraging sustainable consumption and environmental care through learning in natural settings; from an economic perspective, it increases employability and productivity, promoting teamwork, creativity, innovation, a positive work ethic, and high-level performance (Bassachs et al., 2020; Opstoel et al., 2020), and, from a social viewpoint, fosters a culture of peace, improves inclusion, enhances coeducation, and promotes gender equality (Davis, 2016; Guthold et al., 2020; Sánchez-Hernández et al., 2018). Therefore, effective incorporation of the SDGs in preservice teacher education is crucial (UNESCO, 2017).

Previous literature on PE teacher training shows that little attention has been paid to the inclusion of sustainability in curricula and, specifically, to the development of competencies for ESD (Fröberg & Lundvall, 2021). In fact, to date, their education has focused on activities oriented towards the knowledge and use of sports techniques, tactics, and rules, as well as the design and selection of appropriate tasks for teaching PE (Backman & Barker, 2020). Thus, mechanistic viewpoints continue to prevail in initial teacher training, and the potential of PE to develop some of the objectives and goals of the 2030 Agenda is not being utilized. Therefore, it is urgent to use alternative perspectives in PE teacher training, which include an integrative approach to movement culture and issues related to inclusion, social justice, and gender equality (Barber, 2018; Walton-Fisette & Sutherland, 2018). This perspective must empower future PE teachers to: (1) be aware of the importance of education for achieving sustainability (Cicmil et al., 2017); (2) develop key competencies that are relevant to addressing the SDGs (UNESCO, 2017); (3) acquire basic subject knowledge concerning the SDGs; and (4) know and understand the SDGs, their purposes, and their implications (SDSN Australia Pacific, 2017). Taking these elements into account, it is necessary to choose the most appropriate strategies for integrating the SDGs into university teaching—e.g., by integrating the SDGs into all undergraduate and postgraduate courses in a cross-cutting manner (UNESCO, 2017), in collaborative projects with practical applications, as a specific and ad hoc integration into subjects, or through specialized sustainability subjects. In any case, whatever strategy is used to integrate the SDGs into the initial training of future PE teachers, its development must go through the following stages (Baena-Morales & González-Víllora, 2022; Yuan et al., 2020): (1) fostering student awareness of, and sensitivity to, the importance of PE for sustainability by promoting healthy and responsible consumption habits (for example, reduce, reuse, recycle); (2) promoting a deep understanding of sustainability, for example, integrating specific competencies of SDG 5 into the PE curriculum, such as achieving gender equality, empowering all women and girls, and ending all forms of discrimination against them; and (3) designing actions that combine PE with sustainability, e.g., physical activities in natural settings, seeking to be in tune with the environment (Olive & Enright, 2021), and fostering a respectful and critical relationship with the environment. Into these three stages, the five main elements of the learning process (awareness, knowledge, attitude, skills, and participation) have to be integrated. This teaching-learning approach has to be contextualized (Lynch, 2019) in such a way that sport and physical activities are useful for mitigating and/or solving problems that affect sustainable development. In sum, for training the sustainable PE teacher, a new holistic, systemic, and participatory formative pedagogical model is required (Baena-Morales & González-Víllora, 2022; Iyer-Raniga & Myla-Andamon, 2016; Poza-Vilches et al., 2019; Sterling, 2011) that, beyond focusing on theoretical knowledge of the principles of sustainability, contributes to social transformation and opens paths towards more sustainable local and global societies (Li et al., 2018; UNESCO, 2017).

The difficulties often faced by faculty in integrating the SDGs into their teaching are particularly related to university policies and curricula (Kopnina, 2018; Pellín et al., 2021), whether or not SDGs are

mandatory in initial education, the overload of cross-cutting issues, limited time for training, and overspecialization of degrees. Within the normative framework of national education policies, universities are often autonomous in what they teach, but this training is unequal and variable in different contexts and countries. For example, in Scotland, there are guidelines requiring lecturers to be knowledgeable about sustainable development and competent to contribute to ESD (Gough, 2016); however, in Spain, there are no clear regulations regarding the compulsory nature of this type of training. Therefore, its integration into university education is conditioned by the commitment of authorities and faculty (Geli et al., 2019). Stronger policies and guidance are needed to ensure that teachers and, ultimately, children and young people understand the importance of their role in sustainable development to ensure that the SDGs are included in university curricula (Mazon et al., 2020).

In addition, there are other difficulties such as the pressure of an overloaded curriculum (Poza-Vilches et al., 2019; Verhulst & Lambrechts, 2015) and the variability of the time for initial training. Gough (2016) states that this can range from one year of training after receiving a secondary education certificate to become a teacher in Bangladesh to a two-year Master of Education program for secondary school teachers in Finland and Australia. There are also differences in the training of primary and secondary teachers in terms of the content and focus of the programs. Secondary teachers are trained to teach specialized subjects, and the preferences and pressures of their specializations could be an impediment to integrating the SDGs into their teaching. These barriers are compounded by other impediments, such as: (1) a lack of ESD-savvy or a lack of adequately trained specialists (Larrán et al., 2015); (2) insufficient funding and scarce material resources (Aleixo et al., 2018); (3) a lack of an institutional climate that supports creativity, innovation, and risk-taking to transform traditional education into ESD; (4) a lack of rewards and/or recognition for institutions and faculty that undertake ESD programs; and (5) a prevalence of traditional disciplinary curriculum frameworks that make embedding sustainability (Albareda-Tiana et al., 2018; Evans et al., 2017), which is transdisciplinary, complex.

Based on this framework and having identified the gaps in the scientific literature on the topic, the objectives of this study were: (1) to analyze the perceptions of sustainability of future PE teachers; (2) to know their perceptions of the role of PE in promoting the SDGs; and (3) to identify, according to students' opinions, the obstacles that prevent them from being future teacher promoters of sustainability.

2. Method

The study used a qualitative approach as the aim was to capture and analyze in depth the perceptions of sustainability of preservice teachers (Creswell, 2013). A content analysis technique was used to classify the information into units of meaning (Kyngäs, 2020). Within the qualitative paradigm, this strategy makes it possible to identify the presence of specific concepts, themes, and patterns to interpret and describe specific phenomena (Bengtsson, 2016). Krippendorff (2018) defines it as a “research technique aimed at formulating valid and replicable inferences from texts or other meaningful data sources to their context of use” (p. 24). Specifically, a summative and conventional content analysis was used (Hsieh & Shannon, 2005). This enabled the interpretation of the latent and manifest meaning of the information in its context, as well as the recognition of the issues most emphasized by the participants, through counting the frequency of occurrence of each of the emerging semantic units (Stemler, 2001).

2.1. Setting, participants, and ethics

The study involved 341 preservice teachers of physical activity and sport sciences (33% women) from three universities in Spain. The mean age of the interviewees was 20.2 ± 3.4 years. Approximately half of the sample were students from Institution 1 (53.67%); the rest belonged to

Institution 2 (26.39%) and to Institution 3 (19.94). First-year students accounted for 32.3%, second-year students for 46.4%, third-year students for 11.5%, and fourth-year students for 9.8%. All participants consented to the release of the data obtained for scientific use. The information collected was treated confidentially in accordance with Spain's Organic Law on Personal Data Protection and Guarantee of Digital Rights March 2018 of 5 December. The research was approved by the ethics committee of the University of Alicante with code UA-2022-03-17. .

2.2. Procedure and data collection

The convenience sampling method was employed for selecting the study sample (Patton, 2015). The questionnaire was sent to a total of 350 students (with a response rate of 97.42%). The questions asked in the questionnaire are presented in Table 1. The instrument used for data collection consisted of six questions, five of which were open-ended and one closed-ended. In line with the objectives of the study, these related to the preservice teachers' perceptions of the concept of sustainability (1 and 2); the relationship between the SDGs and PE (3); the contribution of PE to the SDGs (4 and 5); and (6) their limitations to incorporate the SDGs in their future professional performance. In addition, preliminary questions were asked to obtain sociodemographic information (gender, age, and academic year).

The instrument was validated by three PhD experts with more than ten years of experience in sustainability and educational research at university level. They were external to the research project. The selection of experts was based on the following characteristics: 1) knowledge of integrating sustainable development into PE; 2) experience in teaching PE; and 3) knowledge of the research methodology. The instrument was validated by a team of judges, consisting of three expert teachers and researchers in educational research. They were invited to review the questionnaire due to (1) their extensive experience and recognition in the field of qualitative analysis and teacher training, and (2) ease of access. To validate the instrument, the experts followed a structured process that included the following steps:

Content review: Each expert independently evaluated the instrument in terms of clarity, relevance, and comprehensiveness. They provided specific comments and suggestions to improve the instrument and ensure that it adequately addressed the constructs and objectives of the research.

Instrument structure review: The experts also evaluated the structure and format of the instrument, including the order and grouping of questions, its relevance to the study objectives, and participant instructions. Areas for improvement were identified and adjustments were made based on expert recommendations.

Consensus and final refinement: After receiving feedback from all the experts, a virtual meeting was held to discuss suggestions and reach a consensus on necessary modifications. The instrument was refined based on this consensus, and a final review was conducted by the experts to ensure its validity and quality. Finally, an evaluation process was conducted to verify the correct design of the instrument. Two types of

evaluations were used: The first aimed to evaluate the clarity of the phrases (content) and the second the effectiveness of the data (content efficacy).

Data collection was carried out through a form created in Google Forms. The preservice teachers completed the questionnaire during school hours. Ethical aspects were respected, taking into account the ethical principles of the Declaration of Helsinki. All participants were informed of the purpose of the research, their voluntary participation, their anonymity, and the confidentiality of the information provided. The preservice teachers gave their informed consent, in writing, for the scientific dissemination of the results. Data collection took place during the month of September 2022.

2.3. Data analysis procedure

An interpretative analysis of the data was conducted with the help of AQUAD 7 software (Huber & Gürtler, 2013). This tool was selected for its ability to categorize and organize the information into units of meaning. The content analysis followed the phases proposed by Bardin (2002) of pre-analysis, exposition of the material, and processing and interpretation of the results. After an iterative and exhaustive reading of all the information, the codes and subcodes used in the analysis emerged inductively. These were grouped into two categories capable of encompassing and defining their meaning. The categories were chosen on the basis of their clarity, usefulness, and natural exclusion. In this process it was necessary to eliminate some identical and recurrent terms. During this stage, the principles of completeness, representativeness, homogeneity, and relevance were followed, which facilitated the development of indexes and indicators for coding. Once the analysis instrument had been defined, it was verified that all the units of meaning were located in some of the emerging categories, codes, and subcodes. Its validity was also corroborated by the same experts who had previously validated the data collection instrument. The system of categories, codes, and subcodes used is shown in Appendix I.

For the exploitation of the material, the same code was applied to similar units of meaning. Conversely, this changed when dealing with different semantic units. Finally, conclusions were drawn and verified, using the interpretation, concurrence, and recounting of each of the codes and subcodes used.

This study meets the reliability criteria established by Lincoln and Guba (1985) for qualitative research. In terms of the study's credibility, this was achieved through various actions. First, it should be noted that the framework of emerging categories and codes was reviewed and validated by the same experts who validated the instrument. Additionally, the three researchers conducted two rounds of independent coding to verify its validity. In the first round, an agreement rate of 83% was achieved, while in the second round, it reached 93%. On the other hand, and following Shenton (2004), all steps followed during the coding process were discussed and agreed upon by all members of the research team in weekly meetings. These sessions were used to verify and discuss any modifications made to the framework of categories and codes. In this way, a consistent and systematic interpretation was carried out throughout the entire analysis process. The research team's experience in this area of knowledge should also be taken into account (Shenton, 2004). They all have extensive experience in the study of EDS, PE, and qualitative research, exceeding seven years in some cases. In addition, the research team discussed their interpretations with three other colleagues from their department who have experience in this area of knowledge. To strengthen credibility, and following the guidelines of Elo et al. (2014) and Shenton (2004), participants were involved in verifying the data analysis process. To do this, a written copy of the results was provided to 23 of the study participants. Specifically, they were asked to confirm the accuracy of the interpretations made. Transferability was achieved through a detailed description of the methodology followed and the achievement of theoretical saturation (Sandelowski, 2008), as sufficient data were collected to validate the

Table 1
Questions asked of survey respondents.

Questions
1. What do you understand by sustainability?
2. What words would you relate sustainability to?
3. Which of the 17 Sustainable Development Goals do you think are most relevant to Physical Education?
4. How can Physical Education contribute to the achievement of the Sustainable Development Goals?
5. Do you think it is possible to include the Sustainable Development Goals in Physical Education programmes? Please briefly explain your arguments.
6. What limitations do you have to promote sustainable development in Physical Education teaching?

patterns and emerging categories.

Analysis of the participants' discourses allowed us to organize their voices into two categories: (1) perception of sustainability, and (2) SDGs and PE. The results are presented in figures and tables. These are used to capture the results of the calculations made during the analysis process. Specifically, they include.

- The absolute frequency (AF), which corresponds to the number of times participants mention a unit of meaning.
- The absolute frequency percentage (AF %), calculated as $AF \times 100 / \text{total AF}$.

In addition, the results are presented with a set of narratives that serve to illustrate the meaning attributed to each of the codes and subcodes used in the analysis process. The text segments are identified with an alphanumeric code to ensure anonymity.

3. Results

For a better presentation of the findings, the following two emerging categories are presented, from which the voices of the participants were reorganized.

3.1. Category 1: perception of sustainability

The first category is structured into three codes alluding to the prospective PE teachers' degree of understanding of sustainability (Table 2).

With regard to the first of these codes, the participants repeatedly point out that sustainability refers above all to the management of resources based on criteria of effectiveness and efficiency and linked to values of justice and equity. An example of this is the following statement: "Sustainability is the action plan to be implemented to ensure the availability of resources and their fair and equitable use" (Est_002). Hence, establishing a close link between sustainability and environmental care, they insist on the idea that sustainability is based on the reduction of overexploitation of natural resources and on balanced and responsible consumption. These perceptions show that some participants understand the meaning and value of sustainable development only in relation to the environmental dimension of sustainability. In addition, the participants link this construct with the need to guarantee more respectful production and consumption models for the environment. In this regard, one participant stated: "The concept of sustainability is related to consumption and sustainable consumption is one in which we use only the necessary resources, without overusing or compromising their production" (Est_006). From this stance, it can be inferred that future teachers are aware of the responsibility that the concept entails and that, in practice, it translates into the adoption of behaviors and habits more committed to the balance of the planet. In contrast to this position, some voices, albeit less frequently, express the

belief that sustainability refers to the maintenance of a system over time. They consider that human action has repercussions for the living conditions of future generations, and therefore identify sustainability with acting with tomorrow in mind. In fact, those who adopt this position refer to sustainability as "the actions that are taken to improve the present without worsening the future, either socially, environmentally, or economically" (Est_033). Sustainability thus becomes the most effective instrument for bequeathing a legacy of solidarity to future society, as one of the preservice teachers states: "Meeting our own needs, but with the aim of not leaving future generations without being able to meet theirs, ensuring a balance" (Est_066).

Analysis of the participants' discourses also shows that their perception of sustainability is vague and general, since when relating this concept to other terms, they repeatedly use a set of generic expressions that are also applicable to other areas. This is epitomized by the following text segments: "Life, power, create, maintain, empower" (Est_041) and "Generations and good condition" (Est_053). Within this trend, narratives that emphasize terms linked to the idea of time especially stand out, such as: "Stability, durability, longevity" (Est_087). They also use expressions related to the attitudinal component and, less frequently, to the axiological level: "Good, ethical, common sense" (Est_033). In summary, and despite the fact that they associate sustainability with terms that in some cases imply action, continuity, or moral behaviors, it is not possible to appreciate a deep understanding of the concept. This majority trend undoubtedly demonstrates a limited internalization of the meaning and relevance of sustainability in ensuring the well-being of people and the planet.

In contrast to this general and recurrent trend, it is possible to note the use of other terms more closely related to sustainability—specifically, to the three dimensions that make it up. In this case, expressions associated with the environment and care for the planet stand out: "Nature, pollution, recycling, climate change" (Est_043). In the last instance, and with a scarce presence, they use terms related to social and economic sustainability. For example, one of the participants links sustainability to the idea of "Equality, civic-mindedness, empathy, society, and development" (Est_021). In general, the narratives of these participants reveal a higher degree of understanding of the concept. However, it must be borne in mind that focusing mainly on the environmental dimension carries the risk of ignoring the social and economic components of sustainability. In this sense, it is important to keep in mind that the promotion of sustainable development cannot be centered only on an isolated component but requires a holistic and interrelated understanding and action among its three dimensions. Therefore, it can be seen that the participants' perception of sustainability presents a certain degree of inaccuracy and vagueness. Evidence of this is that when they relate sustainable development to other related terms, they mainly emphasize the environmental aspect and overlook the social and economic dimensions of the construct.

3.2. Category 2: SDGs and PE

When analyzing the links between the SDGs and PE, participants believe that the goals most closely related to PE are SDG 3 (Health and well-being), SDG 4 (Quality education), SDG 5 (Gender equality), and SDG 10 (Reducing inequalities) (Fig. 2).

On the other hand, participants believe that the SDGs least connected to the area of PE are SDG 6 (Clean water and sanitation), SDG 7 (Affordable and clean energy), SDG 9 (Industry, innovation, and infrastructure), SDG 1 (End poverty), and especially SDG 2 (Zero hunger). Thus, SDGs related to the social dimension stand out, with less prominence given to SDGs focused on environmental and economic development.

With regard to the role of PE in achieving the SDGs, the participants emphasize above all the opportunities that this subject offers to raise awareness of the importance of sustainability, but they do not indicate how this task could be carried out (Table 3).

Table 2
Perceptions of sustainability.

Category	Codes and subcodes	AF	AF (%)
1. Knowledge about sustainability	1.1. Notion of sustainability	72	12.50
	2.		
	1.1.1. Present-future balance	94	16.32
	3.		
	1.1.2. Effective resource management	124	21.53
	1.2. Specific related terms		
	1.2.1. Environmental dimension		
	1.2.2. Social dimension		
	1.2.3. Economic dimension	12	2.08
	1.3. General related terms	225	39.06
Total		576	100

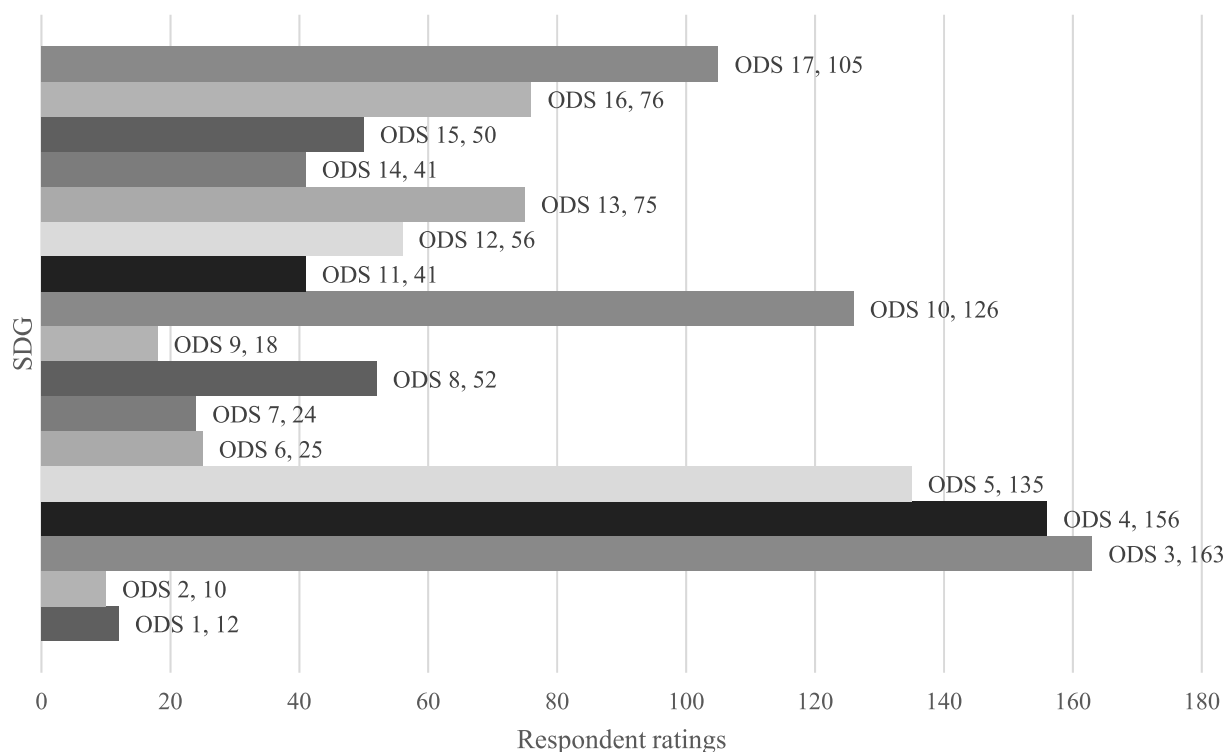


Fig. 2. Relationship between SDGs and PE.

Table 3

The Sustainable Development Goals and physical education.

Category	Codes and subcodes	AF	AF (%)
1. SDGs and PE	2.1. Role of PE in achieving SDGs		
	2.1.1. Raising awareness of values	136	21.83
	2.1.2. Improving education	37	5.94
	2.1.3. Promoting healthy habits	36	5.78
	2.2. Integration of SDGs in PE curriculum		
	2.2.1. Yes, in a specific way	139	22.31
	2.2.2. Yes, as in all other subjects	18	2.89
	2.2.3. Yes, but only some of the SDGs	22	3.53
	2.3. Barriers to being a sustainable teacher		
	2.3.1. Educational barriers	152	24.40
	2.3.2. Socio-economic barriers	47	7.54
	2.3.3. No barriers	31	4.98
	2.3.4. I don't know	5	0.80
Total		623	100

According to preservice teachers' discourses, schools have a responsibility to promote the attitudes and values needed to facilitate sustainable and inclusive growth. Based on this premise, the participants understand that PE is the most appropriate framework for raising students' awareness of, and commitment to, the principles of sustainability. The following text segments are examples of this: "Raising people's awareness to contribute to the SDG goals through the disciplinary skills that PE brings to individuals" (Est_033) and "Creating values in pupils that make them see things differently" (Est_058). Undoubtedly, the responsible and collective action in terms of sustainability necessarily requires prior awareness. Given this need, education becomes one of the most strategic instruments to increase awareness. In this regard, according to the participants of our study, PE and teachers in this curricular area can significantly contribute to this awareness raising.

In fact, they believe that the very nature of the discipline and the content it addresses give it a privileged role in the achievement of the SDGs, and that it can even be worked on specifically in class: "It is in this subject that we begin to know ourselves as people, value others as equals, and when we can begin to introduce environmental measures,

because as humans we become aware of another issue when we are aware of ourselves" (Est_021). Indeed, PE facilitates the discovery of oneself and others, an essential requirement for achieving sustainable development. The first stage towards sustainability involves the person knowing themselves, being aware of their capabilities, and committing to change, but they must also feel part of a community and believe that their actions have an impact on their well-being and that of others. This potential of PE for learning about the SDGs is also reinforced by the suitability of some of the teaching methodologies that are commonly used in this curricular area, such as games and dramatization. The participants also emphasize the importance of conducting collaborative and playful activities, since they influence and stimulate the acquisition of prosocial skills, which are essential for sustainable development. The following narrative is a clear example of this idea: "In it we find ideal characteristics to be able to contribute to the SDGs such as teamwork, the distribution of roles, and without forgetting that everything is done in a playful and social environment, improving and enhancing our contribution, as long as it is well planned" (Est_118). Therefore, it is necessary to intensify the presence of this type of learning situation in the PE curricular proposals.

PE preservice teachers also insist that many of the values promoted by sport are aligned with the inspiring principles of sustainability. They point out the potential of this subject to develop both social values, such as cooperation, and individual skills, such as responsibility to promote change: "PE covers many areas and inculcates many values which, in my opinion, can be a positive contribution to the SDGs, such as cooperation, awareness of change, or others" (Est_002). Moreover, the fact that some sports are practiced in the natural environment helps society to become aware of the importance of caring for and respecting the environment. In particular, they highlight the opportunities provided by PE for students to value their natural environment in a rational way. According to their opinion, as shown in the following narrative, sports practice in contact with nature can become a powerful loudspeaker in spreading the message of sustainability: "Promoting environmental awareness and education, in which physical activities in the natural environment play an essential role" (Est_149).

With a similar presence in their accounts, the participants also highlight the role of PE in improving educational practices and promoting healthy habits. They understand that this curricular area is of great importance for educational change as it not only affects students' motor skills, but also helps them to understand and critically analyze the world around them, which is essential for achieving the SDGs. In particular, they refer to the potential of PE to promote problem-solving skills, which is a key competence of ESD. In fact, one of the participants indicates that PE is capable of "[e]ducating students, providing and offering information and guiding the correct use of it, as well as personal development of the students, not only by learning content, but also by being able to relate it to real problems and learning how to solve them" (Est_020). This involves developing other skills such as critical thinking and decision-making abilities, preliminary steps for solving the complex problems currently affecting humanity, such as poverty, hunger, and inequalities. To this must be added the experiential nature of this subject, which contributes, in a decisive way, to the greater involvement of students in the teaching-learning process and, consequently, to improvement in the quality of education: "PE has a lot to teach, being one of the most practical subjects in the curriculum" (Est_024). This applicative nature of PE allows students to apply the knowledge and skills acquired in class. This is especially favorable for promoting a more realistic and contextualized curriculum, as well as achieving a more inclusive, equitable education that promotes lifelong learning opportunities. On the other hand, as mentioned above, some argue that the strength of PE for achieving the SDGs lies mainly in its ability to promote the acquisition of a healthy lifestyle. In fact, those who take this position argue that the adoption of more sustainable habits allows a more efficient use of economic resources, especially in the healthcare field: "Healthy lifestyles can be created, which in the long term is economical for countries because less is spent on healing the population. This would improve growth of other areas such as education" (Est_183). However, despite the close relationship that has traditionally been established between PE and health, it is striking that there is little mention in their discourses of the potential of this curricular area to promote healthy lifestyle habits. In contrast to this trend, participants repeatedly emphasized the role of PE in raising awareness and promoting values and attitudes aligned with sustainability. Based on this, the participants were particularly insistent on the need to integrate the SDGs into the curricular proposals for PE. Most of the voices argue that it is in this specific area that this type of content needs to be worked on. A clear example of this is the following statement: "Yes, I think it is the right subject to include them" (Est_047).

The reasons for this are many and varied, the close relationship between PE and sustainability and its potential to address such issues in the classroom being the most important. As one preservice teacher emphasizes, "[the aim of teaching is to educate people in all areas, and PE is a good way to value sustainability in students and thus encourage them to be responsible]" (Est_062). In addition, they point out that integrating the SDGs into this curriculum area would be a significant boost to the subject and recognition of its value. This idea acknowledges the reciprocal benefit between PE and the SDGs, since this discipline could benefit from such integration: "Yes, because it would help to make PE not only about exercise or sport, but to extend it to the civic, social, environmental, and nutritional concept, thus giving a more accurate concept of what I consider to be true PE" (Est_037). From this perspective, incorporating sustainability into the curriculum of this subject would mean a true transformation of its meaning and disciplinary usefulness. That is, the integration of the SDGs could contribute to the reinvention of the discipline, which would transcend the boundaries of mere sports and become a tool for promoting the well-being of people and society.

However, in contrast to this majority discourse, some narratives reflected a certain reticence when it comes to addressing sustainability in PE classes. From their perspective, only those SDGs that are most closely related to the content of the subject should be addressed, as otherwise they believe that the subject would be distorted. This is highlighted by

the following: "It depends on the SDGs, as it is true that some of them are closely linked to PE, but I think that in the case of others it would be more advisable to deal with them in other subjects that are closer to them" (Est_055). In particular, they are in favor of integrating only those SDGs related to health or environmental care, given the close relationship that has usually been established between these issues and PE. In fact, the superficial and limited conception of this curricular area causes some participants to only be able to establish links with SDG 3. An example of this is the following narrative:

It is always good and necessary for the majority of people to be aware of these SDGs. Therefore, I think it is a good thing that they are included in school curricula. However, I think that PE curricula should cover the goals that are more related to health and well-being, instead of talking about each and every one of these goals. (Est_095)

Finally, there are some voices that believe that the educational treatment of the SDGs should not only take place in this subject, but also in the other areas that make up the school curriculum. The reason they argue for this lies, above all, in the need to mainstream this type of content in order to guarantee its adequate acquisition: "I believe that it should not only be in the PE curriculum and that it should be an objective of all subjects, and that they should work cooperatively to achieve it. Just including it in the PE curriculum will not be very efficient" (Est_146). Indeed, interdisciplinarity constitutes one of the basic principles of ESD and a *sine qua non* condition for promoting sustainability in classrooms. If interdisciplinary work is not carried out, it will not be possible to address sustainability in a holistic way, and therefore the effectiveness of any action will be compromised. Hence the need for interdisciplinary and global approaches and methodologies that put an end to the common practice of compartmentalizing study plans. However, it must be emphasized that the presence of this type of narrative was rather rare and occasional.

With regard to the constraints to being future teacher promoters of sustainability, the last of the codes to emerge, the participants refer mainly to educational obstacles. Among others, they particularly emphasize the lack of training and experience in dealing with such issues in the classroom. In fact, one of the preservice teachers openly doubts their knowledge and skills in this area: "I may not have enough information on how to motivate students to engage in SDG-related activities" (Est_006). In the same way, they also refer to the scarcity of resources and the existence of a curriculum characterized by rigidity and content overload: "... broad curriculum of predetermined content and objectives, obligatory content and objectives established by the government" (Est_118). The pressure exerted by encyclopedic curricula on schools and teachers causes, in their opinion, the curriculum framework to become one of the main obstacles for ESD. Closely related to this, there are some voices that highlight the absence of a quality education policy for this curricular area, the most immediate reflection of which is the reduced number of teaching hours allocated to it. The following narratives exemplify this position:

The main constraint is the shortage of hours for PE. (Est_067)

... the little importance that the State gives to PE, there is no real policy towards this area in the Ministry of Education. Sadly, for many civil servants and even teachers, PE serves as a filler. (Est_183)

Indeed, PE is seen at a social level as a complementary and accessory curricular area, which will not be useful or decisive for the individual's personal and professional future. This biased conception ends up permeating among the members of the educational community themselves, who, far from considering it as a basic and essential subject, classify it as a second-category curricular area. Even the students themselves abandon sports practice as they progress towards higher education stages. In fact, a lack of pupil interest and insufficient support from the management team, families, and other members of the teaching staff are other limitations mentioned by the participants: "Finally, I believe that the fact that pupils, parents, and other teachers do not give

the subject of PE the importance it deserves is a serious problem" (Est.067) or "In many cases, teachers are often constrained by people in higher positions who do not let them act" (Est.093). However, the presence of such barriers in their discourse is limited. On other occasions, participants even mention obstacles related to the current socio-economic model, and especially to the lack of social awareness of sustainability. As one of the participants indicates, "the ignorance of a large part of society in preserving the planet and the lack of interest that exists" (Est.147) influence the educational treatment of sustainability in the classroom. This may lead to the belief that achieving the 2030 Agenda also requires the involvement of other agents and groups outside the school, such as the media or the business sector.

On the other hand, there are several narratives, albeit less frequent, that reject the existence of potential barriers: "None, because all current problems are reversible with time, effort, and unity" (Est.15). From these participants' perspective, professional commitment, teaching creativity, and teamwork are key to overcoming any kind of barrier to sustainability. In conclusion, it is important to underline that, while there were participants with a more confident and optimistic attitude, there were also some voices that were not able to identify possible limitations. Although the presence of these narratives was rather anecdotal, they are paradigmatic examples of the participants' difficulties in projecting themselves as future teacher promoters of sustainability. An illustrative proof of this trend is the following text segment: "As I am not yet a teacher, I can't imagine what my limitations will be" (Est.082). These types of perceptions demonstrate the need for initial training based on a realistic educational model that encourages reflection and brings future PE teachers closer to the reality of the classroom.

In general, the participants emphasize the relevance of PE for promoting sustainability in school spaces. In fact, they are strongly in favor of its integration into the contents of this curricular area. However, despite the existence of this favorable position, they are also aware of the difficulties, especially educational, they will have to deal with to become truly sustainable teachers.

4. Discussion

This study aimed to analyze PE preservice teachers' perceptions of sustainability. Specifically, their view on this construct was analyzed, their opinion on how PE can contribute to the achievement of the SDGs, and the barriers that, in their view, prevent them from being future teacher promoters of sustainability. While there is a strong relationship between PE and the SDGs (Salvo et al., 2021), the results showed that participants had a vague perception of sustainability, relating it to generic terms. In their narratives, they also highlighted the importance of fostering attitudes and values necessary for sustainable development in schools and especially in PE, since, for them, it is a specific and suitable subject for promoting sustainability.

4.1. Preservice teachers' perception of sustainability

Although the preservice teachers prefer to associate sustainability with imprecise terms, which is indicative of their lack of education, their narratives also reflect other more specific definitions, as well as conceptualizations in terms of effectiveness and efficiency. Previous literature in the sustainability framework has pointed out the gaps in ESD knowledge among university students (Albareda-Tiana et al., 2018; Sinakou et al., 2019; Vega-Marcote et al., 2015). With regard to the most prevalent definitions, those linking sustainability to the environmental dimension stand out, followed by the social dimension. These dimensions have been highlighted by authors such as Linnér et al. (2020), Opstoel et al. (2020), Taylor et al. (2019), Thorpe et al. (2021), and Welch et al. (2021). For these reasons, all areas, including PE, should integrate the SDGs into their teaching (Fröberg & Lundvall, 2021). This could be due, above all, to the fact that the Spanish PE curriculum has a high percentage of socio affective content (Otero-Saborido et al., 2020)

and includes physical activities that preferably take place in natural environments (Baena-Extremera et al., 2015; OECD, 2019). However, the development of the economic dimension through PE should not be ruled out, since the skills promoted by this subject, such as teamwork, cooperation, and respect for others, could favor the development of skills related to students' future professional performance (Baena-Morales et al., 2022; Fleming & Ferkins, 2006; Jaitman & Scartascini, 2017). Given this shortcoming, it would be interesting to promote the development of employability skills in PE undergraduates. This could perhaps increase preservice teachers' positive perceptions of their initial training and their profession. The findings for preservice teachers' perception of sustainability are consistent with those of the exploratory qualitative study conducted by Baena-Morales et al. (2023) with in-service PE teachers. In this research, it was found that PE teachers exclusively conceive sustainability as an essentially environmental requirement. Although this does not use exactly the same study population as the present research, it serves as an example to show how sustainability and sustainable development are not really integrated in the field of PE. Therefore, it could be of interest to implement the idea that Leal Filho et al. (2019) propose, as the level of implementation of the SDGs in curricula should be increased.

4.2. Perceptions of preservice teachers about SDGs and physical education

One of the objectives of this study was to understand preservice teachers' perceptions of the role of PE in promoting the SDGs. In this regard, they highlighted the value of PE for social development and, to a lesser extent, for environmental and economic development. Participants in the study related PE mainly to SDG 3 (Health and well-being), SDG 4 (Quality education), SDG 5 (Gender equality), and SDG 10 (Reducing inequalities). This selection largely coincides with a preliminary study conducted by the Official College of PE Graduates of Spain, where in-service teachers highlighted SDG 3 and SDG 4 as those most related to PE (COLEF, 2021). Baena-Morales et al. (2021) also highlighted this link, although, in addition, in this study, the participating teachers highlighted SDG 16 (Peace and social justice) among those most closely linked to PE. In this same study, teachers' knowledge of the relationship between the SDGs and PE was poor, since, although it has been repeatedly highlighted that PE promotes economic development (Baena-Morales & González-Villora, 2022; Dudfield & Dingwall-Smith, 2015; Lynch, 2016; MINEPS VI, 2017), teachers minimally related this subject to other SDGs such as SDG 2 (Zero hunger) and SDG 1 (End poverty). These findings, taken together, demonstrate the need for sustainability training not only for preservice teachers, but also for university teachers (Spanish Network for Sustainable Development, 2020; UNESCO, 2017). In sum, although there is sufficient evidence showing that PE contributes not only to the social and environmental dimension, but also to the economic dimension (Baena-Morales & Ferriz-Valero, 2023; Consejo Iberoamericano del Iberoamericano del Deporte, 2019; Dudfield & Dingwall-Smith, 2015; MINEPS VI, 2017), the findings of our study allow us to conclude that the university training received is marked by an incomplete vision of the scope of PE.

On the other hand, it is incongruous that PE preservice teachers have highlighted environmental issues and, at the same time, environmental protection has been selected by few participants among those potentially addressed by PE—SDG 6 (Clean water and sanitation), SDG 7 (Affordable and clean energy), SDG 11 (Sustainable cities and communities), and SDG 12 (Sustainable consumption and development). In this regard, Istrate (2020) suggests that the PE can work on specific strategies to improve water quality, reduce polluting discharges, and increase the efficiency of water use in sports facilities. Likewise, campaigns can be carried out to support free access for all people to the use of renewable energies by increasing energy efficiency, as well as guaranteeing access to public services for all people in vulnerable situations. In addition, it is possible to promote the construction of specific public

spaces for sports practice such as gyms and stadiums (Fröberg & Lundvall, 2021); and, in large cities, PE can improve transport and mobility systems by promoting healthy cities (Corbett & Mellouli, 2017; Mercé et al., 2021; Salvo et al., 2021) and sustainable consumption and production (Baena-Morales & Ferriz-Valero, 2023). In relation to these ideas, the narratives of the preservice teachers who participated in the study showed that the main contribution of PE to the SDGs is an awareness of the values needed to facilitate sustainable development, the promotion of healthy habits being mentioned to a lesser extent. While it is essential that education fosters the formation of positive values and attitudes towards sustainability (United Nations General Assembly, 2015), it is also essential that it promotes well-being, health, and the acquisition of healthy habits (Ding et al., 2016; Sallis et al., 2016). More specifically in the subject of PE, in previous work, several indications have been established that allow for a direct link between the intervention of PE teachers and strategies that could contribute to sustainable development (Baena-Morales & González-Víllora, 2022). In this research, it is suggested that all three dimensions of sustainable development can be addressed through PE—for example, through contents such as plogging or self-construction of materials for the environmental dimension; the social dimension through methodologies such as the model of personal and social responsibility or service learning; and finally, the economic dimension by developing employability-related competences in students such as cooperation, teamwork, and critical thinking.

4.3. Integrating the SDGs into the physical education curriculum: opportunities and barriers

It seems sensible to consider the difficulty of integrating ESD into the current education system, as it requires a shift in thinking on the part of both teachers and university students (Iyer-Raniga & Myla-Andamon, 2016; Li et al., 2018). Consequently, the preservice teachers emphasized the idea that PE is a useful tool for achieving the SDGs as it allows the content to be worked on in a specific way. This is reinforced by the use of active didactic methodologies in the teaching of the subject, by the values involved in the practice of sport, and by the opportunity that PE offers to understand and solve real problems. However, some participants were in favor of linking PE only to health and the environment, while others argued that the educational treatment of the SDGs should also be carried out in the other subjects. This, in fact, has meant that one of the main barriers detected in previous literature is the dominant existence of traditional disciplinary curricular frameworks that hinder the incorporation of sustainability (Albareda-Tiana et al., 2018; Evans et al., 2017). The idea of integrating the SDGs into different subjects has already been taken up as an essential task within ESD (Rieckmann et al., 2017). Despite this, and as argued by Fuentres-Camacho et al. (2019) and Tasdemir and Gazo (2020), this process has not yet been realized in PE. The latter two studies also highlight the importance of identifying potential barriers to the integration of the SDGs. In this regard, the preservice teachers in our study pointed mainly to educational barriers, followed to a lesser extent by socioeconomic barriers. These findings are consistent with the study by Baena-Morales et al. (2022), conducted with PE teachers, which highlights the negative influence of external factors, especially the lack of time and poor teacher training, along with internal factors such as teachers' own motivation. In addition to the above, higher education policies in Spain are an important obstacle (Geli et al., 2019; Pellín et al., 2021), since in contrast to what happens in other countries such as Scotland (Gough, 2016), the possibility of integrating sustainability into initial teacher training has not yet been considered.

4.4. Limitations and future research

During the course of this research, a series of limitations have been detected that could be useful for the design of future studies. Firstly, the

sample was collected only from three Spanish universities, so it would be interesting to extend the study to other national and foreign higher education institutions in order to contrast the results in different sociocultural contexts. Secondly, the scientific community is encouraged to evaluate the relationship between PE and sustainable development, as there is little scientific literature on the subject, which has made it difficult to discuss the results. In relation to this idea, students' inaccurate perceptions about sustainability have led to the recording of not very extensive narratives, causing a simplification of the coding of the results into two categories. Another limitation that could be acknowledged is the few practical proposals put forward by the interviewees for incorporating ESD into PE. We consider this to be serious, as it shows the lack of awareness and training in sustainability among PE preservice teachers. Thus, everything seems to indicate the need to develop educational policies at national level and educational strategies at the classroom level that focus on the relationship between PE and the three dimensions of sustainable development: social, environmental, and economic. Future research could assess whether these policies and strategies are indeed effective and enhance students' knowledge and skills sufficiently to integrate the SDGs in their professional development as teachers. In addition, we consider it essential that forthcoming qualitative studies attempt to assess the skills, attitudes, and values necessary for sustainable development in schools and especially in PE.

5. Conclusions

A number of factors have been found among PE preservice teachers that are similar to those in other educational populations. Generalist educational guidelines, poor training of university teachers, a lack of resources, and rigid and overloaded curricula have been found to jeopardize the development of PE teachers who can promote sustainability. Furthermore, PE preservice teachers have too generic a perception of sustainability, relating it mainly to an environmental perspective. In this work it has also been shown that PE is positively valued as a subject that could promote the attitudes and values necessary for sustainable development in schools, although preservice teachers do not seem to be clear about which strategies are appropriate for this. These facts seem contradictory, so we suggest that in order to mitigate these problems, sustainability should be a mandatory component of PE teacher training in particular. In this regard, university managers have a responsibility to take a number of measures, including the creation of a specific subject on ESD and PE, or that this content be given more weight in some subjects of the curriculum. Changing the pedagogical approach to teacher education, taking ESD principles into account, is a challenge that education faculties can no longer ignore. Only in this way will preservice teachers be able to play the role of leaders for sustainability, see their profession as useful and necessary for society, and understand the crucial role of PE in the sustainability of the environment, society, and the economy.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.tate.2023.104254>.

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