

## Article

# Transforming Learning Spaces on a Budget: Action Research and Service-Learning for Co-Creating Sustainable Spaces

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**Abstract:** Transforming learning spaces has become a priority for many schools, not only for implementing emerging methodologies but also for sanitary reasons due to the COVID-19 pandemic. Schools struggle to find solutions for the lack of space in order to respect the required safety distance, especially public schools with a very tight budget and many administrative barriers to overcome. From participatory action research, findings confirmed that expanding and refurbishing indoor and outdoor space in many public high schools is urgent. Then, an opportunity emerged to develop a new learning space in one of the high schools in touch with the research team at Miguel Hernandez University working on educational spaces since 2017. This article describes the action research (AR) carried out, its main results regarding needs and deficiencies in public high schools in our surroundings, and a subsequent Service-Learning experience promoted by the research group as a solution for upgrading and extending educational spaces and simultaneously developing students' soft skills, empowering youth, participation, local partnerships and other sustainable development goals meeting 2030 Agenda.

**Keywords:** learning spaces; service-learning; sustainable development goals (SDGs); education for sustainable development (ESD)



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## 1. Introduction

In the last decade, there has been a significant debate in the literature fostering the transformation of learning spaces. Likewise, education for sustainable development recommends institutions to act as role models, transmitting sustainability and engaging stakeholders in participatory methodologies. In 2017 the University Miguel Hernández of Elche (UMH) in Spain initiated a study on learning spaces under the umbrella of the PhD program for environmental sciences and sustainability and the high school teacher training department. The main goals were to explore the current situation of learning spaces in public high schools of the area, find out what the real conditions were, and create actionable knowledge for planners and decision-makers about the design and use of new environments. Finally but most importantly, to empower those researched to start action, no matter how small. The way to proceed with this research was through action research.

It is no longer questioned that space facilitates pedagogical change [1,2], influences academic outcomes [3–5], and is related to health and wellbeing [6–9]. Studies have emerged during the last decade that considers the design of learning spaces as a support factor for the incorporation of 21st-century teaching-learning methodologies [10–12]. These methodologies include an approach towards education for sustainable development and applied learning, with self-directed activities that permit the student to be in touch with the “real” world and labor market outside school and university life [13,14].

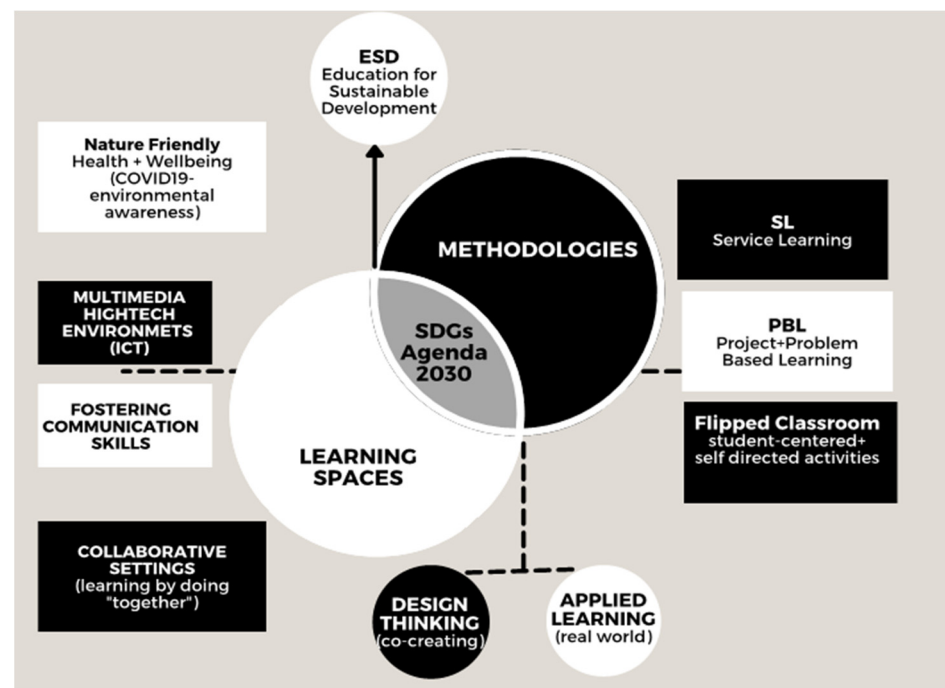
The Service-Learning experience explained in this paper is only a mere consequence of the action research approach of the investigation about learning spaces and an example of a 21st-century methodology. With the worldwide importance of active, engaging, student-centered methodologies, there has been an increase in Service-Learning programs [15–20]. Service-Learning is a form of experiential education [15,20] with positive learning outcomes [15], ideal for implementing SDGs. We encounter recent examples relating Service-Learning with SDGs, such as SDG3 [21,22], SDG5 [23], SDG6 [24]. Figure 1 is a reminder of the topics of each one of the 17 SDGs named by the UN for addressing Agenda 2030. The experience described in this paper covered several of these SDGs discussed further in the article.



**Figure 1.** Sustainable development goals (SDGs). Source: <https://www.un.org/sustainabledevelopment/news/communications-material/>, accessed on 9 August 2021.

In Spain, although Service-Learning is not unknown, it is not widespread. The Spanish Association for Service-Learning (Red APS) was officially created in 2014 with the task of promoting and spreading the best practices in Spain. According to Red APS, Service-Learning is an educational model that combines theoretical learning with service to the community all in one project. By means of organized activities, the students use their knowledge to solve problems in an authentic situation, thus transforming and improving the real world [25]. Although there are several types of Service-Learning [17,18], in this paper, we will refer to Project-Based Service-Learning, where students (as consultants) are asked to find a solution to a problem the client (community) has by developing a project. It is not charity, as they both (consultants and the client) benefit from the experience [18].

Thus, Service-Learning offers an excellent opportunity to also practice interpersonal skills. It improves work skills for effective 21st century job performance, such as public speaking, communication and listening, teamwork, time management, etc. [19,26]. This is core in today's education at all levels but urgent in vocational education training [26–28], as is the case in our experience. Figure 2 shows a global picture of some of the most outstanding 21st-century components of the teaching-learning process that we have considered in our study concerning learning spaces.



**Figure 2.** Outstanding 21st-century components of the teaching-learning process.

### Research Questions

This paper is part of a larger study on learning spaces in public high schools in the southeast of Spain (area of Elche-Alicante). The main goal of the investigation is to create knowledge for planners and decision-makers about the design and refurbishment of educational space that could help in the implementation of 21st-century methodologies, as well as teaching SDGs and thus, co-creating learning spaces.

The research focuses on the following questions:

Regarding learning spaces . . .

1. What is your current situation?
2. What challenges do you face?
3. What solutions can be put forward?

In the process of investigation–reflection–investigation, a fourth question was added:

4. How can we use Service-Learning to address the change?

## 2. Method and Materials

To answer the aforementioned questions 1–3, the research team engaged in a participatory action research method [29,30]. Action research is a human-centered methodology powerfully emerging in social studies, such as education or human geography as a vehicle for change [27–29]. It is an active methodology where both the researchers and the community engage in problem-solving. At the same time, they are producing knowledge [31–35].

Action research (AR) uses qualitative and quantitative tools for gathering information. In our research, we integrated data from participatory observation during design thinking workshops, from custom-designed surveys, site visits to high schools, and face-to-face interviews with fifteen principals of all the public high schools of Elche. An online questionnaire was developed and distributed to the high schools between January and July 2018 in order to be answered by principals or any designed member from the head team. This custom-designed questionnaire included 25 major questions classified in different sections: formal learning spaces, informal learning spaces and transit areas, key elements concerning general comfort (acoustics, temperature, ventilation), remarks regarding technology, teaching methodologies, sustainability programs, and energy consumption of the

high school buildings. Most responses were binary (Yes/No), specifying the existence of the different facilities consulted.

School design information was completed during site visits and interviews. The purpose of each visit was to interview the principal of the school and members of the head team to verify and complete information from the questionnaire. The interviews, followed by a guided tour of the educational facilities, indoor and outdoor learning environments, proved to be a highly relevant research tool. The semi-structured questionnaire with informal questions added on during the tour, using Turner's framework [36], and based on those included in the original questionnaire, provided valuable information, which is not easy to gain when requested in writing. This fact addresses the particular importance of qualitative data to help better understand the issues discussed. Missing responses in the online survey were gathered from personal interviews when site visits were performed.

The following is the background of the service-learning experience, the description of the participating schools that make up the group studied, and finally, the indicators used in the descriptive analysis.

### *2.1. Background of Action-Research before the Service-Learning Experience*

The research team was, at first, an informal, open, multidisciplinary group, staffed by faculty of University Miguel Hernández of Elche with experience in pedagogy, statistics, educational technology, geography, and environment and high school management, who were also involved in teacher training, as well as architects with experience in the construction of school buildings. In this context, they received feedback from student teachers that carried out their teaching practices in the nearby educational community and also from teachers and principals working in high schools. This multidisciplinary group often discussed the lack of alignment between the theory of new methodologies and sustainable approaches and the reality in the learning spaces, even in the new buildings. They began research using a participatory action research methodology [29–31] regarding these issues. It is interesting to highlight that in these processes, the research team acts as a coach that facilitates and empowers those involved in order to achieve transformation of the situation they are seeking to improve [30,31].

From their position at the university, the research team fostered seminars, conferences, projects, and design thinking workshops at different levels.

The first design thinking workshops were conducted by architects in 2017 and took place at the University Miguel Hernández of Elche for promoting innovative learning spaces at the university. The design thinking workshops were replicated to different focus groups during 2017 and 2018 (student architects, student teachers, in-service teachers, as well as principals). Several projects were fostered and financed by the University Miguel Hernández of Elche, with the main goal of the University being to reinforce the bond with schools of the area, improving innovation and education in a collaborative way, and at the same time stimulating digital competence and community service. The research team served as the link between schools and the university and ultimately offered to investigate the situation of all the public high schools of the municipality, fifteen in total, and gain ideas for improving future schools or renovating spaces in the existing ones.

The fact that a new public high school building was about to start its construction in the city of Elche encouraged the team to write reports and request face-to-face meetings with local and regional authorities in order to inform them about the ongoing research at the university and offer cooperation. After 10 years of demanding a new high school in Elche, the construction works are going forward, and the new facilities will start running for the academic year 22–23.

Figure 3 shows pictures of teachers and principals in design thinking workshops sharing needs and exchanging ideas for transforming learning spaces in their schools.





**Figure 3.** Design thinking workshops.

After two years of the ongoing investigation, one of the high schools involved in the study, IES Severo Ochoa of Elche, contacted the team and requested collaboration to create an outdoor learning space in their facilities, using sustainable materials, reducing as much of the noise of surrounding traffic as possible, and integrating nature. The team proposed to approach it through a Service-Learning project, establishing an alliance with another school, the EASDA, a vocational school of arts and design in Alicante. Figure 4 illustrates the process and timeline of the ongoing investigation. The study begins in 2017 with a literature review on keywords “learning spaces”, “sustainable development goals” (SDGs), “active methodologies”, and “participatory design”. During 2017 and 2018, several design thinking workshops were developed. Interviews and surveys to collect data on educational spaces in our immediate area started in 2018, and collaborations for the transformation of educational spaces started in 2020.

## 2.2. Participant High Schools

Fifteen high schools, institutos de educación secundaria (IES), participated in the study about learning spaces, that is 100% of the public high schools in Elche. It is deemed necessary to explain that in public high schools in Spain, students receive compulsory secondary education (from 12 to 16) and can continue studying baccalaureate or vocational training until they are adults. New vocational students can join programs at any age after their compulsory education. This leads to a huge diversity of levels, groups, and programs in the same school. Even before the COVID-19 sanitary alert, the targeted schools were crowded. Table 1 shows the schools implicated in the study, name, construction year, number of teachers, number of students, age of students, and opening hours.

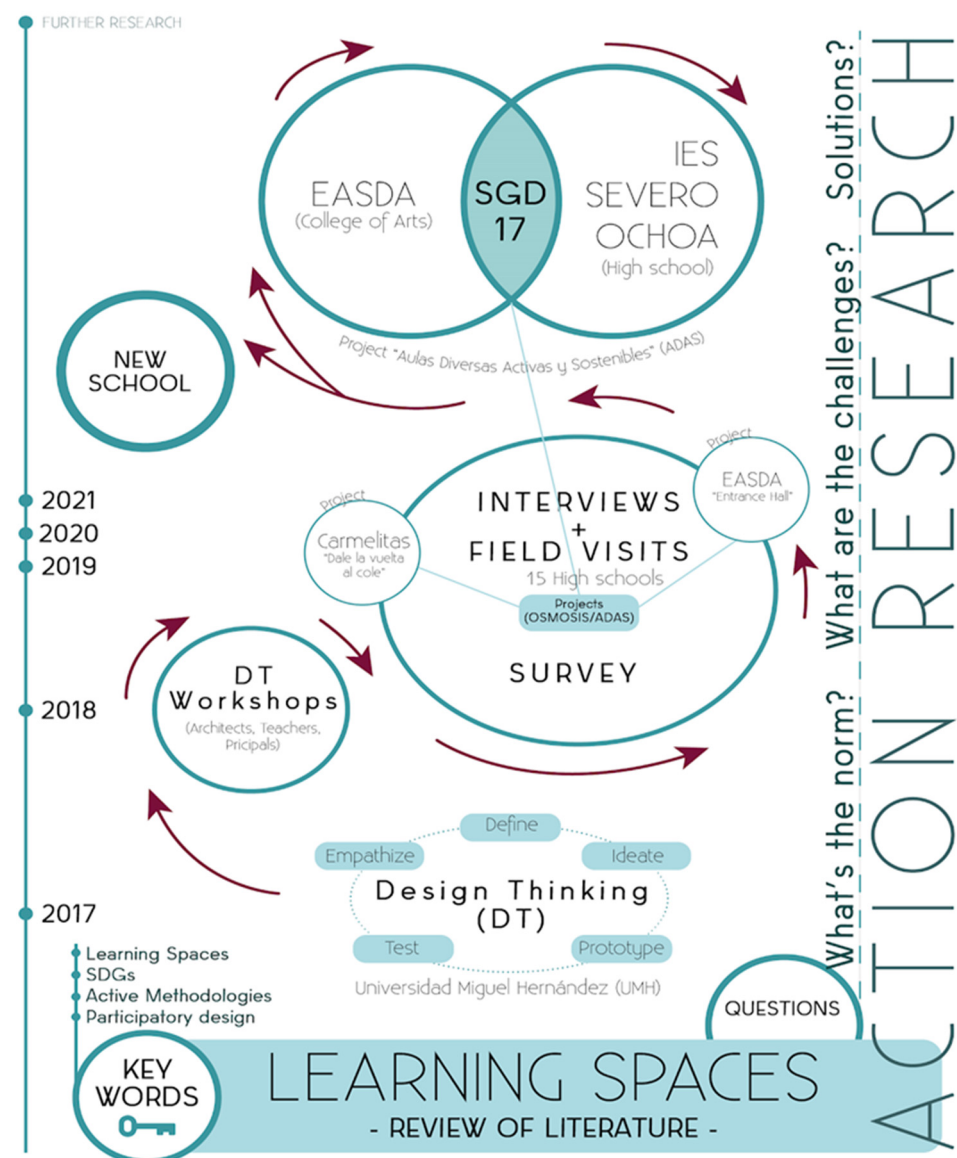


Figure 4. Infographic showing the track of the study.

### 2.3. Indicators Proposed for Description

From the questions of the survey passed to the fifteen high schools, indicators were built by averaging (and standardizing on a scale of 0–10) the dichotomous scores (0/1) provided to identify different related features present in schools. Proposed indicators are:

ACU (acoustics): Acoustic conditions of the learning spaces.

FRI (friendly): Accessibility and wellbeing. It recognizes inviting and friendly spaces. This indicator also covers questions related to the ergonomic design of space and furniture.

CLIM (climate control): Thermal comfort and ventilation.

CONNECT (connectivity): Electrical and technological connectivity, the use of mobile devices, facilities for laptops, PCs, screens, multimedia projectors, plugs, and sockets.

EP (environmental programs): The integration in the school curriculum of educational programs for environmental and sustainable education.

EFF (efficiency): Integrates information associated with energy efficiency, use of natural light, and renewable energies, as well as maintenance and cleaning requirements due to building design.

**Table 1.** List of the studied public high schools in Elche. Source: Generalitat Valenciana, <http://www.ceice.gva.es/es/web/centros-docentes/consulta-general>, accessed on 10 May 2020.

| IES              | Construction Year/Refurbishment | Number of Teachers | Number of Students | Age Range | Opening Hours |
|------------------|---------------------------------|--------------------|--------------------|-----------|---------------|
| La Asunción      | 1963/1968                       | 80                 | 850                | 12–20     | 8–22 h        |
| Carrús           | 1975/1995                       | 129                | 1200               | 12–50     | 8–22 h        |
| Sixto Marco      | 1955                            | 131                | 1200               | 12–50     | 8–22 h        |
| La Torreta       | 1978                            | 154                | 1400               | 12–50     | 8–22 h        |
| Pedro Ibarra     | 1979                            | 62                 | 460                | 12–20     | 8–15 h        |
| Monserrat Roig   | 1986/1987                       | 100                | 1000               | 12–50     | 8–15 h        |
| Tirant Lo Blanc  | 1991                            | 89                 | 915                | 12–50     | 8–22 h        |
| Severo Ochoa     | 1994                            | 88                 | 900                | 12–50     | 8–22 h        |
| Cayetano Sempere | 1994                            | 103                | 1100               | 12–50     | 8–15 h        |
| Victoria Kent    | 1997                            | 120                | 1300               | 12–50     | 8–22 h        |
| Misteri          | 2004                            | 112                | 1200               | 12–20     | 8–15 h        |
| Nit de L'Albà    | 2004                            | 92                 | 917                | 12–30     | 8–15 h        |
| Joanot Martorell | 2004                            | 80                 | 765                | 12–20     | 8–15 h        |
| La Foia          | 2004                            | 65                 | 500                | 12–20     | 8–15 h        |
| Torrellano       | 2004                            | 80                 | 800                | 12–20     | 8–15 h        |

EXPO is identified with the existence or not of spaces for presentations, project work, music, art exhibitions, versatility in classroom design, entrance halls, and transit areas.

As scale indicators were standardized to provide values between 0 and 10, a categorization was defined in order to distinguish centers with “inadequate resources”, those with punctuations below 5, “adequate”, with punctuations between 5 and 7.5, and “outstanding”, above 7.5. Descriptive values are shown in terms of percentages, means, and standard deviations. Comparisons among schools built before and after 2000 are resolved in terms of a two-sided Student *t*-test, providing the resulting *p*-values.

### 3. Results and Discussion

#### 3.1. Quantitative Results and Discussion

Table 2 shows the percentage of high schools situated in outstanding, adequate, or inadequate positions in regard to each of the seven indicators. Meaningful information in Table 2 (gray shading) is that 86.7% of the schools show inadequate results regarding indicator “EFF” that can relate with SDG7, SDG9, SDG11, SDG12, SDG13, however, 73.3% are outstanding in “EP”, environmental programs integrated into the pedagogical curriculum (SDG4). This makes a gap visible between the built environment (SDG9, SDG11) and the theory of the curriculum, space design, and educational programs. The EXPO indicator, which integrated issues regarding versatility in classroom design, entrance halls, and transit areas for presentations and project exhibitions, also shows that 73.3% of the schools are in an inadequate position.

Table 3 compares schools built before and after the year 2000, as initial differences were suspected in the construction of educational buildings. From 2000 to 2004, five new high schools were built in Elche, following contemporary designs. However, these new buildings present some deficiencies related to thermal conditions (CLIM), proved at a 5% significance level, compared with those built before the year 2000. Due to the importance of thermal and environmental quality of working places [8,37–40], the implications of these results have been analyzed in a separate paper.

**Table 2.** Percentage of schools situated in outstanding, adequate, or inadequate positions in regard to the defined indicators (acoustic, friendly, climatic conditions, connectivity, environmental projects, energy efficiency, and exhibition and display spaces).

| Position    | ACU    | FRI    | CLIM   | CONNECT | EP     | EFF    | EXPO   |
|-------------|--------|--------|--------|---------|--------|--------|--------|
| INADEQUATE  | 13.30% | 33.30% | 13.30% | 0.00%   | 0.00%  | 86.70% | 73.30% |
| ADEQUATE    | 40.00% | 66.70% | 46.70% | 73.30%  | 26.70% | 13.30% | 26.70% |
| OUTSTANDING | 46.70% | 0.00%  | 40.00% | 26.70%  | 73.30% | 0.00%  | 0.00%  |

**Table 3.** Mean punctuations (and standard deviations) for indicators in buildings constructed before and after year 2000. Row “*p*-value” contains *p*-values from Student-*t* comparisons for before–after buildings.

| Construction                   | ACU         | FRI         | CLIM        | CONNECT     | EP          | EFF         | EXPO        |
|--------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Before 2000                    | 6.67 (2.5)  | 5.30 (1.09) | 7.73 (1.51) | 6.77 (1.19) | 8.71 (1.05) | 3.20 (1.23) | 3.33 (2.22) |
| After 2000                     | 7.00 (0.75) | 6.32 (1.29) | 5.73 (1.38) | 6.94 (1.21) | 8.00 (0.78) | 3.00 (2.12) | 4.00 (2.79) |
| <i>p</i> -value <i>t</i> -test | 0.703       | 0.17        | 0.03 **     | 0.80        | 0.17        | 0.85        | 0.66        |

Note: \*\* means 5% statistical significance.

### 3.2. Qualitative Findings and Discussion

Qualitative findings from the interviews provide more insight to the questions and goals of the research: What are the challenges faced by the public high schools regarding learning spaces? Evidence seen during the site visits and reported by the interviewees have been summarized in the three following dimensions: (1) lack of space and a need for space versatility, (2) ICT and active methodologies, and (3) sustainability

#### 3.2.1. Lack of Space and a Need for Space Versatility

The principals of the fifteen public high schools in Elche were interviewed, and they all insisted on the need for more space and space versatility. Even before the COVID-19 sanitary alert, the targeted schools were crowded. The principals argued that if the school had more space (indoor or outdoor) susceptible of being transformed to teaching-learning space under reasonable conditions, attention to diversity could improve, more programs could be added, and student ratio would be reduced in some groups, all of this is considered important for quality education (SDG4).

The need for more room is so great that any type of compartment is transformed into a learning space, and therefore versatility is a priority of space design. If spaces are versatile, a wider range of solutions are possible.

Principals claim that this problem is evident even from the first stages of a new facility. This is due to the existing gap between the official profile of class groups when the creation of a new school is proposed and the many possibilities of multiplying groups in attention to diversity once the school is operating. Principals explain that in order to avoid school drop-outs, many programs offer smaller settings that help students benefit from more direct instruction, and consequently, more spaces are needed. In this case, spaces do not necessarily need to be bigger but must have proper conditions to make them transformable. The COVID crisis has made this point even more critical, adding health issues.

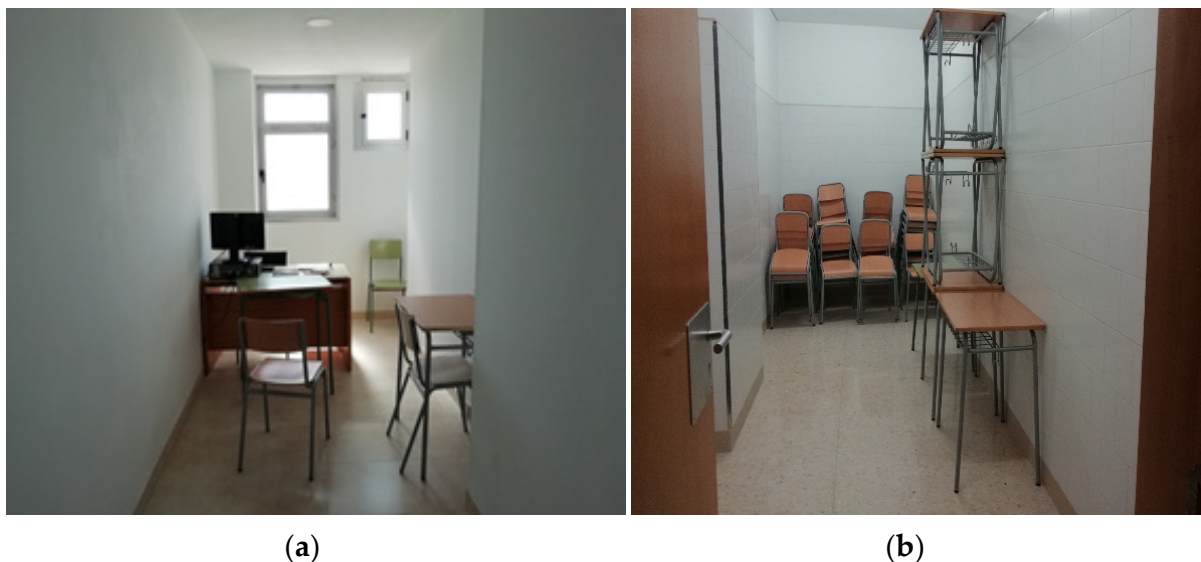
Figure 5a,b illustrates the use of a space that originally was not designed for learning. Transit areas, corridors, and corners under staircases are being used for co-working, reading, audio or video-recording, etc., thereby providing an opportunity for small groups of students to work together on self-oriented tasks.





**Figure 5.** (a) End of a corridor transformed into a classroom. (By IMontiel CC-BY-SA). (b) Transit area enabled for reading or co-working. (By IMontiel CC-BY-SA).

In some schools, even changing rooms and restrooms have been transformed into learning spaces. “It might not offer optimal conditions, but it is a solution for specific moments or activities” says Principal X, referring to the space illustrated in Figure 6a. This is only possible when light and ventilation conditions are appropriate (Figure 6a). Consequently, in support of versatility and flexibility, and in the interest of SDG3, we strongly discourage designing spaces without natural ventilation (Figure 6b), which was quite common in the buildings of the contemporary schools constructed after the year 2000 that we visited.



**Figure 6.** (a) Toilet transformed into a learning space. (By IMontiel CC-BY-SA). (b) Spaces without natural light or ventilation can only be used for storage. (By IMontiel CC-BY-SA).

It seems essential that the team of architects and planners that design a high school should have an insight into the operating programs of a school, and not only of the rigid technical standards that the educational administration provides to builders. This would offer more versatility and functionality, even in spaces that have not been originally planned

for academic use [41]. Greater knowledge of the real operating system of a high school could be gained with multidisciplinary workshops based on design thinking techniques and action research methods, as we have experimented with during the research. The participatory skills noted in the multidisciplinary design thinking workshops favor empathy, and greater insight into the users' needs (SDG11, SDG16, SDG17). However, engaging stakeholders in the participatory analysis is not an easy task. Tools such as the ones used in design thinking workshops [42–44] are not familiar to all: principals, teachers, students, families, architects, and especially to the local and regional administration. Apparently, it is deemed more urgent to build new facilities (to offer a quick solution to lack of space) than to carefully examine their functionality and sustainability prior to building (SDG11). We recommend that decision-makers invest more time and resources in understanding the needs of the users.

### 3.2.2. ICT and Active Methodologies

Traditional teacher-centered education is still dominant in the targeted schools, as derived from the interviews with the management teams during the visits carried out. However, active methodologies are being implemented, slowly but gradually. There is no doubt that multimedia technology is used for both student-centered and teacher-centered approaches. In the last decades, great efforts have been made in all countries to improve teacher training in emerging methodologies and to supply the schools with multimedia and ICT infrastructure [45–47] (SDG4, SDG9).

Onsite visits verify that all classrooms are equipped with one computer, projector, and loudspeakers. However, information from the interviews reveals that ICT and active methodologies are implemented in the learning process largely depending on the individual teachers. It should be stressed, though, that this is not a matter of only the teacher's will or teacher training. Teachers experience many challenges in the implementation of ICT in their classrooms due to several pitfalls. In the first place, although there is a computer in the classroom, very frequently the computer or the connection to the internet, projector, or speakers are not operating efficiently. Principals report a need for qualified "technical staff" to ensure the operation and maintenance of the installations; otherwise, it becomes an added task to the workload of the ICT teachers.

The new situation generated by COVID-19 after March 2020 strained and tested the methods used until then and urged for remote teaching-learning strategies, which required high levels of ICT infrastructure and digital skills. With all its difficulties and problems, the "New Normal" led to spectacular progress in the transformation of teaching and learning methodologies to remote and blended learning. From now on, above all, due to the COVID-19 pandemic, virtual and blended learning environments will have a significant impact. Connectivity and ICT should be enhanced and reinforced in the schools, and technical staff contracted in the interest of achieving SDG9. Educators participate in courses and in-service training and are aware of the benefits of transforming learning spaces for implementing a more updated teaching-learning process. However, there is a great gap between what teachers and school leaders learn in training courses and what is in their power to change. Principles of the high schools explain that budgets are always limited and that they face many bureaucratic obstacles if a space transformation is significant and requires consulting architects or engineers.

### 3.2.3. Sustainability

Findings of the study show there is a gap between the reality in present school design and new sustainable approaches present in the guidelines for Agenda 2030. SDG4, in its target 4.7, proposes rethinking all learning environments (virtual and physical) in order to transform learning, inspiring more student-centered approaches, collaborative decision making, global competencies, and accountability in terms of a more sustainable world. Although the holistic approach of sustainability that binds the environment, the economy and the society [48,49], detailed in the guide "Education for Sustainable Development:

A Road Map”, published by UNESCO in 2020 [50], is not yet widespread, it is definitely starting to develop. This “new” education follows the principles of recent reports and guides [48–53] in order to prepare students to behave as global citizens and train them to practice not only academic skills but also critical thinking and participatory techniques that will help them increase their abilities to solve problems, fostering cooperation. An example of the policies and recommendations passed on to all targeted schools by the regional education administration is the didactic guide delivered in May 2021 [51], encouraging teachers to implement cross-cutting activities in any subject, thus spreading knowledge about SDGs.

Moreover, it is agreed that the design of the educational building, including playgrounds, sports fields, access areas, plays an important role in transmitting the “hidden curricula” that reaches beyond written programs [5,54] and educates in energy efficiency, climate change, financial responsibility, care for nature, etc. [2,33]. Following is an example of some of the questions for gathering such information from each one of the schools:

1. Are renewable energies used for air-conditioning or heating systems? YES/NO
2. Are renewable energies used for hot water in the gym? YES/NO
3. Is there a system for greywater recycling and/or is there a system for rainwater harvesting for watering the school gardens? YES/NO
4. Are there systems or devices for reducing electricity consumption? (motion sensors, programmable timers, LED luminaires) YES/NO
5. Is recycling encouraged in the school curriculum with easy access to all types of containers: paper, plastic, glass, batteries, ICT waste? YES/NO

The answer to the first three questions was “NO” in 100% of the cases. A total of 86.7% of the schools presented inadequate conditions regarding the mentioned indicator about energy efficiency (see Table 2 “EFF”).

For operating the boilers for the heating system, conventional fossil fuel is used in 100% of the cases. An added difficulty is that the buildings are not provided with functional temperature zoning. Boilers are kept working at full capacity even when some areas of the building do not need to be heated.

Regarding the use of renewable energies, all principals refer to the existing barriers for the installation of photovoltaic panels; therefore, none of the fifteen schools use photovoltaic panels for the production of electricity or hot water heating. Hereby we cite a comment of one of the principals in 2018: “*The building is provided with a large flat roof, ideal for solar panels, we have asked for authorization for a photovoltaic installation but it has been denied by the Authorities*”. Although regulations in Spain are changing, the new high school, expected to be completed in 2022 at this stage and time, has not been designed with renewable energy systems either.

Furthermore, there is unanimity among the interviewees concerning the problems resulting from the insufficiency of electrical power. Many of the buildings, even those built after 2000, were not designed to address the needs generated by new technologies (sockets, pc, projectors, etc.) or the increase in electrical power required by the installation of air conditioning equipment.

Additionally, the study confirms the extended use of glass walls in the schools built after the year 2000 and the implications that this entails. These spaces do not benefit from natural ventilation, which makes it necessary to install air conditioning. When that is the case, the operation cost of the building in energy consumption increases. Yet, what is more significant is that deficient ventilation can cause health problems in the occupants of the room [6,55]. In fact, these spaces do not comply with the regulations included in PROTOCOL COVID-19 [56] (SDG3).

Several studies highlighted, even before the pandemic caused by COVID-19, the need for adequate environmental conditions in learning spaces [6,8,38,39,55]. During the academic year 2020–2021, the COVID-19 regulations for ventilation emphasized these requirements. The “guide for ventilation of classrooms” published in October 2020 (CSIC,



2020) states clear guidelines and concludes that the risk of infection is largely reduced when windows are opened, and rooms are ventilated [57].

There is a powerful concern on environmental quality and natural spaces, even stronger in the wake of the COVID crisis. We recommend considering the possibility of increasing outdoor learning spaces in order to benefit from the positive effects of nature and nature-inspired elements in learning environments [33,58–60], especially in the interest of SDG3, SDG6, SDG7, SDG11, SDG12, SDG13, and SDG15. Indoor environmental issues in educational buildings were already important [61–64] and now gain more significance [56,57]. Incorporating nature and ergonomic furniture into educational spaces provide benefits in reducing stress and improving respect for the environment [59]. We should design more natural, friendly, comfortable spaces that encourage civic, egalitarian, and conscientious behavior in teenagers. This is an important part of the hidden curriculum of new learning spaces and can be of great help in creating a positive, warm, and environmentally friendly educational climate [59,60,65,66].

Additionally, regarding vegetable gardens and their use as an interdisciplinary teaching tool for ESD, findings show that interest in these spaces is growing. However, the principals argue that it is difficult to integrate the academic goals of working the vegetable garden into the curriculum of high school subjects. Site visits indicate that the use of these spaces (Figure 7) is only punctual and very often limited to individual, enthusiastic teachers that adapt their program for a specific group and year but without continuity, maybe because they are transferred to a different school the following year or perhaps because they are required to teach a different subject.



**Figure 7.** Vegetable garden in one of the visited high schools. [IMontiel CC-BY-SA].

#### 3.2.4. Brief Reflection about Budgets and Sustainability

The economic world crisis of the beginning of the 21st century and now the sanitary crisis due to COVID-19 urges the need to optimize the economic investment made in educational spaces [54]. New spaces require a “pandemic-free” design with a view to future sanitary alerts.

Architects and designers, and especially the infrastructure departments of the educational administration, should bear in mind that once the construction works of a new school are finished, the principal (of a Spanish public high school) deals with a very limited budget for changes. Schools should be an example of sustainable design practices [40,51], aligned with SDG 12: “Ensure sustainable consumption and production patterns”. Clearly explained in Education for Sustainable Development: A Roadmap [50] (p. 28), “The entire learning institution needs to be aligned with sustainable development principles, so that learning content and its pedagogies are reinforced by the way facilities are managed and how decisions are made within the institution”. Well-designed, sustainable learning spaces require fewer expenses in terms of operating costs and promote responsible financial education [67].

Findings of the ongoing investigation about sustainable learning spaces prove that the design of the learning space should not come into conflict with the educational objectives of the institution [68] or the health and wellbeing of the users [8,40], requiring adaptations to make the facilities functional. However, we have experienced that it is not easy to communicate the pedagogical needs for a more updated teaching-learning process to the planners, architects, and decision-makers. Very rarely do these new constructions imply a participatory process. Nevertheless, we would like to underline that the ongoing investigation has proved productive as, due to discussion of these issues, participating members were able to integrate modifications in the layout plans of the new high school, even before the sanitary alert existed. Most of these amendments were associated with an increase of natural light and ventilation, and so the new instructions (GVA, 2019) [69] read: "... natural ventilation is increased opening windows to each one of the changing rooms" (p. 2); "window openings in order to allow direct natural ventilation in restrooms" (p. 3); "windows are added to light and ventilate areas of the cafeteria" (p. 3). These are the only modifications that findings of our investigation were able to contribute to the design of the building of the new high school. Although they are a small contribution, after COVID-19 ventilation instructions [58], by no means can these changes be considered a trivial matter.

We are optimistic with the Service-Learning experience provided to one of the high schools for co-creating a new outdoor learning space on a budget. A society that wishes to transmit to the younger generations an education for sustainable development understands that it is a task, not only of the educators, but of everyone's concern and even of the building design. The Service-Learning experience provided to one of the high schools as a solution is explained next.

#### 4. A Service-Learning Experience for Improving Learning Spaces on a Budget

This part of the article presents an example of a Service-Learning experience as a solution for extending spaces and sheds light to question 4): How can we use SL to address the change? We recommend this practice to other schools in similar situations. Following, some clues are presented to perform the change with a high guarantee of success towards the 2030 Agenda.

It is a common practice that public high schools transform their learning environments mainly through solidarity projects where students, teachers, and parents help. These changes are modest and low-profile and are mainly limited to paintings in transit areas, recycled furniture for libraries or for assembly rooms, or adapting outdoor areas for "formal learning". Under these circumstances, the principal of one of the high schools contacted the research team at University Miguel Hernández, seeking ideas for transforming and extending their own learning spaces with a tight budget. The participatory action research that had started in 2017, which had the double goal of creating knowledge for school planners and empowering stakeholders to act even if just small changes were in their power, was bearing its fruits.

The need of the high school was to design new outdoor learning spaces where developing an environmental project aligned with all the SDGs, implementing active methodologies even under the requirements of COVID-19. The research group, acting as a link, suggested a Service-Learning project between two schools: IES Severo Ochoa and the EASDA (vocational school of arts and design of Alicante). During the process, the high school agents (teachers and students) gathered ideas for transforming their learning spaces on a budget, and the vocational education students practiced their theoretical knowledge in a real-life situation by generating designs for the outdoor classroom required. Everything was carried out using a participatory approach, where students at both schools were involved in pursuing innovation in a democratic way. The research group at the university coordinated the experience, and a new learning space ("The BIO-CLASS") emerged.

Table 4 summarizes the relationship between SDGs, targets, and outcomes of the Service-Learning experience. This project covers 10 SDGs and 21 of the 2030 Agenda targets. Detailed information about the steps followed in the implementation of this experience is given next.



**Table 4.** SDGs and 2030 Agenda Targets covered, as well as outcomes of the Service-Learning project.

| SDG  | Target  | Outcomes  |
|--|---|---|
| 3. Health and Wellbeing                    | 3.4 Promote mental health and wellbeing.  | The BIO-CLASS guarantees protection against COVID-19. Provides natural ventilation and distance in a nature friendly learning space.  |
| 4. Quality Education                       | 4.1 Quality secondary education leading to relevant and effective learning outcomes.<br>4.4 Increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs, and entrepreneurship.<br>4.7 Ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles.<br>4.A Build and upgrade education facilities, inclusive and safe. | The teaching-learning approach used to co-create is an active methodology based on learning by doing with effective learning outcomes.  |
| 7. Energy                                  | 7.1 Access to affordable and modern energy services.<br>7.2 Increase renewable energy.<br>7.A Promote investment in energy infrastructure and clean energy technology.<br>7.B Expand infrastructure and upgrade technology.   | The BIO-CLASS is an expanded outdoor room that uses natural light and ventilation. If possible, solar panels will be added for charging devices.                              |
| 8. Economic Growth                         | 8.6 Reduce the proportion of youth not in employment, education, or training.   | The vocational students can include the project in their portfolio for future job interviews.   |
| 9. Innovation and infrastructure           | 9.1 Develop sustainable infrastructure.<br>9.5 Enhance scientific research.<br>9.C Significantly increase access to information and communications technology.  | The space will be technology rich and with WIFI access.   |
| 11. Sustainable cities and communities     | 11.6 Reduce environmental impact of cities.<br>11.7 Provide universal access to safe, inclusive, and accessible, green and public spaces.<br>11.C Use of local materials.   | Improvement of the recreation area with a green construction that promotes an attitude of caring for the environment.   |
| 12. Responsible consumption and production | 12.5 Reduce waste generation through prevention, reduction, recycling, and reuse.<br>12.6 Encourage companies, especially large (school infrastructure dept.) to adopt sustainable practices.   | Sustainable construction built mainly with recycled and reused materials and provided by students and local businesses.   |
| 13. Climate action                         | 13.3 Improve education, awareness-raising, and human and institutional capacity on climate change.  | Located in the SE of Spain, in a semi-desertic area, the BIO-CLASS is ideal for raising awareness on climate change.  |
| 16. Peace and justice                      | 16.7 Ensure responsive, inclusive, participatory, and representative decision-making at all levels.   | The participatory approach methods used for gathering ideas and taking decisions educate the students in responsibility and democracy.  |
| 17. Partnerships                           | 17.16 Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology, and financial resources.   | In order to reach global partnerships we must learn to start with alliances with close, local entities.<br>Both schools also participate in international Erasmus + programs. |

Following, we will describe in detail the Service-Learning project undertaken to improve spaces at IES Severo Ochoa.

#### 4.1. The Beginnings

In 2018, EASDA, school of arts and design, with vocational students (ages 18 to 25) engaged in a project called “*Action in the Entrance Hall: An Informal Learning Environment for Interaction between Students and Faculty*”. Vocational students and teachers were the primary actors and decision-makers of the refurbishment of the entrance hall, and with a little financial support from the university, they carried out their renovation. Figure 8 illustrates the final view of the EASDA hall after the project implementation.



**Figure 8.** Refurbishment undertaken by vocational students at EASDA school.

Meanwhile, high school IES Severo Ochoa was participating in projects with younger students (12–16 years old) related to active methodologies, ICT, or project-based learning and was already using outdoor spaces as an extension of “classrooms” under very basic conditions (Figure 9). Both schools were active in innovation and thus considered ideal for a partnership for improving learning spaces through a Service-Learning project.



**Figure 9.** High school outdoor space used for leisure and for formal learning before the Service-Learning project.

#### 4.2. The Way

Steps carried out for the implementation of the project through the alliance of the aforementioned schools (illustrated in Figure 10):

- During September 2020, the research team contacted EASDA in order to share the proposal formulated by IES Severo Ochoa. A pair of virtual meetings were enough to

contact leaders first and professors later, and so to promote a visit to the IES in order to find the peculiarities and needs of the high school in situ.

- In October 2020, EASDA students and teachers, together with two members of the university research team, visited the high school IES Severo Ochoa and participated in a design thinking workshop with fourteen 16-year-old students registered in the 4th year high school subject “Scientific Culture”. This group was prepared to initiate an educational project on sustainability. Two teachers at the high school and the principal also took part in the workshop. Due to the limitations of COVID-19, the number of vocational students during the visit was reduced to six participants, and active techniques used in design thinking workshops [39] that require moving around were restricted for sanitary reasons. However, the brainstorming for needs and solutions proved a success of participation, the EASDA students as “consultants” took notes and pictures of the spaces they were to work on, and the high school students felt they could express their needs and opinions in front of real future “designers”, teachers, and their own principal. *“It was a feeling of being empowered”* reported one of the teachers.
- In November 2020, back at the school of arts, information was transferred to the rest of the participants (vocational students and instructors). EASDA students, as “experts”, designed and prototyped ideas on the subject of “Interior Design and Project Management”. This work was incorporated by the professors at the school of arts into the curriculum of the first semester as part of the portfolio that would be used and evaluated as the final project of the semester. A total of 15 EASDA students participated, coming from two degrees, mostly individually, and nine of them (from the lowest school level) forming a unique team (seven projects were developed).
- In December 2020, seven models were presented to a board of evaluators formed by two members of the research team of the university, the principal of IES Severo Ochoa, and five professors of the EASDA. This time the interaction was all virtual and technology-based due to the sanitary lockdown. The model called “BIO-CLASS” (Figure 11) was chosen by the jury to be implemented, attending the main preferences of the principal of the high school, who was, without doubt, the person most in tune with the needs of the IES.
- In January 2021, the winning project was presented to the high school students, who evaluated it regarding the rubric prepared by teachers and researchers (basically how sustainability had been integrated into the project). The presentation also served as an excuse to assess their learning about the various types of materials and energy sources used in the design of the BIO-CLASS and studied during the course. The mean grade given by the students to evaluate the project was 4.2 on a scale of 1 to 5. The high school students will also participate in the gathering of recycled materials that will be used in their BIO-CLASS. During the spring and summer of 2021, the “BIO-CLASS” will be set up and will be ready to use as an extra learning space in September 2021 with an approximate cost of EUR 3000, using small local industries and the advice of a chartered engineer.
- In March 2021, vocational students concluded their Service-Learning experience, and before they started internships in businesses and companies to complete their vocational studies, the EASDA school organized an award ceremony. All students (15) received a gift and a certificate for participating in the Service-Learning project as “consultants”, plus the student whose project was chosen by the high school (“the client”) received from EASDA an economical bonus of EUR 100. Being a “real life” project, the experience can be used for their portfolio when seeking a job after graduation.

|   |                        | Academic Year 2020-21<br>UMH-EASDA-IES SEVERO |                |                              |                              |                |                  |
|---|------------------------|---|----------------|------------------------------|------------------------------|----------------|------------------|
| ACTIONS                                 | 2017-2019              | SEP 2020                                      | OCT 2020       | NOV 2020                     | DEC 2020                     | JAN 2021       | MARCH 2021       |
| UMH Workshops, Projects & Programs      | At UMH and several IES |   |                |                              |                              |                |                  |
| First meetings with teachers. Planning. |                        | Virtual                                       |                |                              |                              |                |                  |
| Visits & Design Thinking                |                        |   | On site at IES |                              |                              |                |                  |
| Project Development                     |                        |   |                | Blended and on site at EASDA |                              |                |                  |
| Presentation & Evaluation               |                        |   |                |                              | Virtual and on site at EASDA |                |                  |
| Presentation to Users                   |                        |   |                |                              |                              | On site at IES |                  |
| Award Ceremony                          |                        |   |                |                              |                              |                | On site at EASDA |

Figure 10. Timeline of the Service-Learning project to design an outdoor classroom at IES Severo Ochoa High School, Elche, Spain.



Figure 11. Winning project designed by vocational students to be implemented as an outdoor classroom at IES Severo Ochoa High School, Elche, Spain.



As soon as the new BIO-CLASS is built, the research team will proceed with its evaluation of the pedagogical and sustainability use.

This Service-Learning experience proved satisfactory for all participants. In the words of the coordinator of the project at EASDA, *“We are delighted to share these experiences, and the final result has been very satisfying both for the students and for the school. Please, count on us to participate in other similar projects”*. It is *“real-life”* learning for all involved, and *“we are aware that, although this is a small step towards action, for teachers, students and parents it mitigates the feeling of powerlessness”*, says the high school principal. In other words, the project helps the stakeholders believe that change is possible, thus fulfilling the goals and targets of Agenda 2030. The project highlights positive effects on learning spaces as a result of the collaboration of three institutions (UMH with the research team—EASDA with vocational students—IES with compulsory students) in finding solutions to extending and transforming learning spaces with very limited budgets. The project implemented active methodologies, raised awareness on SDGs, and on sanitary needs caused by COVID-19. In addition, it created a meaningful field experience opportunity for vocational students eager to practice their technical knowledge, delivering a design model that will be implemented in a real-life situation adjusted to a very tight budget.

## 5. Conclusions

The findings of our investigation reveal that more communication between the planners of learning spaces and users would facilitate new ways of learning and working in line with co-creating spaces on a budget. However, improving communication between planners, designers, and users is not an easy task. There are many difficulties that are beyond the scope of this paper in order to incorporate participatory methods in the design of learning spaces. We found these participatory techniques easier to carry out for the renovation of spaces in schools that are already functioning than for the design of new buildings. In this sense, the Service-Learning experienced by IES Severo Ochoa supports one of the beliefs required for transforming learning spaces: start small but start [70]. It also proves that renovating spaces does not always have to be costly; it is possible to start with recycled or inexpensive materials. This experience can be extended to other learning spaces that may require different Service-Learning projects not directly related to interior design, such as academic use of vegetable garden space in high schools.

In second place, we understand that many principals, leadership teams, and teachers that are willing to innovate find there is a great gap between what they learn in courses and in-service training and what is in their power (and budget) to change. We recommend finding alliances with universities and other local organizations in order to potentially start a small Service-Learning project, but that will surely open a path towards an education more hand-in-hand with sustainable development.

Finally, more empirical research is needed to follow up and evaluate sustainable learning spaces such as the *“BIO-CLASS*, result of a Service-Learning participatory process with a budget of only EUR 3000. However, we wish to highlight that in education for sustainable development, high-profile, costly, public learning spaces (more than EUR 11 million have been allocated for the construction of the new high school) [71], should be evaluated, even more so, in order to blend-in educational objectives with the hidden curriculum of the space designed.

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