

Boosting student engagement and dedication in physical education through a self-made materials approach: insights from a comparative investigation to sustainability

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Abstract

Background: The ongoing climate change crisis, leading to irreversible alterations, underscores the critical role of education and teaching within the sustainable development paradigm. Current research suggests that Physical Education can significantly contribute to fostering a shift towards a perspective where sustainability is a fundamental aspect. The limited research focusing on exploring the nexus between sustainable development and Physical Education underscores the need for delving deeper into methodologies apt for its progression within the sustainable domain. Among various strategies, it is proposed that Physical Education can enhance the environmental facet of sustainable development via self-fabricated materials. **Methodology:** A cohort of 103 high school students (54 females), aged 13.88 ± 1.254 , participated in this quasi-experimental study, encompassing diverse grade levels. The sample was bifurcated into control and experimental groups in a non-random fashion, with 1st and 3rd grade students forming the control group and 2nd and 4th grade students comprising the experimental group. The instructional unit employed during the process incorporated six sessions. Traditional task assignment methodology was adopted by 1st and 3rd grade students (control group), whereas problem-solving and microteaching styles were primarily employed by the 2nd and 4th grade students (experimental group). **Results:** The mean and standard deviation of various items were assessed, with items 3, 9, 19, and 28 scoring highest for the control group, and items 3, 18, 20, and 28 leading for the experimental group. A comparative analysis of results acquired by both groups demonstrated significant differences in items 14, 17, and 19. Additionally, a gender-based analysis of the descriptive statistical data was performed. Significant bilateral asymptotic differences in men (items 10, 14, 17, and 19), whereas no significant differences were observed in any section of the questionnaire for women. **Conclusions:** Implementing an intervention that developed an alternative sport based on self-fabricated materials yielded superior outcomes in aspects such as the motivation to acquire this type of knowledge, dedication to the subject, and satisfaction with the self-made materials. This was particularly evident in the group exposed to active, competence-based methodologies like problem-solving, compared to the control group that employed traditional methodologies.

Keywords: Physical Education; Sustainable Development; Self-Fabricated Materials; Student Engagement Problem-Solving; Methodology

Introduction

Causality of Sustainable Development

Climate change is an ongoing problem that is leading to irreversible changes (IPCC, 2021). The origin of global climate change could be due to geological changes brought about by mankind. In fact, the biological era in which we live is known as the Holocene, however, the multiple ecological problems caused by human actions have led to the concept of this era being changed to the Anthropocene¹* (Lewis & Maslin, 2015). One of the main human causes of this environmental change is that the last half century has seen global population growth, which in turn has led to an exponential increase in resource use and pollutant emissions. It is true that, through the use of technology, these figures have been reduced, but the reality is that for the moment this is insufficient. To achieve an effective transition to sustainability, resource use must complement technological advances. However, the reality of the situation is that global societies and economies encourage wasteful consumption, inhibiting the social change necessary to achieve the path to sustainability (Wiedmann et al, 2020). To address this environmental problem, the concept of sustainable development is presented, which implies limits imposed by the current state of technology, social organisation in terms of environmental resources and the capacity of the biosphere to absorb the effects of population (Brutland Commission, 1987). The Commission on Sustainable Development, which is constituted within the framework of the United Nations Economic and

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Social Council, promotes combating poverty and meeting the basic needs of all in order to achieve a higher quality of life. Development is involved in ensuring that developed economies remain linked to environmental protection, which is inherent in the concept of sustainable development, focusing on the sources of environmental problems rather than the symptoms (Brutland Commission, 1987). In order to address the above-mentioned problems, the Sustainable Development Goals (SDGs) exist, objectives that aim to analyse real parameters in terms of the progression of different principles and values agreed by the Member States at the World Summit on Sustainable Development (WSSD).

Importance of Education for Sustainable Development

This paper aims to address the concepts of sustainability and education, as well as the relationship between them. We have previously explained in general terms what the former consists of, and now we will focus on the latter. It was in 1992 that the idea of sustainable development was disseminated and considered relevant; this change in perspective was the trigger for the United Nations General Assembly, where resolution 57/254 was passed on 20 December 2002, proclaiming the Decade of Education for Sustainable Development (2005-2014), characterised by considering education as a vital element for achieving the sustainability of the planet (Sureda et al; 2019). Within the SDGs, we find the fourth goal, which works directly on Quality Education, highlighting among other factors inclusive, equitable and quality education, and is also in charge of promoting learning opportunities for all and for all. This is why the knowledge, skills, values and attitudes needed to foster sustainable development are addressed through Education for Sustainable Development (ESD). At the core of this goal, there are seven targets, in this research we will try to contribute to target 4.7, because it deals with sustainable development. The existence of this target means that education has a dual role: as a target to be achieved and as a fundamental strategy for achieving the rest of the SDGs. ESD is made up of different competences that aim to empower individuals to reflect on their own actions, considering their social, cultural, economic and environmental effects throughout their lives (Muguerza and Chalmeta, 2020).

Education, and specifically teaching, must build a solid involvement to lead the transformation processes towards a new worldview where sustainability is a basic premise (Barroso, 2018). The aim of this study is to analyse the level of awareness and involvement of educational centres with regard to sustainability in general terms, and specifically its relationship with ESD. It is worth highlighting the relevance of the latter concept mentioned above, since ESD is intended to enable students to create their own critical and informed decision-making and action, and thus to address existing environmental issues. It is therefore worth asking how the education system contributes to promoting the concept of sustainable development and action in favour of it, and it is interesting to analyse how the general legislation regulating Compulsory Secondary Education (ESO) in Spain deals with the concept of sustainability.

This is why different parameters must be addressed, such as the regulations and documents that regulate curriculum development, the resources and teaching resources used, the dynamics and organisation present in the classroom, the way in which the concept of sustainability is worked on, interpreted and put into practice by students and teachers, and the way in which the acquisition of this knowledge related to sustainability is assessed, as well as the development of the competences necessary for its application and the resolution of specific situations or problems (Sureda-Negre et al., 2013). To this end, by means of the practicum within the bachelor's degree in Physical Activity and Sport Sciences, developed in the teaching branch, a study will be carried out focusing on the four courses that make up ESO.

There are different subjects to work on sustainability in the educational sphere, one of them being Citizenship Education, which is considered an appropriate subject, due to the fact that different current research shows that this subject is essential when developing curricular proposals in terms of the orientation of what the educational aims should be, learning contents, methodologies and evaluation criteria based on Human Rights, all of which are taken into account and applied in order to train students to become active and committed to the configuration of a more equitable, just, supportive and sustainable planet and system (Andrés et al. , 2014; Cabrera, 2007). In this way, competencies and skills, specifically socioemotional skills, are directly related to learning, so that a school climate that favours confidence and autonomy generates motivation and commitment to academic tasks, in turn increasing the capacity for reflection and transformation in the educational centre (Mena, Romagnoli and Valdés, 2009).

On the other hand, there are studies focusing on the same objective, but which are approached from another perspective, from the teaching of future secondary school teachers, with the aim that they apply the knowledge acquired and develop the competences of the field of Experimental Sciences (specialities of Biology and Geology and Physics and Chemistry) in accordance with a commitment to the environment and with a commitment to sustainable development. The research is made up of the following objectives: analysis of the teaching guides, with the aim of examining the extent to which ESD is present, formation of collaborative teams of teachers to promote the acquisition of competences in sustainability and ESD among the training targets of their teaching projects and to arbitrate the resources, means and procedures for their effective achievement, as well as proposals that seek to promote attention to ESD in the training of secondary school teachers (Llinares, García-Berlanga et al., 2019).

Relationship between Physical Education and the Sustainable Development Goals

When the term sustainability is applied to Physical Education, it becomes an integral Physical Education, because it responds to a unitary and systemic character of the human existence, pretending to express the way in which a pedagogical task acts on the globality of the being, either in a sensitive or physical way. This type of pedagogical intervention proposes to teach how to take care of the extra-body, i.e. the shape and form of the body, and in turn, this concept covers terms such as balance, harmony, adaptability, expression or body communication (Baena-Morales & Ferriz-Valero, 2023). On the other hand, the integral nature of its definition is also centred on the internal perception of corporeality, experiences, and emotions, which is also called intra-body. Integral physical education poses motor problems that necessarily require the active involvement of all its participants, as it tries to break down the monotony of people's lives, trying to stimulate, through its active methods, attention to one's own body and sensitive life, as an effective means of feeling integrated in nature. It is therefore important to create an awareness that this gift provided by nature must be returned, and to generate this thought constitutes a challenge for the subject of Physical Education within the scope of sustainable development and the consolidation of a human culture (Otero, 2002).

Physical Education teachers are faced with a multitude of situations in which schools are not sufficiently prepared and there is a shortage of material for classes. Therefore, teachers have to push themselves and look for solutions to solve this lack of material in order to prevent students from being limited to monotonous, routine and repetitive classes. This is why it is essential to incorporate new materials, methods and strategies to support teachers in order to avoid this routine.

In view of the above, the aim of this study is to work on sustainability by focusing on the self-construction of materials, using these materials to put into practice a series of new sports and physical activities that can have a very positive and motivating influence on pupils. The aim is for them to put their cognitive and motor skills to the test in the creation of the material, always making use of the support of the group and working on co-education (Baena-Morales et al., 2022).

In addition, this type of session will prioritise the role of recreation over competition, promoting attitudes of solidarity, respect, enjoyment, and cooperation. Another important aspect that these sessions promote is the development of organisational skills, by working with alternative activities, games and modified sports. Educating in the separation of waste, and in the reuse of materials for different activities, is one of the best ways of involving Physical Education in sustainability and environmental protection (Pérez, 2018).

For all these reasons, the present work aims to create a didactic unit in which we work with recycled materials, which will be created by the students of the four years of Secondary School. The method of this study will be quasi-experimental, and the pupils will be given a questionnaire after the sessions, which will include questions about the same concepts, and at the same time a series of questions to find out their opinion about what they thought of the didactic unit, whether they found it useful, whether it was motivating, etc. Likewise, we will work from two teaching methodologies, the first will be through a more traditional methodology working from the assignment of tasks and the second methodology used will be a more active and competent one focusing on problem solving and using styles such as reciprocal teaching, guided discovery and microteaching, being the courses of 1st and 3rd ESO those who will work through the first method, and the students of 2nd and 4th ESO will work through the second method named. This will enable us to analyse the influence of the different teaching styles and/or methods in Physical Education classes, thus culminating the main objective of this study, and with the aim of finding out which method or strategy is most effective for the development of the subject. In this way, the possibility of working on the self-construction of materials in Physical Education has been considered, analysing two teaching methods or strategies at the same time. To date, no study has been found that deals with these competences by means of these teaching methods.

In this line, Physical Education is considered an indispensable means of working on sustainability and environmental protection, and it is therefore hoped that through this teaching unit, pupils will be made aware of the need to have an attitude of sustainability and critical thinking with regard to the actions carried out by human beings that can affect the environment. At the same time, the aim of this research is to analyse which teaching methodology is most appropriate, in terms of the development of both physical and cognitive skills and abilities and in terms of parameters such as motivation, satisfaction with the work carried out and learning capacity, for working on a didactic unit on the self-construction of materials. In addition, as secondary objectives relating to the opinion presented by the students with respect to parameters such as the usefulness they give to this type of intervention, the benefits it provokes. As well as making Physical Education teachers aware of the existence of an alternative to the lack of material existing in the majority of centres.

Material & Method

Objectives

To evaluate the impact of an intervention based on the alternative sport of Bottleball, based on the self-construction of materials, on the awareness of pupils in Compulsory Secondary Education on environmental protection and responsible consumption (Hypothesis 1). To analyse the influence of different teaching styles and methodologies in the development of an alternative sport based on the self-construction of materials, comparing

the traditional assignment of tasks with competence and active methods such as problem solving. As well as to carry out a comparative analysis by sex of the results analysed (Hypothesis 2)

Design

The methodological design of this study is quasi-experimental. The sample was divided into two groups in a non-randomised way, the control group made up of students in 1st and 3rd year of ESO, and the experimental group made up of 2nd and 4th year of ESO

Participants

To carry out the research, a non-probabilistic sampling by chance or by accessibility was carried out at the Colegio Santísimo Sacramento Feyda. A total of 103 ESO students (54 females) completed the research (13.88 ± 1.254). The sample was composed of different ESO courses (see table 1).

Table 1. Description of the sample according to gender and grade level

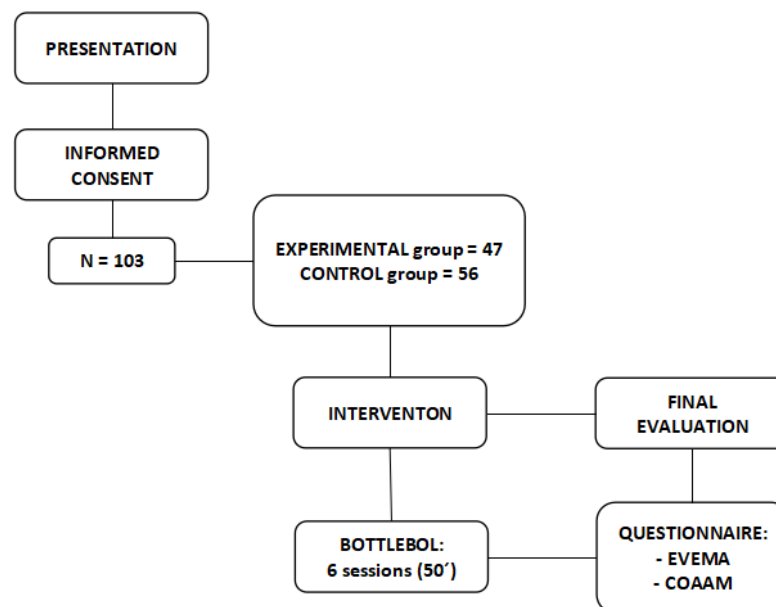
Course	Man	Women	Total
4º ESO	10	12	22
3º ESO	14	13	27
2º ESO	10	15	25
1º ESO	15	14	29
Total	49	54	103

Procedure

The decision as to which grades were to form part of each group was determined taking into account several criteria: to begin with, to choose for the experimental group the grades with the greatest predisposition and the best behaviour. On the other hand, the intention was to alternate ESO grades so as not to choose the grades with the youngest pupils in one group and the most advanced grades in the other, so as not to be affected by the age of the pupils, so it was decided to alternate 1st and 3rd ESO as the control group and work using traditional methodology, and 2nd and 4th ESO as the experimental group, carrying out the intervention by means of problem solving.

An intervention based on the methodology of self-construction of materials will be carried out, where pupils will work on an alternative sport called Bottleball (Annexes 3, 4 and 5). The methodology will be differentiated by groups, i.e., the 1st and 3rd ESO courses will work with a traditional methodology based on the assignment of tasks and will be part of the control group, however, with the rest of the courses (2nd and 4th ESO) we will mainly use problem solving, as well as working with styles such as microteaching, the latter will be the experimental group. The intervention will consist of different stages, which are shown in Figure 1. The didactic unit used within the process consists of 6 sessions.

Figure 1. Intervention procedure



On the other hand, in order to carry out this study, informed consent had to be requested from the families in order to carry out the research with their children (see Appendix 2). All participants were informed of the objectives of the study by means of an authorisation signed by the parents of the pupils as a transfer of data for scientific use. The ethical aspects presented in the Declaration of Helsinki were respected in the design of the study. This research was approved by the ethics committee of the University of Alicante with code UA-2022-03-17.

Instruments

A quantitative questionnaire was carried out (see appendix 1), which was given to the students at the end of the intervention due to the nature of the same, which is designed to carry out a post-intervention, with the aim of finding out different aspects related to the didactic unit of self-construction of materials, among which the following stand out: satisfaction, involvement and motivation regarding this type of alternative activities, as well as the ease and usefulness of carrying them out in Physical Education classes.

Questionnaire for evaluating the experience of self-construction of materials.

A questionnaire with aspects related to the self-construction of alternative PE materials was carried out: to find out the PE students' attitudes and opinions about their process of constructing alternative materials. A set of two questionnaires was used, the first one developed by Méndez-Giménez and Fernández-Río (2012), consisting of 20 items belonging to the Experience Evaluation Scale with Recycled Materials (EVEMA) (Méndez-Giménez & Fernández-Río, 2012). In turn, the questions belonging to the Questionnaire on the opinion and attitude towards self-construction of materials (COAAM) developed by López-Fernández and Benítez-Porres (2018), based on the work of Prentice and Robinson (2010), were added to this. The EVEMA is composed of 20 items that assess the degree of usefulness, effort, motivation, satisfaction, and commitment experienced by each participant. In order to find out the opinions and attitudes of the students after the intervention, and their assessment of the educational potential of this methodology, they were administered the Questionnaire on the opinion and attitude towards the self-construction of materials, consisting of 13 items. However, the Questionnaire on the opinion and attitude towards self-construction of materials was modified, using only 8 questions, and a total of 28 between the two questionnaires. The questions that were removed from the questionnaire were because these items were designed to be answered by future teachers and not by secondary school students. The responses follow a five-point Likert format where 1 is "Strongly Disagree" and 5 is "Strongly Agree". Finally, it should be noted that the instrument used has a Cronbach's Alpha of 0.81 while the EVEMA showed a reliability of 0.95 (Abellán & Hernández-Martínez, 2021).

Statistical analysis

All continuous variables described above were subjected to a normality test (Kolmogorov-Smirnov). The data were similarly subjected to a chi-square analysis and univariate statistical analysis for non-parametric samples, specifically the Mann-Whitney U test, to assess differences between groups (EXP vs. CON) at post-intervention. The significance level was set at $p < 0.05$ in all cases. The statistical programs Statistics Product and Service Solutions (IBM ® SPSS ® Statistics Version 24.0.0.0) (International Business Machines Corp., Madrid, Spain) and Microsoft Excel ® in its 2016 version (Microsoft Corp., Redmond, WD, USA).

Results

Descriptive analysis

The results analysed under the normality tests analysing the statistical parameters, degree of freedom and significance can be seen in Table 2.

Table 2. Mean and standard deviation of the analysed values

Items	Control (n=56)		Experimental (n=47)	
	Mean	Desviation	Mean	Desviation
Factor 1.				
Ítem 1	3'51	1'349	3'6	1'365
Ítem 2	2'26	1'206	2'56	1'315
Ítem 3	4'19	0'97	4'12	0'931
Ítem 4	3'72	0'877	3'67	1'169
Ítem 5	3'85	0'884	3'56	1'007
Ítem 6	2'72	1'314	2'58	1'239
Ítem 7	3'36	1'092	3'21	1'036
Ítem 8	3'62	1'226	3'88	1'051
Ítem 9	4'09	0'974	3'95	1'09
Ítem 10	2'74	1'376	3'38	1'347
Ítem 11	3'83	1'11	3'56	1'053
Ítem 12	3'6	1'035	3'51	1'009
Ítem 13	3'74	1'188	3'3	1'264
Ítem 14	3'47	1'195	3'91	1'099
Ítem 15	3'72	1'192	3'98	2'98

Ítem 16	3'77	1'127	3'49	1'162
Ítem 17	3'47	1'232	3'79	1'12
Ítem 18	3'94	1'03	4'05	0'975
Ítem 19	3'72	1'063	4'15	1'315
Ítem 20	3'96	1'122	4	1'024
Factor 2.				
Ítem 21	3'91	0'88	3'7	0'914
Ítem 22	3'55	0'974	3'35	1'066
Ítem 23	2'94	1'342	3'07	1'404
Ítem 24	3'36	1'112	3'26	1'071
Ítem 25	3'81	1'056	3'58	1'18
Ítem 26	3'57	1'211	3'47	1'12
Ítem 27	3'36	1'15	3'42	1'074
Ítem 28	4'15	0'955	4	1'091

Factor 1. Degree of usefulness, effort, motivation, satisfaction and commitment.

Factor 2. Opinion and attitude towards self-construction of materials

In this section, a comparison is made of the results obtained by both the control group and the experimental group, where it can be seen that the only items that show differences between groups at the level of significance are 14, 17 and 19 (see table 3). On the other hand, a comparison is made by sex of the descriptive statistical data. Table 4 shows that men do show differences in the bilateral asymptotic significance (items 10, 14, 17 and 19) while in women there is no significance in any section of the questionnaire.

Table 3. Descriptive statistics

Items	Z	Sig. asymptotic
Factor 1.		
I1	-0,648	0,517
I2	-1,536	0,125
I3	-0,969	0,333
I4	-0,046	0,963
I5	-1,436	0,151
I6	-0,081	0,936
I7	-0,693	0,488
I8	-0,942	0,346
I9	-0,682	0,495
I10	-1,805	0,071
I11	-1,391	0,164
I12	-0,878	0,38
I13	-1,923	0,054
I14	-2,229	0,026
I15	-1,594	0,111
I16	-0,989	0,323
I17	-2,06	0,039
I18	-0,085	0,932
I19	-1,978	0,048
I20	-0,388	0,698
Factor 2.		
I21	-1,729	0,084
I22	-1,154	0,249
I23	-0,318	0,75
I24	-0,375	0,708
I25	-0,76	0,448
I26	-0,915	0,36
I27	-0,269	0,788
I28	-0,393	0,695

Factor 1. Degree of usefulness, effort, motivation, satisfaction and commitment.

Factor 2. Opinion and attitude towards self-construction of materials

Table 4
Descriptive statistics differentiated by sex.

Sex	Man		Woman	
Items	Z	Sig. asymptotic	Z	Sig. asymptotic
Factor 1.				
I1	-0,441	0,659	-1,368	0,171
I2	-1,352	0,176	-0,789	0,43
I3	-0,209	0,834	-1,144	0,253

I4	-0,274	0,784	-0,61	0,542
I5	-1,402	0,161	-0,834	0,404
I6	-0,153	0,878	-0,055	0,956
I7	-0,651	0,515	-0,425	0,671
I8	-0,389	0,697	-1,126	0,26
I9	-0,878	0,38	-0,195	0,846
I10	-2,169	0,03	-0,545	0,586
I11	-1,188	0,235	-0,931	0,352
I12	-1,259	0,208	-0,082	0,935
I13	-1,734	0,083	-1,07	0,285
I14	-2,337	0,019	-0,932	0,351
I15	-1,549	0,121	-0,587	0,557
I16	-1,913	0,056	-0,309	0,758
I17	-2,465	0,014	-0,508	0,611
I18	-0,129	0,897	-0,262	0,793
I19	-1,986	0,047	-0,918	0,358
I20	-0,107	0,915	-0,467	0,641
Factor 2.				
I21	-1,401	0,161	-1,057	0,29
I22	-0,67	0,503	-1,07	0,285
I23	-0,576	0,565	-0,833	0,405
I24	-0,857	0,391	-0,064	0,949
I25	-0,924	0,356	-0,237	0,813
I26	-0,653	0,514	-0,558	0,577
I27	-0,174	0,862	-0,24	0,81
I28	-0,554	0,58	-0,088	0,93

Factor 1. Degree of usefulness, effort, motivation, satisfaction and commitment.

Factor 2. Opinion and attitude towards self-construction of materials

Discussion

The aim of this research was to evaluate the impact of a Bottleball teaching unit, based on the self-construction of materials, on the awareness of Compulsory Secondary Education students about the importance of environmental protection and responsible consumption, as well as to analyse the influence of different teaching styles in Physical Education classes. Previous studies have analysed how teaching a didactic unit related to sustainability can affect the different parameters related to pupils' abilities and values; however, the same didactic unit has not been worked on using different teaching styles. The data obtained show that 12 of the items obtained higher scores from the experimental group, with only items 14, 17 and 19 standing out in terms of significance. Analysing the level of significance for each of the genders, it can be seen, women do not show significance in any of the items. However, males do show differences in bilateral asymptotic significance (items 10, 14, 17 and 19). Thus, the students generally state that the items where the greatest differences between groups are found are in the parameters related to motivation to learn the contents of the subject (item 14), increased commitment to the subject (item 17) and pride in the materials created (item 19). Also, it is men who experience greater significant differences than women, coinciding with the aforementioned items and the sum of parameter 10, which deals with the intention to work with these contents if were they the teachers. Despite the above, the results obtained did not show significant differences between the control group and the experimental group.

According to the data obtained, after the intervention, both groups have become aware of the importance of the attitude of sustainability and critical thinking with respect to actions that may affect the environment (H1). Similarly, but without significant differences, greater motivation, cooperation and development of cognitive and executive skills were shown in the students who worked through the problem-solving teaching style compared to the control group. Significant differences were found in the comparison by sex, where males did show differences in the bilateral asymptotic significance (items 10, 14, 17 and 19), while in females there was no significance in any section of the questionnaire (H2). On the other hand, no relevant differences were found between groups in the evaluation of parameters such as the perception of improvement in motor skills (item 4), the ability to show abilities that are not very evaluated in PE (item 12), access to more significant and motivating knowledge (item 15), fitting in with the students' way of learning (item 16), except in variable 17, related to the increase in the student's motor commitment (H3). Similarly, no major differences were observed in the groups as a whole for the criteria related to autonomy, responsibility and care of material (both their own and others') (item 20) (H4). Continuing with the objectives of the study that were not significant between groups, is the estimation of whether working with a new and innovative sport encourages teamwork in the students, and therefore, group interaction (item 18) (H5). To conclude the analysis of the objectives set out in the form of hypotheses in the first section of the method, no different scores were found between groups with regard to the usefulness of this type of didactic unit (item 5), the knowledge of whether it represents a significant benefit in their learning (item 7), and the degree of satisfaction that the experience provokes in them (item 9)

(H6). Different studies have shown great differences in the results when comparing traditional teaching methodologies and active methodologies, the latter being the ones that provide the greatest benefits to students in the course of Physical Education classes, alluding to values such as motivation, satisfaction and autonomy, among others. This occurs because in this way they are more involved in the game, learn more, and do not perceive the duration of the didactic unit, in contrast to students using the traditional methodology, who experience behaviour that presents a lower perception of learning, less interest in the tasks and the competition, less knowledge of the sport and its rules, and in general less enjoyment (Calderón et al., 2013). On the other hand, Sympas et al. (2017) pointed out that teachers justified the use of reproductive styles in terms of control, discipline and the greater practice time they generate in the classroom. Despite this, the same study found that the advantages claimed by teachers who used more productive styles were the contribution to the development of student responsibility and autonomy. In turn, studies such as the one by Capella et al. (2014) claim that this type of programme develops learning about PE teaching practice such as conflict management, adaptability, feedback and evaluation, all of which are difficult to learn through traditional learning methodologies. Regarding the development of management and problem-solving skills, academic performance and critical thinking, as well as competences, Yorio and Feifei (2012) claim to obtain good results in the evaluation with the group, where we find aspects such as those that develop APS and self-construction of materials described by Rubio (2009): personal, interpersonal, for civic thinking, the implementation of projects, citizenship and social, vocational and professional transformations.

However, this research did not obtain results as significant as those found in previous studies (Botella et al., 2022). The results suggest that despite the great change that implementing an unfamiliar methodology provokes in the students, being the students mostly used to traditional or teacher-centred styles, the fact of having analysed the influence of two different methodologies but during an innovative unit with an alternative sport such as Bottleball, may already be motivating in itself for both groups, without distinguishing between one methodology and the other.

On the other hand, the fact that this unit was taught by me during my internship, instead of being taught by the schoolteacher, may also have influenced the study. Another further reason influencing the results obtained was that the intervention had an unfamiliar and innovative character, which could have influenced the students, capturing their attention and interest, and thus leading to greater involvement of both groups.

After having carried out this study, it would be convenient to analyse this type of research with a larger sample and carrying out interventions using didactic units of different content blocks. It would also be useful to design a questionnaire beforehand to compare the different parameters to be analysed before and after the intervention. In this way, it would be possible to find out which teaching methods and styles are most effective for each sport or activity. Based on these limitations, and starting from the objectives proposed in this study, a line is left open for an educational intervention that takes the present work as a starting point, with a more ambitious study being considered. Future studies could focus specifically on analysing which method is most effective for teaching a unit that promotes sustainable development, working with and comparing different alternative sports, as well as comparing interventions in different schools and at different levels of education (including Primary and Baccalaureate). Finally, it would be interesting to apply pre-intervention and post-intervention questionnaires, dealing with different aspects and dimensions, and not only focusing on items focused on student-related parameters, but also carrying out a questionnaire in order to take into account the teacher's appreciation.

Conclusions

The concept of Sustainable Development is increasingly present in Education. One of the subjects considered appropriate to work on it is Physical Education, which seems to have special qualities to develop integrated educational proposals within the methodology of Self-construction of materials. Within this framework, Physical Education is considered an indispensable means of working on sustainability and environmental protection, which is why I hope that through this study, students will be made aware of the need to have an attitude of sustainability and critical thinking with respect to the actions carried out by human beings that can affect the environment. Carrying out an intervention developing an alternative sport based on the self-construction of materials, obtained greater results in items such as motivation to learn this type of knowledge, commitment to the subject and satisfaction with the materials constructed, by the group that had a methodological intervention through active and competence-based proposals such as problem solving, compared to the control group that worked through the traditional methodology. However, in the rest of the 28 items that make up the questionnaire provided, both groups obtained similar values. The novelty that working an alternative sport within an educational environment based on imitative programming presents for the students could explain why there are no major differences between groups in the values analysed in the questionnaire. It would be of interest to carry out studies involving other levels of education, such as High School and Primary Education, as well as involving teachers in the completion of the forms. If we want to promote the sustainability of the planet, it is essential to educate in sustainable values from educational centres, because as Barroso (2018) mentions "education, and specifically teaching, must build a solid involvement to lead the transformation processes towards a new worldview where sustainability is a basic premise".

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