

TEACHERS' PERSPECTIVES REGARDING OUTDOOR STEAM EDUCATION: AN EXPLORATORY STUDY

M. Correia, T. Ribeirinha, D. Beirante, A. Portelada, C. Martins, S. Galinha

Santarém Polytechnic University, School of Education (PORTUGAL)

Life Quality Research Center (PORTUGAL)

Abstract

This study explores teachers' perceptions on using outdoor school spaces for interdisciplinary STEAM education through a survey conducted in a school cluster in a Portuguese city. The findings highlight that while teachers acknowledge the potential benefits, the actual utilization of these spaces is sporadic, especially at higher educational levels. Outdoor areas are predominantly used for physical activities, with limited interdisciplinary engagement due to various challenges, including curriculum extension. Addressing these challenges is crucial for enhancing STEAM education, emphasizing the urgent need for comprehensive teacher training to fully leverage the educational potential of outdoor spaces.

Keywords: Outdoor education; STEAM approach Teacher training.

1 INTRODUCTION

In recent years, there has been an increasing interest in the interdisciplinary educational approach known as Science, Technology, Engineering, Arts/Humanities, and Mathematics (STEAM). This trend is grounded in the demonstrably positive impact this approach has on children and young people's attitudes and learning outcomes, as well as the imperative to foster their curiosity and engagement with the content covered by these academic domains [1], [2], [3]. Recognizing this imperative, scholarly literature emphasizes the development of interdisciplinary pedagogical strategies, beginning from the earliest stages of education, anchored in pertinent social and cultural contexts [2], [4], [5].

Outdoor environments and natural settings assume particular significance in this educational paradigm, providing a rich backdrop for outdoor learning experiences [6], [7]. In fact, schoolyards can serve as a complement or extension of the classroom, offering a meaningful setting for outdoor education and facilitating a wide range of learning opportunities [8]. These settings facilitate exploration, inquiry, observation, debate, manipulation, and a reconnection with the natural world through sensory engagement. There is a vast body of evidence that shows the beneficial effects of outdoor education on students' academic achievement in science, critical thinking skills, enthusiasm for learning, and intrinsic motivation [9], [10]. Furthermore, exposure to nature confers physical and psychological well-being benefits. Consequently, the immersive and experiential nature of outdoor education is anticipated to foster students' holistic development and welfare while fostering a meaningful connection to STEAM subjects [6]. By enhancing students' interest and involvement in these activities, outdoor education holds promise for cultivating a deeper appreciation and engagement with STEAM learning [7], [11], [12].

Despite the myriad pedagogical opportunities provided by school outdoor spaces, their use is limited [13] due to numerous challenges, such as the requirements of school curricula and the lack of pre- and in-service training for teachers [14]. Teacher training plays a pivotal role in surmounting these obstacles and successfully integrating STEAM activities from kindergarten onwards [15], particularly by emphasizing the integration of outdoor learning into daily teaching practices [16]. Therefore, it is important to understand teachers' perceptions of the challenges and opportunities of these approaches. While recent research has focused on aspects of outdoor learning [14], [17], [18], [19], [20], [21], studies examining its integration with STEAM education remain scarce [7], [11], [12]. To achieve this goal, a questionnaire was distributed among a selection of schools in a Portuguese city, aiming to elucidate how teachers perceive outdoor spaces within their school premises.

2 METHODOLOGY

Recognizing the potential of outdoor education to connect STEAM concepts with real-world experiences, enhance learning significance, and foster holistic development in children and youth, coupled with the absence of concrete data on teachers' practices, perceptions, and training needs in utilizing outdoor spaces, our research team embarked on an exploratory study. This endeavor aimed to elucidate and

describe the current landscape within a group of schools in Santarém. Such methodological approach is essential for acquainting ourselves with the phenomenon under investigation, laying the groundwork for the design of comprehensive studies, training programs, or research instruments with greater insight and accuracy [22].

For this study, the sample comprised a school cluster in the city of Santarém, Portugal, encompassing one middle school and 10 kindergarten and elementary schools. The questionnaire includes 10 questions designed to characterize the participants, along with 70 closed questions—both single and multiple-choice. It offers options such as "other(s)" and "which one" to ensure diverse responses and avoid bias. Of these, 50 questions employ a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), to gauge agreement with specific statements. In 12 questions, the scale ranges from 1 (never) to 5 (always), assessing the frequency of teachers' practices. Additionally, three open-ended questions are provided, although participation is voluntary due to the exploratory nature of the research.

The content and format of the online questionnaire underwent validation, involving (1) consultation with a panel of experts renowned in outdoor and/or STEAM education, and (2) a pre-test with volunteer teachers who received the questionnaire link via email. Feedback and suggestions were collected and used to refine the questionnaire. The study was approved by the Ethics Commission of the Research Unit of Polytechnic University of Santarém. The finalized version was then distributed online to all kindergarten, elementary, and middle school teachers within the selected school cluster. Of the 166 teachers, 49 responded to the questionnaire, with 40 females and nine males, averaging 54 years of age, as presented in Table 1.

Table 1. Characterization of the school's outdoor spaces.

<i>School Level</i>	<i>Population</i>	<i>Participants</i>	<i>% of participation</i>	<i>Sample representativity</i>	<i>Global representativity</i>
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%

Closed-ended questions were analyzed descriptively, and the binomial test assessed the statistical significance of response percentages. Responses were divided into two categories: one encompassing "strongly disagree," "disagree," and "neither agree nor disagree" (cat. ≤ 3), and the other comprising "agree" and "strongly agree" (cat. > 3). For open-ended questions, a categorical content analysis was conducted based on emerging data categories.

3 RESULTS

3.1 Characterization of the school's outdoor spaces

The assessment of outdoor spaces within the group's schools indicates a predominantly positive perspective among respondents. Specifically, 65.3% of participants acknowledge these areas as well-maintained and enjoyable. Moreover, a significant majority of 83.7% believe that the size of these spaces adequately accommodates the number of users, with 71.4% affirming their accessibility to all children/young people, including those with specific needs. Another notable aspect is that 63.3% perceive suitable safety conditions in outdoor spaces. However, concerning amenities that offer protection against the elements such as the sun, rain, or inclement weather, approximately half of the respondents, 55.1%, express agreement, while 44.9% either disagree or have no opinion. Furthermore, a significant proportion, 32.7%, refrain from expressing a definitive opinion regarding the presence of accessible and manipulable material resources for children/young people, while 20.4% mention their absence. Conversely, nearly half, 46.9%, acknowledge the provision of such resources in outdoor spaces. These findings are detailed in Table 2.

Table 2. Characterization of the school's outdoor spaces.

%	Overall appearance	Dimension	Accessibility	Security	Protection	Resources
Totally disagree	0,00	6,10	6,10	6,10	8,20	2,00
Disagree	18,40	6,10	12,20	14,30	24,50	18,40
Neither agree nor disagree	16,30	4,10	10,20	16,30	12,20	32,70
Agree	51,00	51,00	57,10	55,10	46,90	34,70
Totally agree	14,30	32,70	14,30	8,20	8,20	12,20

<i>Binomial test</i>						
Exact Sig (2 tailed)	.044	<.001	.004	.085	.568	.775
cat <=3 (%)	.35	.16	.29	.37	.45	.53
cat>3 (%)	.65	.84	.71	.63	.55	.47

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

The inferential analysis of statistical significance indicates that for the characteristics of "overall appearance," "dimension," and "accessibility," the percentage of respondents selecting the categories "agree" and "totally agree" (categories >3) is significantly greater than 50% ($p < 0.05$). This suggests that these attributes are widely acknowledged by most teachers.

3.2 Outdoor spaces: pedagogical opportunities

In terms of pedagogical opportunities afforded by the school's outdoor spaces, a significant majority of respondents express favourable perspectives. Notably, 61.2% agree that these areas support the development of diverse activities that foster various skills, including scientific exploration, performance arts, sports, and health-related endeavours, among others. Furthermore, 71.4% affirm that these spaces facilitate interdisciplinary activities and collaborative work. Additionally, 61.2% of respondents believe that these outdoor spaces promote the creation of inclusive environments. Moreover, 67.3% agree that they facilitate engagement with nature, providing opportunities for gardening, exploring forests, tending to vegetable gardens, and observing local flora and fauna. Furthermore, 64.6% concur that these spaces stimulate students sensorially, nurturing their cognitive and emotional development by encouraging exploration and curiosity. Finally, a significant majority of 81.3% acknowledge that these outdoor spaces support collaborative activities. These findings are detailed in Table 3.

Based on the analysis of the table, it can be inferred that concerning the potential of outdoor spaces, the responses that are particularly noteworthy are those pertaining to the facilitation of "interdisciplinary activities and work," "contact with nature," and the promotion of "collaborative activities." These aspects exhibited statistically significant proportions of agreement among respondents ($p < 0.05$).

Table 3. Pedagogical opportunities afforded by the school's outdoor spaces.

%	Skills	Interdisciplinary	Inclusive environments	Contact with nature	Sensory stimulation	Collaborative activities
Totally disagree	2,00	0,00	0,00	10,20	4,20	2,10
Disagree	20,40	10,20	10,20	14,30	14,60	2,10
Neither agree nor disagree	16,30	18,40	28,60	8,20	16,70	14,60
Agree	38,80	49,00	46,90	40,80	43,80	52,10
Totally agree	22,40	22,40	14,30	26,50	20,80	29,20

<i>Binomial test</i>						
Exact Sig (2 tailed)	.152	.004	.152	.021	.059	<.001
cat <=3 (%)	.39	.29	.39	.33	.35	.19
cat>3 (%)	.61	.71	.61	.67	.65	.81

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

3.3 Outdoor spaces: challenges

When it comes to factors constraining or hindering pedagogical practices in outdoor spaces, respondents' perspectives exhibit significant divergence. Notably, 71.1% of respondents disagree that normative or regulatory restrictions pose an obstacle. However, opinions are more divided regarding curriculum extension. While 40.0% disagree with the notion that the time allocated to activities is challenging to reconcile with the curriculum's length, 42.2% view the relationship between time and curriculum length as a limiting factor. Concerning the possibility of students' lack of interest, the majority (82.3%) disagree with this assertion. Moreover, a large majority (91.1%) either disagree or have no opinion on whether the inexperience of teachers hinders pedagogical practices in outdoor spaces. Opinions diverge regarding resources, with 40.0% agreeing that they pose a limiting factor, while 33.3% disagree. However, when combining those who disagree with those who have no opinion, the total reaches 60.0%, indicating high statistical relevance. Additionally, over half (53.4%) of respondents believe that problems accessing the internet or computer equipment hinder outdoor activities. Most respondents (88.9%) either disagree or express no opinion on the notion that there are difficulties in controlling risks in outdoor activities. Finally, regarding parental involvement, 51.1% of respondents do not view it as a limiting factor, while 22.2% refrain from expressing an opinion, and 26.7% acknowledge it as an obstacle to outdoor activities. These findings are detailed in Table 4.

Table 4. Factors constraining or hindering pedagogical practices in outdoor spaces.

%	Normative restrictions	Curriculum length	Students lack of interest	Teachers' experience	Unavailability resources	Internet	Risk control	Parents' participation
Totally disagree	28,90	20,00	26,70	22,20	8,90	4,40	8,90	13,30
Disagree	42,20	22,20	55,60	48,90	24,40	24,40	55,60	37,80
Neither agree nor disagree	24,40	17,80	13,30	20,00	26,70	17,80	24,40	22,20
Agree	4,40	31,10	4,40	8,90	40,00	37,80	11,10	24,40
Totally agree	0,00	8,90	0,00	0,00	0,00	15,60	0,00	2,20

Binomial test

Exact Sig (2 tailed)	<.001	.233	<.001	<.001	.233	.766	<.001	.002
cat <=3 (%)	.96	.60	.96	.91	.60	.47	.89	.73
cat>3 (%)	.04	.40	.04	.09	.40	.53	.11	.27

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

Following the inferential analysis, it can be deduced that factors such as 'normative or regulatory restrictions of the school', 'lack of interest of the children/young people', 'inexperience of the teachers', 'difficulty in monitoring the level of risk involved in the activities', and 'low participation of parents' are characterized by statistically significant proportions of disagreement among respondents regarding their impact on the limitation or inhibition of pedagogical practices in outdoor spaces ($p < 0.05$). Conversely, 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' elicit almost equal divisions of opinion between those who agree that they impede outdoor educational practices and those who disagree ($p > 0.05$).

3.4 Outdoor activities: analysis of the open-ended responses to the questionnaire

The analysis of open-ended responses to the questionnaire reveals a diverse range of pedagogical practices within school settings, although not all align with STEAM activities as recognized by the teachers. A notable proportion of participants indicate that they have never conducted outdoor activities (36% - kindergarten, 42% - elementary, and 65% - middle school). While some participants mention engaging in interdisciplinary activities outdoors (46% - elementary, 35% - middle school), few explicitly reference STEAM activities. Additionally, there appears to be a trend towards interdisciplinarity in the mentioned activities, with particular emphasis on worldly knowledge, environmental studies, and the

arts. In kindergarten, there is a prevalent inclination towards the development of inter- or multidisciplinary outdoor activities, although very few align with STEAM activities.

4 DISCUSSION AND CONCLUSIONS

The findings indicate that despite varying outdoor space sizes and features within the school cluster, teachers generally view their schools' outdoor environments positively. Most respondents recognize key characteristics such as 'overall appearance', 'dimension', 'accessibility', and 'security', which are closely associated with potential outdoor pedagogical activities. These attributes are closely associated with many of the potential outdoor pedagogical activities identified by respondents. For instance, the inclusion of 'natural elements' in the school's outdoor environment resonates with the prevalent belief among kindergarten and schoolteachers, as evidenced in interviews, that outdoor spaces are pivotal for enhancing students' well-being and fostering a connection with nature. Studies by Bentsen et al. [18] and Ernest [21] further confirm teachers' preferences for outdoor areas with natural features. The emphasis on children's well-being is also apparent in Erdem's study [20], where a significant portion of kindergarten teachers expressed the belief that outdoor activities providing opportunities for engaging with nature enhance children's cognitive, physical, social, and emotional development, bolster their immune systems, and decrease the likelihood of illness. Conversely, the importance of appropriate 'dimensions' and 'safety conditions' in outdoor spaces aligns with the concept of children's well-being discussed by elementary and middle school teachers, who associate it with the potential for children to adjust their posture, expend energy, and move freely, thereby promoting overall physical health.

The questionnaire analysis revealed significant pedagogical opportunities such as 'contact with nature', 'interdisciplinary activities and work', and 'collaborative activities'. Similarly, Atmodiwirjo [17] demonstrated teachers' emphasis on the value of outdoor learning in natural settings for experiential learning. Tuulling et al. [16] found that teachers prioritize active engagement of children's senses in outdoor learning, emphasizing the importance of integrating subject areas mandated by the curriculum. Teachers in this study also highlight the integration of different subject areas through interdisciplinary activities in outdoor spaces as key pedagogical opportunities.

The analysis of respondents' answers regarding factors limiting outdoor pedagogical practices unveiled a disparity in perspectives regarding the curriculum length. Elementary and middle school teachers placed greater emphasis on its importance compared to kindergarten teachers. These perceived barriers align with existing research highlighting constraints imposed by school curricula, including time shortages and limited resources, which hinder outdoor learning activities [14], [19]. Conversely, respondents noted that factors such as school regulations, lack of student interest, impractical outdoor spaces, low parental involvement, risk monitoring difficulties, and teacher inexperience were not significant deterrents to outdoor education. These findings contrast with Tuulling et al.'s [16] study, where teachers cited challenges in engaging children and organizing group work outdoors as primary obstacles to outdoor learning.

The availability of accessible and manipulable material resources in outdoor spaces lacked consensus among questionnaire respondents. Limited resources could hinder outdoor activities, and schools might prioritize indoor settings to mitigate potential legal risks. The shortage of necessary tools for outdoor activities and safety concerns were also noted in teachers' responses in Tuulling et al.'s [16] study.

The analysis of teachers' responses to open-ended questions indicates a low level of implementation of STEAM activities, particularly in outdoor settings. These results suggest that teacher training is needed. The limited adoption of these pedagogical methods may result from teachers' reported lack of confidence and proficiency, as evidenced in various studies [7], [14], [17], [19], [21]. Hence, offering training opportunities is crucial for addressing these challenges and enhance teachers' confidence [8].

In conclusion, concerning the educational opportunities afforded by outdoor environments, most teachers express agreement that conducting activities in such spaces promotes the development of diverse skills, facilitates interdisciplinary and collaborative endeavours, nurtures inclusive learning environments, encourages interaction with nature, and engages students sensorially, thereby fostering their holistic development. While acknowledging the benefits of interdisciplinary activities, most respondents highlight constraints in their implementation, citing the rigidity and length of the curriculum framework and the inadequacy of available materials and resources. Concerning STEAM activities in outdoor settings, the absence of learning initiatives underlines the imperative for teacher training.

ACKNOWLEDGEMENTS

This work was supported by national Funds through FCT—Portuguese Foundation for Science and Technology, I.P., under the project number UID/CED/04748/2020.

REFERENCES

- [1] S.M. Jamali, N. Ale-Ebrahim and F. Jamali, “The Role of STEM Education in Improving the Quality of Education: A Bibliometric Study”, *International Journal of Technology Design Education*, vol. 1. pp. 1–22. 2022, doi:10.1007/s10798-022-09762
- [2] T. Stephenson, M. Flear, and G. Fragkiadaki, “Increasing Girls’ STEM Engagement in Early Childhood: Conditions Created by the Conceptual PlayWorld Model”, *Research in Science Education*, vol. 52, pp. 1243–1260, 2022, doi:10.1007/s11165-021-10003-z
- [3] N.H. Kang, “A review of the effect of integrated STEM or STEAM (science, technology, engineering, arts, and mathematics) education in South Korea”, *Asia-Pacific Science Education*, pp. 1-22, 2019, doi:10.1186/s41029-019-0034-y
- [4] K.W. Lindeman, M. Jabot, and M.T. Berkley, “The Role of STEM (or STEAM) in the Early Childhood Setting”, In *Learning Across the Early Childhood Curriculum* (M. Jabot, S. S. Kamil, Eds.), pp. 95–114, Leeds, United Kingdom: Emerald Group Publishing Limited, 2013, doi:10.1108/S0270-4021(2013)0000017009
- [5] E.R. McClure, L. Guernsey, D.H. Clements, S.N. Bales, J. Nichols, N. Kendall-Taylor, and M.H. Levine, “STEM Starts Early: Grounding Science, Technology, Engineering, and Math Education in Early Childhood”, Joan Ganz Cooney Center at Sesame Workshop, 2017, Retrieved from <https://files.eric.ed.gov/fulltext/ED574402.pdf>
- [6] A. Molina-Ascanio, and E. Tasiopoulou, “Outdoor learning in ECEC using EdTech and the STE(A)M approach”, In *Scientix Observatory* (European Schoolnet Ed), pp 1-8, 2023.
- [7] V. Khwaengmek, S. Pitipontapin, P. Pimthong, and O. Bukatunyoo, “Perceptions of pre-service teachers about outdoor learning for STEM Education in early childhood education”, *Journal of Physics: Conference Series 2021*, vol. 1957, no. 012018, 2021, doi:10.1088/1742-6596/1957/1/012018
- [8] J.E. van Dijk-Wesselius, A.E. van den Berg, J. Maas, and D. Hovinga, “Green Schoolyards as Outdoor Learning Environments: Barriers and Solutions as Experienced by Primary School Teachers”, *Frontiers in Psychology*, vol. 10, 2020, doi:10.3389/fpsyg.2019.02919
- [9] K.E. Finn, Z. Yan, and K.J. McInnis, “Promoting Physical Activity and Science Learning in an Outdoor Education Program”, *Journal of Physical Education, Recreation & Dance*, vol. 89, pp.35-39, 2018, doi:10.1080/07303084.2017.1390506
- [10] A. Watson, A. Timperio, H. Brown, B. Keren, and K.D. Hesketh, “Effect of Classroom-Based Physical Activity Interventions on Academic and Physical Activity Outcomes: A Systematic Review and Meta-Analysis”, *International Journal of Behavioral Nutrition and Physical Activity*, vol. 14, 2017, doi:10.1186/s12966-017-0569-9
- [11] B. Haas, Y. Kreis, and Z. Lavicza, “Integrated STEAM Approach in Outdoor Trails with Elementary School Pre-service Teachers”, *Educational Technology & Society*, vol. 24, pp. 205-219, 2021, Retrieved from <https://www.jstor.org/stable/48629256>
- [12] M. Munawar, Y. Setyoadi, P.A. Luthfy, and D. Prasetyawati, “Supporting and Inhibiting Factors of Outdoor STEAM Learning in Early Childhood Education”, *KnE Social Sciences – 6th International Conference on Education and Social Science Research*, pp. 413–424, 2024, doi:10.18502/kss.v9i6.15289
- [13] A. Larsson, and M. Rönnlund, “The spatial practice of the schoolyard. A comparison between Swedish and French teachers’ and principals’ perceptions of educational outdoor spaces”, *Journal of Adventure Education and Outdoor Learning*, vol. 21, pp. 139–150, 2021, doi:10.1080/14729679.2020.1755704
- [14] J.E. Dymont, “Green School Grounds as Sites for Outdoor Learning: Barriers and Opportunities”, *International Research in Geographical and Environmental Education*, vol. 14, pp. 28–45, 2005, doi:10.1080/09500790508668328

- [15] W. M. V. Leung, "STEM Education in Early Years: Challenges and Opportunities in Changing Teachers' Pedagogical Strategies", *Education Sciences*, vol. 13, no. 490, 2023, doi:10.3390/educsci13050490
- [16] L. Tuuling, T. Õun, and A. Ugaste, "Teachers' opinions on utilizing outdoor learning in the preschools of Estonia", *Journal of Adventure Education and Outdoor Learning*, vol. 19, pp. 358-370, 2019, doi:10.1080/14729679.2018.1553722
- [17] P. Atmodiwirjo, "School Ground as Environmental Learning Resources: Teachers' and Pupils' Perspectives on Its Potentials, Uses and Accessibility", *International Electronic Journal of Environmental Education*, vol. 3, no. 2, 2013, Retrieved from <https://files.eric.ed.gov/fulltext/EJ1104866.pdf>
- [18] P. Bentsen, J. Schipperijn, and F.S. Jensen. "Green Space as Classroom: Outdoor School Teachers' Use, Preferences and Ecostrategies". *Landscape Research*, vol. 38, pp. 561-575, 2013, doi:10.1080/01426397.2012.690860
- [19] C.C. Dring, S.Y.H. Lee, and C.A. Rideout, "Public school teachers' perceptions of what promotes or hinders their use of outdoor learning spaces", *Learning Environments Research*, vol. 23, pp. 369–378, 2020, doi:10.1007/s10984-020-09310-5
- [20] D. Erdem, "Kindergarten Teachers' Views About Outdoor Activities", *Journal of Education and Learning*, vol. 7, no. 3, pp. 203-218, 2018, doi:10.5539/jel.v7n3p203
- [21] J. Ernst, "Early childhood educators' use of natural outdoor settings as learning environments: an exploratory study of beliefs, practices, and barriers", *Environmental Education Research*, vol. 20, no.6, pp. 735-752, 2014, doi:10.1080/13504622.2013.833596
- [22] E. Babbie, *The practice of social research*, California: Wadsworth, 1986.