education sciences

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Outdoor STEAM Education: Opportunities and Challenges

Marisa Correia [1,2,*], Teresa Ribeirinha [1,2], David Beirante [1,2], Raquel Santos [1,2], Liliana Ramos [3,4], Isabel Simões Dias [2,5], Helena Luís [1,2], David Catela [2,3], Sónia Galinha [1,2], Ana Arrais [1,2], António Portelada [1,2], Paula Pinto [6,7], Vera Simões [3,4], Regina Ferreira [2,8], Susana Franco [3,4] and Maria Clara Martins [1,2]

1 School of Education, Santarém Polytechnic University, 2001-902 Santarém, Portugal; teresa.ribeirinha@ese.ipsantarem.pt (T.R.); david.beirante@ese.ipsantarem.pt (D.B.); raquel.santos@ese.ipsantarem.pt (R.S.); helena.luis@ese.ipsantarem.pt (H.L.); sonia.galinha@ese.ipsantarem.pt (S.G.); ana.arrais@ese.ipsantarem.pt (A.A.); antonio.portelada@ese.ipsantarem.pt (A.P.); clara.martins@ese.ipsantarem.pt (M.C.M.)
2 Life Quality Research Center, 2040-413 Rio Maior, Portugal; isabel.dias@ipleiria.pt (I.S.D.); catela@esdrm.ipsantarem.pt (D.C.); regina.ferreira@essaude.ipsantarem.pt (R.F.)
3 Sport Sciences School of Rio Maior, Santarém Polytechnic University, 2040-413 Rio Maior, Portugal; lilianaramos@esdrm.ipsantarem.pt (L.R.); verasimoes@esdrm.ipsantarem.pt (V.S.); sfranco@esdrm.ipsantarem.pt (S.F.)
4 Sport Physical Activity and Health Research & Innovation Center, 2040-413 Rio Maior, Portugal
5 School of Education and Social Sciences, Polytechnic University of Leiria, 2411-901 Leiria, Portugal
6 Agriculture School, Santarém Polytechnic University, 2001-904 Santarém, Portugal; paula.pinto@esa.ipsantarem.pt
7 Research Centre for Natural Resources, Environment and Society, 3045-601 Coimbra, Portugal
8 Health Science School, Santarém Polytechnic University, 2005-075 Santarém, Portugal
* Correspondence: marisa.correia@ese.ipsantarem.pt

Abstract: There is a consensus that students should be involved in interdisciplinary activities that promote a solid education in STEAM subjects from an early age. The outdoor settings of schools present an advantageous context for STEAM education, allowing for a myriad of learning experiences. To understand how teachers perceive the pedagogical use of the school's outdoor space, a study was carried out in a cluster of schools in a Portuguese city, including one middle school and 10 kindergarten and elementary schools. A mixed methods approach was used, combining a questionnaire for teachers (N = 49) with interviews (N = 8). The results indicate that teachers' perceptions of the characteristics of their school's outdoor spaces either facilitate or hinder the implementation of outdoor pedagogical activities. Most teachers concur that the outdoors provides contact with nature and encourages interdisciplinary and collaborative activities. However, the teachers surveyed admit to using the school's outdoor spaces only occasionally, and this use decreases as the educational level at which they teach increases. The most common use of outdoor spaces is for physical and motor activities, promoting the well-being of children and youth. Although interdisciplinary activities in outdoor spaces are recognised, their implementation is limited and hampered by factors such as the length of curricula and the lack of training for teachers in these approaches. In this sense, there is an urgent need to train teachers in the interdisciplinary use of outdoor spaces to promote a solid education in STEAM subjects.

Keywords: outdoor learning; STEAM education; teacher education

Citation: Correia, M.; Ribeirinha, T.; Beirante, D.; Santos, R.; Ramos, L.; Dias, I.S.; Luís, H.; Catela, D.; Galinha, S.; Arrais, A.; et al. Outdoor STEAM Education: Opportunities and Challenges. *Educ. Sci.* **2024**, *14*, 688. https://doi.org/10.3390/educsci14070688

Academic Editor: Amber Simpson

Received: 10 May 2024
Revised: 19 June 2024
Accepted: 19 June 2024
Published: 24 June 2024

1. Introduction

Addressing pressing contemporary challenges, particularly those related to nature, such as climate change and sustainable food and energy production, as well as healthcare for a growing global population, requires a holistic educational approach capable of connecting different concepts and knowledge [1]. STEAM (science, technology, engineering, arts,

mathematics) education has therefore been recommended for this purpose from the earliest ages [1–4].

Outdoor education has also been gaining prominence, particularly with the growing concern over levels of obesity and sedentary lifestyles among young people [5]. Furthermore, combining physical activity, digital exploration, and outdoor play can motivate and enhance learning [6]. The lessons drawn from the pandemic crisis underscore the unnecessary reliance on traditional educational settings. That period has not only highlighted the significance of digital resources but has also prompted a re-evaluation of outdoor spaces as valuable environments for learning [1]. Consequently, there is a growing recognition of the need to expand the learning environment beyond the classroom walls.

Outdoor spaces and natural areas such as gardens and schoolyards are resources that can complement classrooms, as they provide a meaningful context for outdoor education, enabling numerous informal and formal learning experiences [7]. Nevertheless, in comparison to other educational settings, schoolyards are used less frequently for the learning process [8]. An integrated approach, combining outdoor learning and STEAM education, represents quite a challenge for school communities, especially because "teachers tend to teach content skills in an isolated manner" [2] (p. 205).

To better support pre- and in-service teachers in developing outdoor STEAM learning experiences, this research aims to determine inhibiting factors and opportunities for this integrated teaching approach through teachers' perspectives. Investigating this type of phenomenon demands a comprehensive approach that transcends disciplinary boundaries. Recognising this, a dedicated team consisting of researchers from different schools within the Santarem Polytechnic University was formed. This diverse expertise ensures a well-rounded exploration that integrates insights from education, physical activity, and healthy lifestyles.

2. Theoretical Framework

The foundations of STEAM education emerged in the 1990s, in the USA, through the efforts of the National Science Foundation (NSF) with the term SMET (science–mathematics–engineering–technology) and gained greater visibility in the subsequent decade with the expansion of the acronym for STEM, integrating two or more of the disciplines [9,10]. It should be noted that 'Arts' brings together the field of humanities, such as visual and plastic arts, design, literature, psychology, sociology, philosophy, and history, among others [11]. The integration of 'Arts' allows students to make their involvement more effective in a holistic, sensitive, creative, and thinking approach [12].

STEAM education enables the development of varied cognitive and technical skills, as well as intrapersonal and social competencies, fostering self-regulation, efficient communication, healthy relationships, and the ability to make decisions and solve problems [13]. In this way, STEAM education considers students as an active part in the educational process, allowing for the development of autonomy in different types of learning situations. Kang [14] notes that the effects of STEAM experiences are positive on cognitive and affective development. According to Lindeman et al. [15] and McClure et al. [16], the period between infancy and the third grade is crucial for the development of STEM-related thinking dispositions, such as curiosity, investigation, evaluation, and analysis. STEM education offers students contextualised and authentic real-life settings to observe, investigate, and collaborate with others to solve meaningful problems. As such, early STEAM education will also help give students a learning mindset and confidence in the face of challenges.

Despite long-standing concerns about childhood obesity, efforts to address the problem have been insufficient [5]. In recent years, numerous experts have advocated for outdoor activities not only for health and well-being but also to enhance student's engagement in learning [17–19]. For instance, a study conducted in Portugal found that the COVID-19 pandemic led to a decline in physical activity and motor skills, highlighting the importance of adopting active learning in outdoor spaces [20]. Indeed, motor activities in outdoor contexts afford interdisciplinarity and transferability among different disciplinary fields because

they enhance contextualised learning. Non-linear methods, such as guided discovery and problem solving, can reinforce a student-centred learning process, allowing interconnections between motricity, cognition, emotion, and social competences [21]. One particularly relevant example is the activity of orienteering, which requires the capacity of wayfinding certain locations, in an unknown place, using a map (or a tool that has the same functions as a map) and, eventually, complementary instruments, such as a magnetic compass. Because orienteering is an outdoor activity that involves travel and enables nature observation, it fosters connections among various disciplines such as physical education, geography, natural sciences, mathematics, or visual arts, at different educational levels [22–24]. This activity can be also used in teacher education [25], fostering positive student interest when the disciplines are effectively integrated, and teachers are adequately prepared [26,27]. Additionally, the integration of outdoor education with digital tools offers benefits to both students and teachers. Using screen time to promote green time can encourage engagement with nature, while physical activity can motivate outdoor science exploration, ultimately enhancing learning through digital exploration and outdoor play [6].

These innovative and active approaches present numerous opportunities and challenges for educators. For instance, difficulties in integrating STEAM content and strategies into school curricula may arise from the lack of confidence of teachers, limited resources, and time constraints [28]. Furthermore, as mentioned earlier, another important challenge is that this interdisciplinary approach involves integrating content from at least two disciplines. According to studies such as those by Brown and Bogiages [29], this has proven to be a major difficulty for teachers in terms of planning and implementing learning activities. In addition to these difficulties, there are challenges associated with outdoor learning. While this approach offers a conducive environment for integrating subjects like mathematics and technology [30,31], studies such as Dyment's [30]. have shown that teachers primarily use outdoor activities to teach science or physical education.

Continuous professional development is essential to overcome these obstacles and effectively integrate STEAM activities from preschool onwards [28]. Tulling et al. [32] also emphasised that teacher education should pay more attention to using outdoor learning in their daily teaching practice. Therefore, it is important to understand teachers' perceptions of the challenges and opportunities of these approaches. Numerous studies have addressed this aspect regarding outdoor learning with pre-service teachers [33] and in-service teachers [34–43]. However, only a limited number of studies have delved into understanding teachers' perceptions of outdoor learning for STEAM education [2,4,44] with the majority focusing on early childhood education contexts. Thus, to advance knowledge in this field, the main aim of this research is to describe kindergarten, elementary, and middle teachers' perspectives regarding STEAM outdoor education. To accomplish this, two research questions were formulated:

1. How do teachers perceive the pedagogical use of outdoor spaces?
2. What specific activities do teachers implement in outdoor spaces, particularly within the framework of the STEAM outdoor education approach?

3. Materials and Methods

In the present study, a mixed methods approach with a sequential exploratory strategy was applied to the empirical research process [45]. This methodological option is not only particularly suited to the development of new survey instruments, but also assumes that the interaction between methods will provide better analytical opportunities and provide more robust answers to the initial questions [46]. However, it is recommended that themes or issues are shared between the different techniques, thus ensuring the unity of the research design and increasing the level of their integration [45].

For this study, the sample consisted of a school cluster from the city of Santarém (Portugal), including one middle school and 10 kindergarten and elementary schools. Data were collected in two main phases: (1) semi-structured interviews; and (2) the development and distribution of a self-filled online questionnaire. The first phase of the research

consisted of eight semi-structured interviews with kindergarten (3–5 years old), elementary (6–9 years old), and middle school teachers (10–12 years old) from the school cluster.

The interviews were conducted in accordance with a pre-established protocol (see Appendix A.1), which encompassed two distinct dimensions: (1) perceptions of the use of outdoor space and (2) teaching practices within an outdoor space. Dimension (1) encompasses the attitudes, beliefs, and experiences of individuals regarding the utilisation of outdoor space. It aims to understand the viewpoints of educators about outdoor space and its role in their daily activities. Dimension (2) seeks to capture how outdoor spaces are used for educational purposes and their effectiveness in enhancing pupils' learning experiences. It focuses on the strategies and activities used by educators when teaching outdoors.

A purposive selection method was employed for the interviewees, with the intention of ensuring that a representative sample of the population was included. All the teachers who participated in the interview had volunteered to do so. The interviews were conducted in person, with two kindergarten teachers, two elementary teachers, and four middle school teachers (two of them at the time of the interview were working in elementary schools—T5 and T6). One of the selected middle school teachers was also the director of the school cluster (T8). The average duration of the interviews was 40 min, and they were audio-recorded with the consent of the participants. Table 1 summarises the biographical data of each participant. Most of the interviewed teachers are based in schools located in the urban area of the city, with only two teaching in schools situated on the outskirts of the urban area (peri-urban).

Table 1. Sample of teachers subjected to interviews.

Participant	School	Gender	Degree	Teaching Degree	Years' Teaching Experience
T1	Urban	Female	BSc	Kindergarten	>30
T2	Urban	Female	Master	Kindergarten	>30
T3	Urban	Female	Master	Elementary	>30
T4	Urban	Female	Master	Elementary	>30
T5	Urban	Male	BSc	Middle School	>30
T6	Urban	Female	BSc	Middle School	<30
T7	Peri-urban	Male	BSc	Middle School	>30
T8	Peri-urban	Female	BSc	Middle School	>30

Following the transcription of the interviews, a thematic content analysis was conducted. The Braun and Clarke [47] six-phase framework was employed for the thematic analysis. The six phases were as follows: (I) Familiarisation with the data, which involved a deliberate immersion in the data to become familiar with its content in depth and breadth. This immersion involved repeated readings of the data in an active search for meanings and patterns. (II) The generation of initial codes. The codes identified an aspect of the data (either latent content or semantic content) that initially seemed to be of interest to the researcher. The coding was conducted manually, and interesting aspects were identified that could form the basis of repeated patterns (themes). The coding process enabled the data to be organised into groups that brought together meanings. (III) The search for themes. At this stage the various codes were categorised into potential themes. The researcher began by analysing the codes and considering how different codes could be combined to form an overarching theme. (IV) A review of the themes. The primary objective of this phase was the refinement of the themes. The refinement process entailed considering the data contained in the themes in a manner that would demonstrate a commonality between them, while maintaining clear distinctions between each theme individually (internal homogeneity and external heterogeneity). (V) The definition of the themes. At this stage, the essence of what each theme deals with was identified, namely, what aspect of the data each theme captures. And (VI) the write-up, a concise, coherent, and logical description of the data story, with sufficient data extracts to demonstrate the prevalence of the theme.

The findings of this analysis are presented in this paper and were utilised not only in the development of the research instrument employed in the subsequent phase, but also to help elucidate the quantitative results.

In the second phase of the research, a questionnaire was developed using the themes that emerged from the interviews and relevant theoretical frameworks [38,48]. In addition to characterising the participants, the questionnaire was organised into the following dimensions: (1) perceptions of the pedagogical use of outdoor spaces, including characterisation, opportunities, and challenges; and (2) outdoor activities, including types of activities carried out by teachers in outdoor spaces. Regarding the sub-dimension of characterisation, the objective was to evaluate outdoor spaces based on several key characteristics, including their overall appearance, size, accessibility, security, and the availability of resources. The opportunities sub-dimension refers to teachers' perceptions of the potential for pedagogical use and enhanced learning offered by the school's outdoor spaces. The challenges sub-dimension identifies potential difficulties in the pedagogical use of outdoor spaces and explores the challenges faced by teachers, such as institutional constraints, lack of resources, or safety concerns that may affect the use of these spaces. Finally, the types of activities sub-dimension focus on the activities that teachers undertake in the school's outdoor spaces. These activities include STEAM experiences, research projects, playful activities, and other pedagogical practices that can be implemented outdoors (for the components in each sub-dimension, see Appendix A.2).

The questionnaire consisted of 10 questions to characterise the participants and 70 closed questions (single or multiple) with the option of "other(s)" and "which one" to allow the collection of new opinions and to avoid conditioning the answers. In 50 questions a 5-point Likert scale was used, ranging from 1 (strongly disagree) to 5 (strongly agree), to indicate the degree of agreement with certain statements. The use of a five-point Likert scale is supported by the notion that (i) as the number of points on the scale increases, the complexity of the respondent's choice and the discrimination between each response option increases [49]; (ii) scales with few response categories may not allow for a sufficient discrimination between respondents' opinions [50]; and (iii) five-point scales are sufficient, as no gain in reliability has been observed for scales with more than five items [51]. In 12 questions, the scale ranged from 1 (never) to 5 (always) to determine the frequency of teachers' practice. In addition, three open-ended questions were included, which were not mandatory given the exploratory nature of the research.

The questionnaire was designed to be self-filled online using SurveyMonkey©. Once developed, its content and form were validated by considering the following aspects [52]: (1) the opinion of a panel of experts with recognised work in the field of outdoor and/or STEAM education (educational practice and academic research) and (2) carrying out a pre-test with some volunteer educators/teachers by sending the link to the questionnaire (https://pt.surveymonkey.com/r/CNSVSVH, accessed on 19 June 2024) by electronic mail, accompanied by an informative text asking for feedback and suggestions on the questionnaire. The questionnaire was reformulated according to the received feedback. And the final questionnaire was distributed online to all kindergarten, elementary, and middle school teachers in the selected group of schools. Out of a total of 166 teachers in the school cluster, 49 responded to the questionnaire (40 females, nine males, with an average age of 54 years), distributed as shown in Table 2. Despite the low response rate, which persisted even after a second round of email communication to boost participation, the data collected were integrated with a more in-depth analysis derived from the interviews.

In terms of academic background, most participants have a bachelor's degree (77.6%), followed by those with a master's degree (18.4%). Only a small percentage hold a doctorate (2%). About 30.6% of the participants have a postgraduate degree or specialisation. Among those with a postgraduate qualification, special education (60%) is the most reported specialisation. In terms of teaching experience, the sample ranged from 15 to 44 years, with an average of 30.18 years (SD = 8.06). In terms of the level of education they teach,

the most common level is elementary (42.9%), followed by middle school (38.8%) and kindergarten (28.6%).

Table 2. Questionnaire respondent characterisation.

School Level	Population	Participants	% of Participation	Sample Representativity	Global Representativity
Kindergarten	18	11	77.78%	22.44%	6.62%
Elementary	45	18	40%	36.73%	10.84%
Middle School	91	12	13.18%	24.49%	7.23%
Special Education	12	8	66.67%	16.33%	4.82%
Total	166	49		100%	29.52%

To analyse the statistical significance of these results, we used the binomial test (SPSS, version 20.0.2.0 IBM Corp., Chicago, IL, USA), splitting the answers into two categories: one comprising 'totally disagree/disagree' and 'neither agree nor disagree' (cat. ≤ 3), and the other including 'totally agree/agree' (cat. > 3). The deliberate choice to include the answer 'neither agree nor disagree' in the first category is justified by its clear distinction from the set of answers that show total or partial agreement. In fact, these last two categories of answers provide a more robust and reliable picture of the trend observed. We opted, however, to keep the 'neither agree nor disagree' category in the survey to avoid an excessive polarisation that would only include more extreme responses, without covering an intermediate level of intensity in the respondents' opinion. However, the priority was to ensure the statistical significance of the strongest categories of agreement, which justifies the decision to set the cut-point at the separation between the first three categories and the other two. According to Marôco [53], this so-called "dichotomisation function" is particularly useful when the variable under study has more than two classes (five classes in this case), and it makes sense to define the limit at which the observations fall into one of the two classes.

The open-ended questions were subjected to a categorical content analysis based on the categories that emerged from the data.

4. Results

This section presents the results of the interviews and the teacher questionnaire. It is organised according to the sub-dimensions of the questionnaire, namely, the characterisation of the school's outdoor spaces, pedagogical opportunities of outside school spaces, challenges of outside school spaces, and outdoor activities.

4.1. Outdoor Spaces: Characterisation, Opportunities, and Challenges

4.1.1. Characterisation of the School's Outdoor Spaces

(a) Analysis of the school director interview

The school director (T8) provided a comprehensive overview of the school cluster, which is made up of 10 schools: the main school, which is a middle school, seven elementary schools, and two kindergartens. The middle school has 4.5 hectares of woods, landscaping, activity yards, sports areas, and semi-sports areas. These include ball fields without the regular dimensions or markings, or any other limitations, where the children play freely.

The school director highlighted that this school is ideally suited to the pursuit of scientific and technological activities, given its ample 4.5 hectares of land. This allows for the implementation of a wide range of educational programmes and initiatives. The external environment is open to the possibility of undertaking projects and obtaining funding, with the objective of ensuring that educational provision is aligned with current realities. This may involve teaching classes and pupils of all aspects, with a particular focus on the STEAM curriculum. Regarding the other schools of the cluster, not all elementary schools have large outdoor spaces and trees. Some schools lack adequate outdoor space,

with limited landscaping and organised areas. This can result in a lack of dedicated space for specific activities, which can ultimately lead to a lack of structured learning opportunities.

(b) Analysis of the closed-ended responses to the questionnaire

The evaluation of the outdoor spaces in the school cluster reveals a predominantly positive view on the part of the teachers. A total of 65.3% (n = 32) agree that these spaces are well maintained and pleasant. Furthermore, a clear majority of 83.7% (n = 41) consider that the size of these spaces is appropriate for the number of users, while 71.4% (n = 35) state that they are accessible to all children/young people, including those with special needs. It is also important to note that 63.3% (n = 31) consider the safety conditions in outdoor spaces to be adequate. However, about half of the teachers, 55.1% (n = 27), agree that there are areas in outdoor spaces that provide protection from the sun, rain, or bad weather, compared to 44.9% (n = 26) who disagree or have no opinion. Finally, a substantial number of teachers, 32.7% (n = 16), do not have a definite opinion on the presence of material resources accessible and manipulable by children/young people, while 20.4% (n = 10) mention the absence of these resources. On the other hand, almost half, 46.9%, (n = 23), recognise that outdoor spaces are equipped with such resources.

After carrying out an inferential analysis of statistical significance, it can be concluded that for the characteristics 'overall appearance', 'dimension', 'accessibility,' and 'safety' (the latter refers only to adequate safety conditions), the percentage of teachers who chose the categories 'agree' and 'strongly agree' (cat. > 3) is significantly higher than 50% ($p < 0.05$, N = 49) (Appendix B.1). This means that these features are significantly recognised by most teachers. Regarding outdoor areas that provide protection from the sun, rain, or bad weather, there is a clear division between the responses given, which may be influenced by the school where each respondent teaches. The percentage of individuals who acknowledge that outdoor spaces have material resources that are accessible and manipulable is not significantly different from those who do not express an opinion or who disagree ($p = 0.560 > 0.05$, N = 49).

4.1.2. Pedagogical Opportunities of Outside School Space

(a) Analysis of the interviews

All teachers refer to the possibility of using outdoor spaces as a learning context in all content areas. The most common idea among kindergarten, elementary, and middle school teachers is that the outdoors is a more challenging space, where well-being is more often observed and with a greater potential for a connection with nature, as demonstrated by the following statements: "It creates more relaxation because they are in a more informal space and can enjoy everything that the outside environment offers them, the breeze, the sounds, the colours and the opportunity to move more freely" (T4). Elementary and middle school teachers refer to the opportunity for children to change their posture, release energy, and move their bodies in a context of greater freedom. But it is also a context in which children are better able to control their posture and regulate their behaviour.

Although almost all of them mention the possibility of working in all the content areas in which they teach, some teachers highlight the areas of expression (physical–motor, dramatic, plastic) as the ones that are most worked in an outdoor space. This is because the outdoors allows the development of skills that are sometimes not worked indoors, such as motor skills, autonomy, and socialisation.

When referring to practices that can be adopted to create meaningful learning activities in the outdoor environment, all teachers mention practical and sensorial activities, and exploratory, interdisciplinary, and playful activities. They highlight some examples that are more related to their teaching area or experience, as the following statements show: "Children have a great need for concreteness, so going outside to measure lengths and widths to calculate areas makes it easier because it's more realistic" (T5); or "Outside we do things that are more practical, more playful, through games and group work, like a Peddy-paper with numerical operations" (T3).

(b) Analysis of the closed-ended responses to the questionnaire

Regarding the pedagogical opportunities afforded by the school's outdoor spaces, it is notable that a significant majority of respondents express a positive view. A total of 61.2% (n = 30) of teachers indicated that these spaces are conducive to the development of a variety of activities that stimulate different skills, including scientific, performative, sporting, and health activities, among others. Furthermore, 71.4% (n = 35) of respondents agreed that they allow interdisciplinary activities and work to be carried out. Finally, 61.2% (n = 30) of respondents agreed that they promote the development of inclusive environments. Furthermore, 67.3% (n = 33) agree that they facilitate contact with nature, offering garden spaces, forests, vegetable gardens, and areas for observing local fauna and flora. Additionally, 64.6% (n = 31) agree that they stimulate students sensorially, promoting their development at both a cognitive and emotional level, encouraging exploration and curiosity. Finally, a significant majority, 81.3% (n = 39), consider that these spaces allow collaborative activities to be carried out.

In terms of the potential of outdoor spaces, carrying out 'interdisciplinary activities and work', 'contact with nature', and the promotion of 'collaborative activities' were the responses that showed statistically significant proportions of agreement from the teachers ($p < 0.05$, N = 49 and N = 48 respectively) (Appendix B.2).

4.1.3. Challenges of Outside School Spaces

(a) Analysis of the interviews

When asked about the reasons for not using outdoor space, some respondents indicated that this space is not always equipped with the necessary resources to facilitate multiple learning activities. Weather conditions are one of the factors mentioned for not carrying out outdoor activities. Teachers also note that the organisation and management of the curriculum, involving multiple teachers contributing different components and the fragmentation into different subjects, makes it more difficult to manage the time for outdoor activities (which teachers think take more time). External constraints such as an extensive curriculum and non-efficient leadership were also referred to by the teachers. Teachers also highlight the use of strategies such as the need to "write everything in the notebook", which can limit the potential for going outside.

The responses of two of the teachers interviewed express some of the limitations felt in the use of outdoor space:

> *"Sometimes we lack ideas on how to delimit or define practices that are interesting for the students and that include the content we want to address. We do not have much time to think about these things. The curriculum is extensive, the outdoor activities are a bit out of our control, and we often avoid them. The students are very used to a typical way of teaching and learning and often when you do something different, they do not understand very well what you want them to do, so going outside is also a difficulty."* (T5)

> *"Being outdoors requires more preparation, in the classroom they arrive and already know their space and the rules, when they go to space the rules change, some children overflow, there has to be more preparation for everything to go well. If there is a routine, they begin to understand the dynamics and what is expected, but if it is punctual, then it requires more preparation. I have not received any training in this area, and I am not sure how to implement these practices without first observing how they are carried out or having colleagues who are interested in these dynamics."* (T6)

The school director's perception of this issue is that societies and parents' view of learning is still very 'traditional', and there is some resistance from parents if they do not identify with what has been taught. Parents are a problem when it comes to innovation; they are very resistant to working differently, in the classroom or elsewhere in the school.

(b) Analysis of the closed-ended responses to the questionnaire

When it comes to the factors that limit or inhibit pedagogical practice in outdoor spaces, teachers' opinions vary considerably. For example, 71.1% (n = 32) disagree that normative or regulatory restrictions are an obstacle. On the other hand, there was a

clear division of opinion among the respondents regarding curriculum extension. While 40.0% (n = 18) disagreed with the idea that the time spent on activities was difficult to reconcile with the length of the curriculum, 42.2% (n = 19) said that the relationship between time and curriculum length was one of the limiting factors. Regarding the possibility of students' lack of interest, the majority (95.6%%, n = 43) disagreed with this hypothesis. Similarly, 86.4% (n = 38) of respondents rejected the impracticality of spaces as an obstacle to outdoor activities.

Most respondents (91.1%, n = 41) expressed disagreement or a lack of opinion regarding the assertion that the inexperience of teachers impedes pedagogical practices in outdoor spaces. Specifically, 71.1% (n = 32) of respondents either strongly disagreed or disagreed, 20% (n = 8) neither agreed nor disagreed, and only 8.9% (n = 3) agreed or strongly agreed. Regarding resources, 36.7% (n = 18) agreed that they were a limiting factor, while 63.3% (n = 27) had no opinion or disagreed. More than half of the respondents (53.3%, n = 24) believe that problems accessing the Internet or computer equipment are a limiting factor for outdoor activities. Most respondents (88.9%, n = 40) disagreed or had no opinion on the statement that there are difficulties in controlling risks in outdoor activities. Finally, 51.1% (n = 23) of respondents disagreed that lack of parental involvement was a limiting factor, while 22.2% (n = 10) had no opinion and the remaining 26.7% (n = 12) concede that lack of parental involvement was a limiting factor.

The results of the inferential analysis are presented in Appendix B.3. It was observed that 'normative or regulatory restrictions of the school'; 'lack of interest of the children/young people'; 'impracticality of the school's outdoor spaces'; 'inexperience of the teachers'; 'difficulty in monitoring the level of risk involved in the activities'; and 'low participation of parents' are the factors with statistically significant proportions of disagreement of the respondents regarding the limitation or inhibition of pedagogical practices in outdoor spaces ($p < 0.05$, N = 45 and N = 44, respectively). On the other hand, for factors such as 'difficulties in reconciling the time spent on tasks with the length of the curriculum', 'unavailability of suitable materials or resources', and 'problems with Internet access and/or availability of computer equipment', the responses are almost equally divided between those who agree that they limit or inhibit outdoor educational practices and those who disagree ($p > 0.05$).

4.2. Outdoor Activities

(a) Analysis of the interviews

The interviewed teachers presented indoor and outdoor spaces as complementary. They highlighted outdoor space as a pedagogical resource that allows them to work on different topics (e.g., mathematics, science, art, physical education, history, geography, Portuguese language). "Everything I do in the classroom; I can also do outside" (T2) shows outdoor spaces as learning contexts. "... Exploring shadows and light, "drawing" with natural materials, observing and recording the sounds of the street, tracing the textures of materials, photographing...." (T1) are examples of outdoor learning activities. T3 stated: "the school include all spaces, whether inside or outside the classroom". She argued that outdoor spaces are suitable for learning Portuguese language or mathematics (e.g., "for Portuguese language, they choose a place to read and then come in the room and we can discuss what they have read"). T4 also considered that in outdoor spaces it is possible to

> *"tell a story; collect elements from nature to make an artistic expression, tennis practice, dancing, games, aspects related to biodiversity, sustainability, such as building a bird feeder and recording observations on whether the birds have eaten; traditional games, social learning and encounters with history, knowledge of cultural heritage".* (T4)

She also added that with outdoor interdisciplinary activities, the students' learning process is more meaningful because the knowledge is articulated: "... when we got a dozen outside, we did an activity with sticks..., when they [the students] had ten sticks they grouped them with an elastic band. This was so significant for them that they all carried ten sticks throughout the year" (T4). T5 shared that it was easier for him to use outdoor space

to work on the area of expression (e.g., mural painting), and T6 talked about expression, mathematics, and the Portuguese language: "... we go outside to draw something we see... mathematical content can be perfectly worked outside, from measurements, areas, geometric shapes... starting from an external element to construct a text". T7, a mathematics and science teacher, stated: "we go to the patio to calculate areas, perimeters to study the aquatic environment, the terrestrial environment... certain insects, see the little bees". Before the COVID-19 pandemic, T8, as a school director, shared that "every year all the school classes came to plant a tree...[currently] the children in the fifth grade come here and play with stones and sticks and pinecones and have pirate and soldier wars...". As a middle school mathematics and science teacher, she uses the outdoor space

> *"... to calculate the height of a lamp from the shadow that forms a right triangle, to calculate the area of a certain flower bed or a door... in science I give the plants... so let's go outside and pull the weeds to see the roots, let's go and look for flowers...".* (T8)

When it comes to the use of technology outdoors, the most common answer is the possibility of taking a photo or a sound recording, which is defined as a technological intervention. They mention that in middle school the mobile phone is an easier resource, as the computer is more difficult to use outside.

(b) Analysis of the closed-ended responses to the questionnaire

Among the outdoor activities with statistical significance between frequencies (binomial test, $p < 0.05$), the lowest frequency (occasionally, rarely, or never) was observed for the following: the resolution of real and relevant problems (76.6%); scientific research/exploration (79.2%); the development of models or prototypes to solve problems (85.4%); and activities involving the local community (66.7%) (Appendix B.4). A slightly better scenario was observed for curricular articulation involving two or more STEAM areas, which occurs occasionally in 49% of cases and frequently in 24.5% of cases.

The trend is reversed for physical and motor activities, such as games or physical exercises, with 70.2% of respondents reporting frequent use. The same pattern is observed for activities that stimulate emotional well-being, with identical results.

According to the results of the binomial test, there is no significant tendency ($p > 0.05$) observed in collaborative work. This suggests that opinions are divided between those who frequently use the space outside the school for collaborative work (46.9%), those who use it occasionally (40.8%), and those who rarely or never use it (10.2%). The same trend is observed for activities promoting healthy and sustainable eating and activities related to the creation/maintenance of school gardens.

(c) Analysis of the open-ended responses to the questionnaire

The data analysis reveals a variety of pedagogical practices in school settings, although not all of them correspond to STEAM activities as identified by all the teachers. A notable proportion of participants report never having carried out outdoor activities (36%—kindergarten, 42%—elementary, and 65%—middle school). Some participants mention doing interdisciplinary activities outdoors (46%—elementary, 35%—middle school), although few explicitly mention STEAM activities. There is also a tendency towards interdisciplinarity in the activities mentioned, with a particular emphasis on worldly knowledge, environmental studies, and the arts. In kindergarten, there is a very strong tendency to develop inter- or multidisciplinary outdoor activities, although very few correspond to STEAM activities.

5. Discussion

Teachers' perceptions of the pedagogical use of outdoor spaces

The results suggest that, despite a considerable diversity in the outdoor spaces among the schools in the cluster—ranging from expansive green areas to more limited ones (T8)—teachers hold a generally positive view of their schools' outdoor environments. Characteristics about 'overall appearance' (e.g., the presence of natural elements), 'dimension', 'accessibility', and 'security' (the latter only referring to adequate security conditions) are significantly recognised by most respondents. These characteristics may be related to many

of the potential outdoor pedagogical activities identified by respondents. For instance, the presence of 'natural elements' in the school's outdoor space aligns with the prevailing notion among kindergartens and schoolteachers, as evidenced in the interviews, that outdoor space is a key location for promoting students' well-being and fostering connections with nature. The studies by Bentsen et al. [35] and Ernest [38] also revealed teachers' preferences for outdoor spaces with natural elements. The notion of children's well-being is also evident in Erdem's study [37], as a significant proportion of kindergarten teachers expressed the view that outdoor activities that provide students with opportunities to engage with nature promote children's cognitive, physical, social, and emotional development, strengthen their immune systems, and reduce their risk of illness. On the other hand, the presence of appropriate 'dimensions' and 'safety conditions' in outdoor spaces is in line with the concept of children's well-being, which was discussed by the elementary and middle school teachers in relation to the possibility of children changing their posture, releasing energy, and moving their bodies in a context of greater freedom. These results differ from those obtained in the study by Atmodiwirjo [34], in which the reasons for the limited use of outdoor spaces were essentially due to restricted access for students to engage with the physical aspects of the school grounds based on various reasons of health, safety, and aesthetics.

Other pedagogical opportunities identified in the interviews arise from the implementation of a vast array of practices in outdoor spaces which can facilitate meaningful learning. Interviewed kindergarten and schoolteachers referred to practical and sensorial activities, and exploratory, interdisciplinary, and playful activities. The results of the questionnaire corroborate the identified opportunities by highlighting 'contact with nature', along with 'interdisciplinary activities and work' and 'collaborative activities', as the opportunities with statistically significant proportions of agreement. Similarly, the Atmodiwirjo study [34] demonstrated that both teachers and directors emphasised the value of outdoor learning in natural settings as an authentic learning environment conducive to experiential learning. The same idea is evident in the beliefs of primary school teachers interviewed in Winje and Løndal's [44] study, who emphasised that taking students out of the classroom and into real-life settings enhances their learning by bridging the gap between school and curriculum and first-hand experiences. Additionally, Tuulling et al. [32] found that teachers placed great importance on children being active and engaging all their senses in the outdoor learning process. However, they also highlighted the importance of integrating subject areas, as mandated by the national preschool curriculum, as a crucial factor for outdoor learning. The integration of different subject areas is also a key concept highlighted by teachers in this study, when they select interdisciplinary activities as one of the pedagogical opportunities that arise from the use of outdoor spaces.

If the characteristics of outdoor spaces appear to be related to the pedagogical potentialities identified, the absence of some characteristics of outdoor spaces may be related to the challenges identified. For example, regarding areas of outdoor spaces that afford protection from the sun, rain, or bad weather, there is a clear distinction between the participants' responses provided in the questionnaire. When questioned about the reasons for not using outdoor space, the interviewed kindergarten and schoolteachers identified weather conditions as a factor preventing the carrying out of activities outside. In Erdem [37], Ernst [38], and Tulling et al.'s [32] studies, teachers noted that parents were reluctant to have activities conducted outdoors during cold weather due to concerns that their children might fall ill. Among other reasons for not organising regular outings, the teachers often cited the lack of a suitable environment.

Another feature of outdoor space that did not meet with a consensus of responses from respondents in the questionnaire was the presence of material resources accessible and manipulable by children/young people. Scarce resources could affect outdoor activities, and schools may also be wary of potential legal liabilities, making it simpler and less risky to keep students indoors. The lack of necessary tools for outdoor activities and safety concerns were also mentioned in teachers' responses in Tuuling et al.'s [32] work.

Again, when discussing the reasons for not using outdoor space, some of the interviewed teachers stated that this space was not always rich enough to enable multiple learnings. Nevertheless, the interviews also revealed other reasons for not using outdoor spaces that are not directly related to the characteristics of the space itself. Elementary and middle school teachers also indicate that the organisation and management of the curriculum, with multiple teachers and fragmentation across different subjects, makes it more challenging to manage the time required to carry out activities outside. The idea that there are many topics to be taught (extension of the programmes) and some external constraints (bureaucratic tasks demanded from teachers, leadership) is also present in the reasons invoked. When these results are cross-referenced with the results of the analysis of the respondents' answers to the question related to the factors that limit or inhibit pedagogical practices in outdoor spaces, the length of the curriculum was a factor that divided the opinion of the respondents. This discrepancy in opinion may be attributed to the teaching cycle in which the respondents are engaged. For those instructing at the elementary and middle school levels, the relationship between time and curriculum length may be a significant limiting factor. Conversely, for those instructing at the kindergarten level, the length of the curriculum may not be a particularly relevant factor. These perceived barriers identified by teachers resonate with findings from other studies, such as the constraints imposed by school curricula, that leave little room for outdoor learning and not enough time to undertake outdoor learning activities [30,36]. These studies have similarly identified challenges stemming from shortages of time, resources, and support, notably including an increased workload for teachers and administrative barriers within schools. On the other hand, the respondents' answers show that factors such as 'normative or regulatory restrictions of the school', 'lack of interest of children/young people', 'impracticality of the school's outdoor spaces', 'low participation of parents', 'difficulties in monitoring the level of risk of activities', and 'inexperience of teachers' are significantly acknowledged by the majority of respondents as factors that do not prevent educational activities from taking place outdoors. These results differ from those obtained in the study by Tuuling et al. [32], in which the teachers stated that they avoided outdoor learning due to challenges in engaging children and maintaining their focus. Furthermore, they cited the organisation of group work outdoors as more challenging.

Although the questionnaire responses indicated that the 'inexperience of teachers' does not limit or inhibit pedagogical practices in outdoor spaces, the interviews revealed that elementary teachers perceive this as a challenge to implementing practices in outdoor spaces, as evidenced by the following excerpts from interviews: "...Sometimes we lack ideas to delimit or define practices that are interesting for students that involve the content we want to address. . ." (T5) or ". . .I have not received any training in this area and I am unsure how to implement these practices without first observing how they are carried out or having colleagues who are interested in these dynamics" (T6). Some of these aspects are also echoed in the literature, such as apprehension regarding the health and safety of young individuals [30,37,38], as well as teachers' confidence and proficiency in conducting outdoor teaching and learning activities [4,30,34,36,38]. Additionally, findings from van Dijk-Wesselius et al. [7] underscored a strong correlation between a lack of confidence in one's own outdoor teaching expertise and concerns regarding losing control and managing children's behaviour, suggesting that these challenges could be addressed through training opportunities.

Activities implemented by the teachers in outdoor spaces, particularly within the STEAM outdoor education approach

The findings indicate that a significant proportion of respondents (36% of kindergarten teachers, 42% of elementary school teachers, and 65% of middle school teachers) reported that they had never conducted outdoor activities. This is not consistent with the findings of Atmodiwirjo's [34] study, where only a small minority of primary school teachers reported that they had never used the school grounds for learning purposes. However, when it comes to kindergarten teachers, the results are more consistent with the published literature.

In Tuuling et al.'s [32] study, more than half of the of kindergarten teachers emphasised that they consistently rely on outdoor learning to engage students in a variety of activities and consider it essential.

However, the analysis of the interviews revealed that when teachers organise outdoor learning activities, their objective is to work on specific curricular areas (e.g., plastic, physical–motor expressions, mathematics, sciences) or, in certain instances, to combine different curricular areas in a playful way.

In the first case, the activities described by the teachers permit students to engage in sensory exploration of the outdoors (e.g., observation, listening, and collecting elements of nature), in physical activity practice, or to apply acquired knowledge in real contexts (e.g., mathematical knowledge in determining areas). The analysis of the closed responses to the questionnaire confirms this analysis to some extent. Physical and motor activities, as well as activities that stimulate students' emotional well-being, are the activities that respondents reported conducting frequently in outdoor spaces, with statistically significant levels of agreement. Similarly, the results of Atmodiwirjo's [34] study indicated that teachers had, in fact, used the school grounds for a variety of learning activities in different subjects. In particular, the data indicated that the use of the school grounds to support learning activities in the sciences was of primary importance. The same idea is present in a study conducted in Denmark, where the researchers observed that most teachers engaged in outdoor learning were science and physical education teachers [35]. The outdoor activities shared by participants in the study encompass content from various subjects, offering a broader range of examples compared to Dyment's study [30], which focuses predominantly on science and physical education activities. However, the examples presented by the teachers seem to deviate from a truly integrative STEAM approach [29].

In the second case, the activities described by the teachers typically combine the areas of expression (plastic and physical-motor expression) with other curricular areas, such as mathematics or science (e.g., treasure hunt with mathematical challenges). The analysis of the open-ended responses to the questionnaire also indicates that there is a tendency towards interdisciplinarity in the activities indicated by the teachers, particularly emphasising worldly knowledge, environmental studies, and the arts. However, a relatively small proportion of these activities described by the teachers align with the STEAM approach. This result is corroborated by the analysis of the closed responses to the questionnaire, which revealed that activities such as curricular articulation (involving two or more STEAM areas), solving real and relevant problems, scientific research/exploration, or developing models or prototypes are the activities that respondents reported doing occasionally, rarely, or never in outdoor spaces with statistically significant levels of agreement. These types of outdoor activities are consistent with findings from other studies; for example, in Winje and Løndal's [44] study, elementary school teachers described activities that combine physical activity with content that students have previously worked on in the classroom, with the aim of integrating and applying classroom knowledge to real-life situations outdoors. The kindergarten teachers in Tuuling et al.'s [32] study also highlighted how outdoor learning seamlessly integrates subjects such as language, mathematics, and physical education and encourages active student participation. Furthermore, they emphasised the versatility of outdoor learning, which allows for a fluid transition between movement-rich play and educational activities.

6. Conclusions

The main purpose of this study was to describe teachers' perspectives in a Portuguese school cluster regarding outdoor STEAM education, identifying opportunities and obstacles to its implementation. To this end, a mixed methods approach was employed to analyse the perceptions of kindergarten and schoolteachers about the outdoor spaces in their schools (characterisation, potential, and challenges) and the pedagogical practices they carry out in these spaces. However, it is important to note that certain limitations must be considered, as they condition the interpretation of the results. As previously stated,

the preliminary interviews were employed in two distinct contexts. Primarily, they were utilised to provide qualitative insights that would ensure the relevance and effectiveness of the subsequent questionnaire. However, it was not ensured that the participants interviewed were representative of the target population of the subsequent investigation. Secondly, the preliminary interviews were employed as follow-up interviews for the sake of convenience, which did not allow for the clarification of information gleaned from the questionnaire that required more detail for a full understanding. Regarding the questionnaire, the low number of participants (49 out of 166) raises concerns regarding the overall representativeness and representativeness by level of education, which makes it impossible to generalise the results.

However, the sequential combination of the results of the qualitative analyses with the quantitative analyses enabled a deeper and more comprehensive understanding of the phenomenon under study. This analysis indicates that the characteristics perceived by teachers in their school's outdoor spaces exert a certain influence on the pedagogical potential and practices that are carried out. In this sense, the characteristics of the outdoor space sometimes appear as facilitators of outdoor pedagogical activities and sometimes as obstacles to their implementation. Although most participants recognise that the spaces in their schools are adequately equipped for outdoor activities, whether in terms of appearance, size, accessibility, or safety, in relation to the resources available, some participants point to the lack of resources as a justification for not carrying out activities in these spaces. In simple terms, school spaces, which vary considerably from one school to another, generally allow STEAM activities to be carried out outdoors. Notwithstanding the constraints of limited outdoor space, the school director interviewed highlighted the capacity of some teachers to devise creative solutions to overcome these limitations.

The results also suggest that, although the potential of outdoor space for carrying out interdisciplinary activities is widely recognised, its enactment in practice, as well as the implementation of activities related to the STEAM approach, is residual.

Regarding the pedagogical potential of using outdoor spaces, most teachers agree that outdoor spaces provide contact with nature and promote interdisciplinary and collaborative activities. However, regarding practices, many teachers interviewed admitted to using the school's outdoor spaces only occasionally for pedagogical activities. This use decreased as the educational level at which these teachers taught increased. The most common uses of outdoor spaces are related to physical and motor activities, activities that promote the emotional well-being of children and young people, and, sporadically, some interdisciplinary and collaborative working practices. The main challenges to the pedagogical use of outdoor spaces are the inflexibility and extension of curricula, the need for teacher training to deal with these approaches, the lack of time for joint planning, and the scarcity of adequate materials and resources.

In this context, it can be argued that the implementation of STEAM activities in an outdoor setting needs more than merely the availability of sufficient space and material resources. The development of this type of practice is contingent upon the professional and personal involvement of teachers to foster consensus and opportunities that reinforce the principles of curricular articulation and interdisciplinary collaboration. Consequently, teacher qualifications represent a pivotal factor in the successful implementation of STEAM outdoor education. In this context, it is crucial to provide teachers with the requisite knowledge, skills, and opportunities to energise teaching in outdoor spaces in an interdisciplinary manner, thereby capitalising on the full potential of outdoor education. Consequently, further research and debate is required regarding the knowledge, experience, and type of training that teachers require to successfully implement STEAM outdoor education.

Author Contributions: Conceptualization, M.C. and T.R.; methodology, R.S., I.S.D. and M.C.; software, D.B. and L.R. validation, all authors; formal analysis, D.B., T.R., I.S.D., H.L., A.P., M.C.M, S.G. and M.C.; investigation, T.R., M.C., D.B., M.C.M., I.S.D., H.L., D.C., L.R. and R.S.; data curation, D.B. and T.R.; writing—original draft preparation, M.C., T.R., D.C., A.A., A.P., S.G., L.R. and S.F.; writing—review and editing, I.S.D., P.P., R.S., R.F. and V.S.; project administration, M.C. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by national Funds through FCT—Portuguese Foundation for Science and Technology, I.P., under the project: Life Quality Research Centre (CIEQV) (UIDP/04748/2020); Research Centre for Natural Resources, Environment and Society (CERNAS) (UIDP/00681/2020); Scientific Employment Stimulus (CEECINST/00051/2018).

Institutional Review Board Statement: The study was conducted and approved by the Ethics Committee of the Research Unit of Santarém Polytechnic University for studies involving humans (NO. 28-2023ESES and 20 December 2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Due to ethical issues, the data collected and analysed in this study are not available to outside researchers.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Appendix A.1. Interviews Methodological Plan

Dimensions	Definition	Example of Questions
Professional Characterisation	This dimension involves describing and understanding the professional profiles, roles, and attributes of individuals.	What is your basic training? How long have you been in the service?
Perceptions	This dimension encompasses the attitudes, beliefs, and experiences of individuals regarding the utilisation of outdoor space. It includes for what purposes the space is used, the perceived quality and accessibility of the space, the level of satisfaction derived from it, and the perceived benefits associated with its use. This dimension aims to understand the subjective viewpoints of users about the outdoor space and its role in their daily activities.	Do you consider that the outdoor space of the school can be used as a learning context? Why?/Why not? What are the reasons that lead a teacher/educator to use the outdoor space as a learning context? What are the underlying causes for not using the outdoor space as a learning context? What practices should teachers adopt to create meaningful learning opportunities for pupils in the outdoor space?
Practices	This dimension focuses on the activities employed by educators when conducting lessons in an outdoor space. It includes the types of educational activities undertaken, the adaptation of teaching strategies for an outdoor environment, the integration of outdoor space into the curriculum, the impact on student engagement and learning outcomes, and the challenges faced, along with the solutions developed. This dimension seeks to capture how outdoor spaces are used for educational purposes and their effectiveness in enhancing teaching and learning experiences.	As a teacher/educator, do you often use the outdoor space in your teaching practice? Can you provide examples of how you use/have used the outdoor space as a learning context? What benefits do you think students can gain from learning in an outdoor context? Based on your experience, what challenges have arisen/arise/could arise from using the outdoor space as a learning context, and how can they be addressed? Have these challenges changed over time?

Appendix A.2. Questionnaire Methodological Plan

Dimensions	Sub-Dimensions	Components
1. Perceptions of the pedagogical use of outdoor spaces	1.1. Characterisation Involves the evaluation of outdoor spaces based on several key characteristics, including their overall appearance, size, accessibility, security, and the availability of resources.	(1) Overall appearance, i.e., whether the outdoor spaces have a carefully maintained and pleasant appearance (e.g., decoration with soft colors and natural elements, organised and accessible materials, clearly divided areas). (2) Size, i.e., whether the outdoor spaces are of an appropriate size for the number of children/young people using the space simultaneously. (3) Accessibility, i.e., whether the outdoor spaces are accessible to all children/young people, including those with specific needs (ramps, handrails, well-defined paths). (4) Security, i.e., whether the outdoor spaces have adequate safety conditions and whether these spaces have areas that offer protection in situations of sun and/or rain (e.g., awnings, sheds, or trees). (5) Resources, that is, whether outdoor spaces have material resources that can be manipulated and accessed freely by children/young people.
	1.2. Opportunities It pertains to teachers' perceptions of the potential for pedagogical use and enhanced learning provided by the school's outdoor spaces.	(1) Stimulate different skills, i.e., enable a wide range of activities to be carried out, stimulating different skills in different areas of knowledge (scientific, artistic, sports, health activities, etc.). (2) Interdisciplinary activities, i.e., enable interdisciplinary activities and projects to be carried out. (3) Inclusive environments, i.e., encourage the development of inclusive environments, organised so that they can be used by everyone. (4) Contact with nature, i.e., encourage contact with nature, including, for example: garden areas, woods, vegetable gardens, trees and flowers, areas for observing fauna. (5) Sensory stimulation, i.e., enhance sensory stimulation to promote the cognitive and emotional development of children/young people, encouraging exploration and curiosity. (6) Collaborative activities, i.e., provide opportunities for collaborative activities.
	1.3. Challenges Identify potential difficulties in the pedagogical use of outdoor spaces, exploring the challenges faced by teachers, such as institutional constraints, lack of resources, or safety concerns that may affect the use of outdoor spaces.	(1) Normative or regulatory restrictions of school. (2) Difficulties in harmonising the time spent on tasks with the length of the curriculum. (3) Children/young people's lack of interest. (4) Impracticality of the school's outdoor spaces. (5) Teachers' inexperience. (6) Unavailability of suitable materials or resources. (7) Problems with Internet access and/or the availability of computer equipment. (8) Difficulties in monitoring the level of risk involved in activities. (9) Low participation of parents.

Dimensions	Sub-Dimensions	Components
2. Outdoor activities	2.1. Types of activities carried out by teachers in outdoor spaces. Focuses on the types of activities carried out by teachers in the school's outdoor spaces. These activities include STEAM (science, technology, engineering, arts/humanities, and mathematics) experiences, research projects, playful activities and other pedagogical practices that can be implemented outside the classroom.	(1) Curricular articulation involving two or more STEAM areas (science, technology, engineering, arts/humanities, and mathematics). (2) Resolution of real and relevant problems. (3) Research/scientific exploration. (4) Development of models or prototypes to solve problems. (5) Collaborative work. (6) Physical and motor activities, such as games or exercise. (7) Activities that stimulate emotional well-being. (8) Activities to promote healthy and sustainable nutrition. (9) Activities related to the construction/maintenance of educational vegetable gardens. (10) Activities involving the local community.

Appendix B

Appendix B.1. Binomial Test (I) to Assess Statistical Significance Regarding Evaluation of Outdoor Spaces

		Category	*N*	Observed Proportion	Exact Sig (2 Tailed)
Overall appearance: Outdoor spaces have a well-kept and pleasant appearance	Group 1	≤3	17	0.35	0.019
	Group 2	>3	32	0.65	
	Total		49	1.00	
Dimension: Outdoor spaces have an adequate size	Group 1	≤3	8	0.16	<0.001
	Group 2	>3	41	0.84	
	Total		49	1.00	
Accessibility: Outdoor spaces are accessible to everyone, including those with specific needs	Group 1	≤3	14	0.29	0.001
	Group 2	>3	35	0.71	
	Total		49	1.00	
Security: Outdoor spaces have adequate security conditions	Group 1	≤3	18	0.37	0.040
	Group 2	>3	31	0.63	
	Total		49	1.00	
Resources: Outdoor spaces have material resources that can be manipulated and accessed freely by children/young people	Group 1	≤3	26	0.53	0.560
	Group 2	>3	23	0.47	
	Total		49	1.00	

Output: SPSS, version 20.0.2.0 IBM Corp., Chicago, IL, USA.

Appendix B.2. Binomial Test (II) to assess Statistical Significance Regarding Pedagogical Opportunities of Outside School Space

		Category	N	Observed Proportion	Exact Sig (2 Tailed)
Outdoor spaces make it possible to carry out a wide range of activities that stimulate different skills in different areas of knowledge	Group 1	≤3	19	0.39	0.144
	Group 2	>3	30	0.61	
	Total		49	1.00	
Outdoor spaces allow for interdisciplinary activities	Group 1	≤3	14	0.29	0.003
	Group 2	>3	35	0.71	
	Total		49	1.00	
Outdoor spaces encourage the development of inclusive environments, organised to be used by everyone	Group 1	≤3	19	0.39	0.144
	Group 2	>3	30	0.61	
	Total		49	1.00	

		Category	N	Observed Proportion	Exact Sig (2 Tailed)
Outdoor spaces encourage contact with nature, including garden space, woodland, vegetable garden, trees and flowers, areas for observing fauna	Group 1	≤3	16	0.33	0.019
	Group 2	>3	33	0.67	
	Total		49	1.00	
Outdoor spaces enhance sensory stimulation to promote the cognitive and emotional development of children/young people and encourage exploration and curiosity	Group 1	≤3	17	0.35	0.079
	Group 2	>3	31	0.65	
	Total		48	1.00	
Outdoor spaces allow for collaborative activities	Group 1	≤3	9	0.19	<0.001
	Group 2	>3	39	0.81	
	Total		48	1.00	

Output: SPSS, version 20.0.2.0 IBM Corp., Chicago, IL, USA.

Appendix B.3. Binomial Test (III) to Assess Statistical Significance Regarding Challenges of Outside School Spaces

		Category	*N*	Observed Proportion	Exact Sig (2 Tailed)
Normative or regulatory restrictions of school.	Group 1	≤3	43	0.96	<0.001
	Group 2	>3	2	0.04	
	Total		45	1.00	
Difficulties in harmonising the time spent on tasks with the length of the curriculum.	Group 1	≤3	27	0.60	0.233
	Group 2	>3	18	0.40	
	Total		45	1.00	
Children/young people's lack of interest.	Group 1	≤3	43	0.96	<0.001
	Group 2	>3	2	0.04	
	Total		45	1.00	
Impracticality of the school's outdoor spaces.	Group 1	≤3	38	0.86	<0.001
	Group 2	>3	6	0.14	
	Total		44	1.00	
Teachers' inexperience.	Group 1	≤3	41	0.91	<0.001
	Group 2	>3	4	0.09	
	Total		45	1.00	
Unavailability of suitable materials or resources.	Group 1	≤3	27	0.60	0.233
	Group 2	>3	18	0.40	
	Total		45	1.00	
Problems with Internet access and/or availability of computer equipment.	Group 1	≤3	21	0.47	0.766
	Group 2	>3	24	0.53	
	Total		45	1.00	
Difficulties in monitoring the level of risk involved in activities.	Group 1	≤3	40	0.89	<0.001
	Group 2	>3	5	0.11	
	Total		45	1.00	
Low participation of parents.	Group 1	≤3	33	0.73	0.002
	Group 2	>3	12	0.27	
	Total		45	1.00	

Output: SPSS, version 20.0.2.0 IBM Corp., Chicago, IL, USA.

Appendix B.4. Binomial Test (IV) to Assess Statistical Significance Regarding Outdoor Activities

		Category	*N*	Observed Proportion	Exact Sig (2 Tailed)
Curricular articulation involving two or more STEAM areas (science, technology, engineering, arts/humanities, and mathematics).	Group 1	≤3	36	0.75	<0.001
	Group 2	>3	12	0.25	
	Total		48	1.00	
Resolution of real and relevant problems.	Group 1	≤3	36	0.77	<0.001
	Group 2	>3	11	0.23	
	Total		47	1.00	
Research/scientific exploration.	Group 1	≤3	38	.79	<0.001
	Group 2	>3	10	.21	
	Total		48	1.00	
Development of models or prototypes to solve problems.	Group 1	≤3	41	0.85	<0.001
	Group 2	>3	7	0.15	
	Total		48	1.00	
Collaborative work.	Group 1	≤3	25	0.52	0.885
	Group 2	>3	23	0.48	
	Total		48	1.00	
Physical and motor activities, such as games or exercise.	Group 1	≤3	14	0.30	0.008
	Group 2	>3	33	0.70	
	Total		47	1.00	
Activities that stimulate emotional well-being.	Group 1	≤3	14	0.30	0.008
	Group 2	>3	33	0.70	
	Total		47	1.00	
Activities to promote healthy and sustainable nutrition.	Group 1	≤3	23	0.48	0.885
	Group 2	>3	25	0.52	
	Total		48	1.00	
Activities related to the construction/maintenance of educational vegetable gardens.	Group 1	≤3	30	0.63	0.111
	Group 2	>3	18	0.38	
	Total		48	1.00	
Activities involving the local community.	Group 1	≤3	32	0.67	0.029
	Group 2	>3	16	0.33	
	Total		48	1.00	

Output: SPSS, version 20.0.2.0 IBM Corp., Chicago, IL, USA.

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