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PRACTICE INSIGHTS

Seedling science communication in rural areas through European Researchers' Night

Raquel Branquinho, Inês Duarte, Cândida Sarabando, Susana Ambrósio, Cláudia Damião, Eduardo Teixeira, Joaquim Duarte and Xana Sá-Pinto

Abstract

This paper presents a practical insight based on the case study of the European Researchers' Night held in the rural village of Armamar, northern Portugal. By moving this initiative beyond traditional academic and urban settings, we helped bridge the gap between science and rural communities, and democratise access to science through a co-creation process, deep-rooted community partnerships, and active student engagement. Drawing from the RERN-Armamar blueprint, we highlight the importance of promoting and/or building from locally established networks of partners, including the school community. Local ambassadors with a diverse range of profiles can act as multipliers, engaging researchers from diverse institutions, teachers, students and their families. Context sensitive formats which promote inclusive, equitable, and sustainable access to science, in addition to the alignment of content with community interests, has further contributed to the success of the action.

Keywords

Public engagement with science and technology; Public perception of science and technology; Social inclusion

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1 ▪ Introduction

The European Researchers' Night (ERN) is an annual event aimed at bridging the gap between science and society [Jensen et al., 2021], fostering public engagement with researchers. Since its inception in 2005, its key goals have been to improve public understanding and perception of science, illustrate its relevance to everyday life, and inspire younger generations to pursue scientific careers [European Commission, 2005]. Today, ERN reaches hundreds of cities, engaging thousands of researchers across Europe in a public celebration of science. The initiative also aims to broaden access to science by reaching new audiences beyond the conventional academic sphere through formats like science shows, art installations, live demonstrations, panel discussions, workshops, and hands-on experiments [Roche et al., 2017].

However, a persistent challenge remains, as most ERN events continue to predominantly occur in urban areas or cities with high population density, mainly near universities, polytechnic institutions, research institutes, or science hubs [Kennedy et al., 2017; Roche et al., 2017; Jensen et al., 2021]. Therefore, it is not surprising that most ERN events occur in venues such as universities, museums, and research institutes, which tend to attract science-aware or part of highly educated audiences. In the literature, only three exceptions include venues such as art galleries and historical sites [Trinity College Dublin, 2012; Cork Institute of Technology, 2012; Science Castle EU, 2021].

As a result, there is a geographic and social asymmetry in the distribution and engagement of science across Europe. This asymmetry, determined by physical proximity to scientific institutions, also impacts the socio-cultural accessibility of science, which frequently fails to engage rural or underserved communities. This bias undermines the ERN's broader mission of inclusivity and equitable access to science. Portugal is no exception to this challenge. In Portugal, as in other European countries, the concentration of ERN events in urban centres highlights the need for additional science communication efforts in rural areas. These regions, often situated at a considerable distance from academic or science hubs, find themselves isolated from opportunities for scientific engagement, exacerbating existing inequalities. To date, there has been a paucity of documentation of ERN events in rural settings (herein designated by the acronym RERN) [Branquinho et al., 2024]. Furthermore, there is a notable dearth of information on the successful organisation of such events in these contexts, as well as on the unique challenges and opportunities they may present.

This paper addresses this gap by reporting on the case study of the RERN event held in the rural village of Armamar, Portugal, located at a considerable distance from traditional academic and metropolitan venues, and represents a non-traditional venue for such event. By exploring the practical insights gained from organising RERN-Armamar, this study evaluates the event through the perceptions of the local community and researchers involved. The findings also provide broader implications for future science communication initiatives in similar settings. By critically assessing this case, the authors aim to contribute to the wider conversation about how science communication practices can be more engaging, inclusive, and accessible, particularly in rural areas, where science is often perceived as distant.

2 ▪ Organising RERN in rural areas: methods and practical insights

2.1 ▪ *The initial steps: defining main goals and their rationale*

The event's initial concept was developed by three of the authors, who have extensive backgrounds in science education and communication, a strong commitment to science communication practices, and deep connections to rural areas. Their aim was to align the event with the ERN's goals while addressing the unique needs of rural communities. RERN-Armamar was designed to democratise access to science, engage with rural communities, and promote scientific literacy, fostering active public participation and lasting engagement with science.

To guide the development of the event, a theoretical framework was applied, consistent with a transformative vision of scientific literacy, which aims to equip individuals with the capacity to engage in scientific debates actively and use science for decision-making and action [Valladares, 2021; OECD, 2023]. According to this framework, scientific literacy is built on three key types of scientific knowledge: i) content knowledge — comprising an understanding of scientific facts, concepts, and theories; ii) procedural knowledge — knowing how scientific investigations are conducted and the methods and practices scientists use; and iii) epistemic knowledge — understanding the nature of science and how scientific knowledge is built and validated. However, scientific literacy is not merely about knowledge — science identity is equally important. A strong science identity is characterised by the following attributes: i) appreciation for science — valuing scientific inquiry, understanding its social relevance, and trusting evidence-based explanations; ii) feeling connected to science — enjoying and engaging with science, seeing oneself as capable of doing science, considering science-related careers, and building relationships with people who work in or understand science; and iii) caring for the environment — being aware of environmental issues, feeling concerned about their impact, and taking action for sustainability [OECD, 2023].

In practice, this framework was embodied to plan the program and design the event's activities. The hands-on activities were mainly developed to promote science knowledge. The engagement of local stakeholders and students in the co-construction and organisation of the event, the "Adopt a Scientist" program and the event's focus on real-world challenges, particularly those pertinent to rural communities (e.g. agriculture, and environmental sustainability), were planned to foster science identity.

2.2 ▪ *Planning and implementing the co-organisation process and ensuring the local community engagement*

To promote public engagement with science in Armamar, the event was organised in collaboration with local stakeholders, who played a crucial role in adapting the event to meet the specific needs of the local community and ensuring active community participation. The objectives of this co-organisation were: i) foster a sense of ownership among local participants, enhancing their science identity; ii) align the event with the community's expectations and social context; and iii) leverage local knowledge and networks to maximise the event's impact [OECD, 2023].

One of the organisers, an active member of the local Science Academy Gomes Teixeira (GOMA), facilitated the project introduction to local stakeholders. GOMA, a well-established local network dedicated to promoting scientific literacy in rural areas, includes key partners such as the public Gomes Teixeira School Cluster (AEGT) and the Municipality of Armamar. This pre-existing collaboration allowed for effective communication and coordination among local institutions, which was instrumental in shaping and organising the event.

The main goals, types of activities, events' location, schedule, and engagement strategies were collectively discussed and decided in a collaborative process coordinated by GOMA. The partners co-developed the final organising plan and allocated tasks among the organisers. Following these initial discussions, other key stakeholders were contacted, including the local Fire Department's prevention team and the Health Centre's nursing staff, who ensured the safety of participants.

GOMA identified and invited three local researchers, all former AEGT students, to join the organising team, further reinforcing the connection between the scientific community and the wider community. These researchers co-lead working groups tasked with organising science stations, logistics and evaluation implementation. Their involvement proved beneficial in multiple ways: firstly, it facilitated the establishment of trust and encouraged more active community involvement; and secondly, it helped to make science more accessible and personally relevant to participants, contributing to the development of their science identity.

The local network was reinforced through national collaborations, including the University of Coimbra (under the SCIEVER consortium — Science for Everyone, Sustainability and Inclusion) [Branquinho et al., 2024], which incorporated Armamar into its thematic framework and provided key institutional support for the event's visibility. Additionally, the Research Centre on Didactics and Technology in the Education of Trainers (CIDTFF) — University of Aveiro contributed by developing an evaluation plan for the event.

To ensure effective implementation, the coordination team organised three meetings with all partners and volunteers during the preparation phase, oriented towards collaborative planning, progress monitoring and finalising the operational details. In the final month preceding the event, meetings with volunteers were held weekly to guarantee that all essential elements were addressed effectively.

2.2.1 ▪ *Defining local ambassadors*

To enhance the impact and sustainability of RERN-Armamar, particular emphasis was placed on the identification and support of local ambassadors — key individuals who played an active role in promoting the event and engaging specific target groups. The ambassadors were selected from both scientific and local community spheres, ensuring stronger outreach and deeper community involvement. Four key profiles were identified — local researchers, teachers, school students and former school students.

Local researchers were expected to have a dual role, acting as connectors between academia and the community. Within the scientific community, they leverage their professional networks to invite colleagues and expand researchers' participation. Within the local community, they were asked to engage their personal networks, promoting the event among family, friends, and community groups. Beyond promotion, their presence at the event

was intended to foster a deeper impact given the shared common background with local participants: helping to foster a sense of identification with science, belonging, interest, self-confidence in scientific abilities, and intentions to engage in future science activities or pursue careers in science and trust in the conveyed message [Kahan et al., 2011; Schiefer et al., 2024]. This approach was inspired by the Native Scientists model [Golle et al., 2022].

Teachers, particularly those already involved in school science clubs (such as GOMA) and/or those motivated to participate in RERN-Armamar, were expected to play a pivotal role as multipliers, by mobilising both educators and students.

Moreover, school students were also invited to act as ambassadors, being enthusiastic promoters among their peers and families, and also playing an active role in encouraging classmates and younger students to attend.

Former students, many of whom had become young researchers, were expected to serve as intermediaries between the school, the local community, and the scientific community. Given their familiarity with these environments, their role was planned to facilitate communication between scientists and the broader community, engaging school students, and encouraging participation from external members of the local community.

2.2.2 ▪ *Designing the RERN-Armamar format and program*

The RERN-Armamar event was held on 29 September 2023 as a free public festival, hosted at the local museum Douro Women's Interpretive Centre (CIMD), situated in the village's historic centre. The programme was designed to engage participants of all ages and backgrounds. To ensure inclusivity and maximise engagement, various activities were offered, catering to diverse interests and learning styles. The programme included:

- Five Flash Talks on the theme 'Science for all: sustainability and inclusion', followed by a question-and-answer session, designed to foster dialogue between scientists and the public [Branquinho et al., 2024].
- Seventeen *Science Stations*, offering hands-on activities focused on rural-relevant topics, including sustainability, natural heritage conservation, health, materials for a more sustainable future, artificial intelligence, and gender equality, among others [Branquinho et al., 2024].
- Guided museum tours, where women's cultural and scientific heritage in the Douro region was highlighted.

The diversity of formats allowed participants to engage with science in ways that were relevant to their lives and interests. This design also enhanced the participants' science identity, including their appreciation for emotional connection to science and their environmental awareness and agency.

Moreover, the close interactions between participants and researchers facilitated direct and meaningful exchanges that enhanced participants' genuine engagement. This is particularly important as even participatory science projects often interpret communication as dissemination. Thus, closer interactions may contribute to changing this perspective, helping to develop researchers' public communication skills and their motivation to promote public

engagement, making science more approachable, creating a lasting connection, and inspiring participants' long-term interest in distinct scientific topics [Golle et al., 2022; Giardullo et al., 2023].

2.2.3 ▪ *Local students' recruitment and involvement in the RERN-Armamar organisation*

The involvement of local students was a key priority and GOMA facilitated their recruitment and participation. In addition to the above this was accomplished by: i) encouraging secondary school students and teachers to actively participate in organising the event; and ii) offering formal incentives whereby students' participation in the event could be included as a bonus in their final discipline grading, a certificate of participation, along with a personalised t-shirt and badge.

Secondary school students were informed about the program's participation options, objectives, and benefits. Those interested filled out an online form indicating their preferred areas of involvement. They could choose to join the "Adopt a Scientist" program and/or assist with logistical and evaluation tasks. Once registered, the volunteers were integrated into a joint WhatsApp group, which was established to facilitate communication between volunteers and coordinators, and for regular updates. The group was also utilised as a channel to resolve any issues that arose. The three local volunteer researchers had a pivotal role in this students' group coordination. In collaboration with the GOMA team, students participated in regular meetings with the volunteer working groups' coordinators to discuss task division, material needs, the evaluation strategy, and the functioning of the "Adopt a Scientist" program. These meetings ensured that all volunteers were well-prepared for their roles and that any potential challenges were addressed in advance. A final preparatory meeting was held a week before the event, where the final schedule and role allocation grid were presented, allowing students to understand their specific responsibilities.

The "Adopt a Scientist" program was an innovative initiative by RERN-Armamar designed to connect secondary school students with researchers to: i) enhance students' scientific knowledge; ii) provide direct access to real-world scientific experiences fostering procedural knowledge; iii) demystify some preconceptions related to science; and iv) deepening students connection to science. By pairing students with scientists, including local ones, the initiative also fostered science identity by encouraging a culture of inquiry among the younger generation, promoting a sense of pride and belonging among the students, and inspiring some to consider pursuing scientific careers.

In this initiative, each participating-student was paired with a maximum of two researchers based on their preferences for specific scientific areas. Briefed on their roles, including assisting the researcher during their activities (defined by each researcher) at the event, students and researchers were introduced on the day of the event. Students were strongly encouraged by their secondary teachers to engage with their "adopted scientists", ask questions, and participate in scientific discussions.

2.2.4 ▪ *RERN-Armamar dissemination and information strategies*

Effective communication with local communities was achieved through public announcements and existing networks, including local schools, NGOs, and municipal

communication channels. Additionally, a strategic dissemination plan was implemented via social media platforms, with active collaboration from participating schools and municipal entities. A participant-oriented approach was emphasised during the event to enhance the overall experience. Drawing on feedback from participants in previous ERN [Roche et al., 2017], each attendee received a user-friendly map (Supplementary material 1) outlining the event agenda and the various activities available. This map was distributed on-site, facilitating navigation and engagement. The number of maps distributed also served as a metric for estimating participant attendance, as each individual entering the venue received a copy.

2.3 ▪ *Researchers' engagement and support*

2.3.1 ▪ *Recruitment phases*

Once the local researchers were engaged, the organising committee expanded the recruitment to non-local researchers. In order to ensure diversity, efforts were made to recruit individuals from a range of genders, disciplines, career stages, and institutional backgrounds, including academic, corporate, and NGO settings. All researchers identified through organisers' contacts and from institutional science communication hubs were invited to the event, with a clear explanation of the event's goals and the expected impact of their participation. In the third stage, a snowball recruitment strategy was employed to broaden participation.

Despite their strong commitment, some challenges emerged, particularly due to researchers' limited availability and their professional obligations, and Armamar's geographical distance from major science hubs. To mitigate these challenges, the organisation implemented several incentives to maximise the commitment of researchers and make participation mutually beneficial. These included: i) framing the event as part of a larger movement to promote scientific literacy and social impact in rural areas, reinforcing its value beyond a single initiative; ii) enhancing professional visibility, as researchers had the opportunity to share their work with new audiences, connect with local institutions, and gain experience in science communication; iii) facilitating networking and interdisciplinary collaboration, fostering connections between researchers and the local community and also between scientists from different fields; iv) offering tailored logistical support, such as travel coordination — transport solutions, including facilitation of group travel, potential accommodation for those travelling from far, and meals; and v) provide professional development opportunities, such as training in science communication for non-specialist audiences and the possibility of leading future outreach initiatives in collaboration with local schools and institutions.

2.3.2 ▪ *Supporting*

Following the confirmation of their participation, approximately six weeks prior to the event, researchers were asked to complete a participation form, including their preferences for the target audience, the formats and types of activities, themes, materials and support required, number of team members for each activity, willingness in joining the "Adopt a Scientist" program, and their interest in attending a science communication workshop.

The two-hour online science communication workshop aimed to help researchers tailor their messages for general audiences and focus on simplifying complex concepts and effectively engaging with non-specialists, through practical exercises. Participants received feedback on their outreach proposals both during and after the workshop.

Individual consultation meetings were held to assist researchers address any potential concerns or uncertainties about logistics, the adaptation of scientific content for non-expert audiences, and general guidance on establishing their science stations or other activities.

2.3.3 ▪ *Cultural and social engagement*

To foster a sense of regional identity, a cultural engagement initiative was devised three hours before the RERN in collaboration with the Armamar Municipality. Researchers were invited to participate in a guided tour of Armamar's historic landmarks, enriching the researchers' understanding of the local context. The social component was complemented with a free dinner provided to researchers, offering also a space for peer networking and exchanging ideas. Researchers were also supported in finding local accommodation.

2.4 ▪ *RERN-Armamar evaluation*

With the RERN-Armamar evaluation we i) assessed participants' perceptions of the event and its outcomes; ii) identified the strengths and weaknesses of the implemented procedures; and iii) gathered suggestions for improving future editions. A combination of methodological approaches was employed, and different audiences were targeted, incorporating both qualitative and quantitative data collection techniques that ensured a more comprehensive evaluation through triangulation [Cohen et al., 2018]. This mixed-methods approach enhanced the validity of the results by drawing from multiple data sources.

Given the nature of the event (open to the public) and its pilot character, we chose to measure participants' perceptions of the event. Measuring scientific literacy across its multiple dimensions would have required a structured pre-post test design, involving extensive survey instruments (e.g. assessment tools such as PISA 2015 [OECD, 2016]), an approach that presents significant challenges in piloting events of this nature. By evaluating the participants' perceptions, we aim to identify specific dimensions of scientific literacy that are expected to be more strongly impacted by events such as RERN, and that can be then tested in future events, with simpler instruments, targeting participants' learning of these specific dimensions.

To assess participants' perceptions, a brief exit survey was administered at the venue. The survey (Supplementary material 2) comprised four Likert-scale statements (1 — strongly disagree, 5 — strongly agree) designed to assess aspects of science identity [OECD, 2023], such as interest in science, self-perceived ability to engage in science-related tasks, expansion of science-related social networks, and the perceived value of science in addressing local issues. To make this evaluation instrument easier to be answered in such content and engaging, the questions were positioned to form a square with the respective Likert scales on the edges (see Supplementary material 2). Participants were asked to make a tear on the value of the Likert scale that represented their opinion regarding each question. To complement this data, participants were also invited to leave additional feedback on

organisers' flipcharts installed on the way out of the event. This feedback was subsequently analysed using inductive content analysis [Cohen et al., 2018] and using descriptive statistics in Microsoft-Excel.

To gain insights from the perceptions of RERN-Armamar volunteers (who are involved in event coordination, welcoming participants, administering surveys, guiding visitors through science stations, and assisting scientists with activities, including the "Adopt a Scientist" programme), a focus group was conducted. The focus group comprised six volunteers (see Supplementary material 3 for the script), herein focused on pivotal questions (numbers 1 and 6) pertinent to this paper. After being transcribed and anonymised, data was subjected to inductive content analysis [Cohen et al., 2018]. The focus group was conducted by one of the authors, with the volunteers having no prior acquaintances.

Researchers who participated in the event were also asked to fill out a questionnaire (see Supplementary material 4) that included both closed and open-ended questions. The closed questions invited the researchers to rate their overall experience of RERN-Armamar on a scale of 1 (poor experience) to 7 (excellent experience). The open-ended questions sought to capture researchers' views on the strengths and weaknesses of the event and suggestions for future improvements and were subjected to inductive content analysis.

3 ▪ RERN-Armamar evaluation results

3.1 ▪ *Researchers' engagement, diversity and evaluation*

RERN-Armamar brought together twenty-six researchers from nine scientific disciplines, encompassing fields as diverse as: microbiology (health, food and aquatic microbiology), chemistry (organometallic and environmental chemistry), biology (natural heritage management and conservation), materials science, renewable energy, food science, sports sciences, social sciences (including science communication, sociology and inclusion), biophysics and nanomedicine, astrophysics, education sciences, computer graphics and artificial intelligence [Branquinho et al., 2024]. This broad scientific spectrum provided participants with unique opportunities to engage with a diverse range of research areas. However, there was a noticeable predominance of researchers from the natural and/or health sciences, which may have inadvertently restricted the participants' exposure to a more balanced representation of scientific disciplines. Future editions of RERN could benefit from targeted efforts to increase disciplinary diversity. Among researchers, the gender distribution was 61.5% female and 38.5% male. Researchers represented fourteen institutions, including private companies (n = 2), non-governmental organisations (n = 3), public (n = 12) and private (n = 7) universities, and polytechnic institutes (n = 2). Future editions of RERN could benefit from targeted efforts to involve a more balanced representation of scientific sectors, ensuring a broader range of perspectives and expertise for participants. It is noteworthy that seven (26.9%) of the researchers were native to Armamar, thereby reinforcing local ties. When the round trip is considered, on average, the researchers covered 298.6 km (maximum 728 km, minimum 78 km) and spent 3 h 28 m travelling (maximum 7 h 18 m; minimum 1 h 10 m) to participate in RERN.

Of the twelve researchers who provided feedback, ten rated the overall event as "excellent" (7), and two rated it as "very good" (6). The positive aspects of RERN-Armamar most

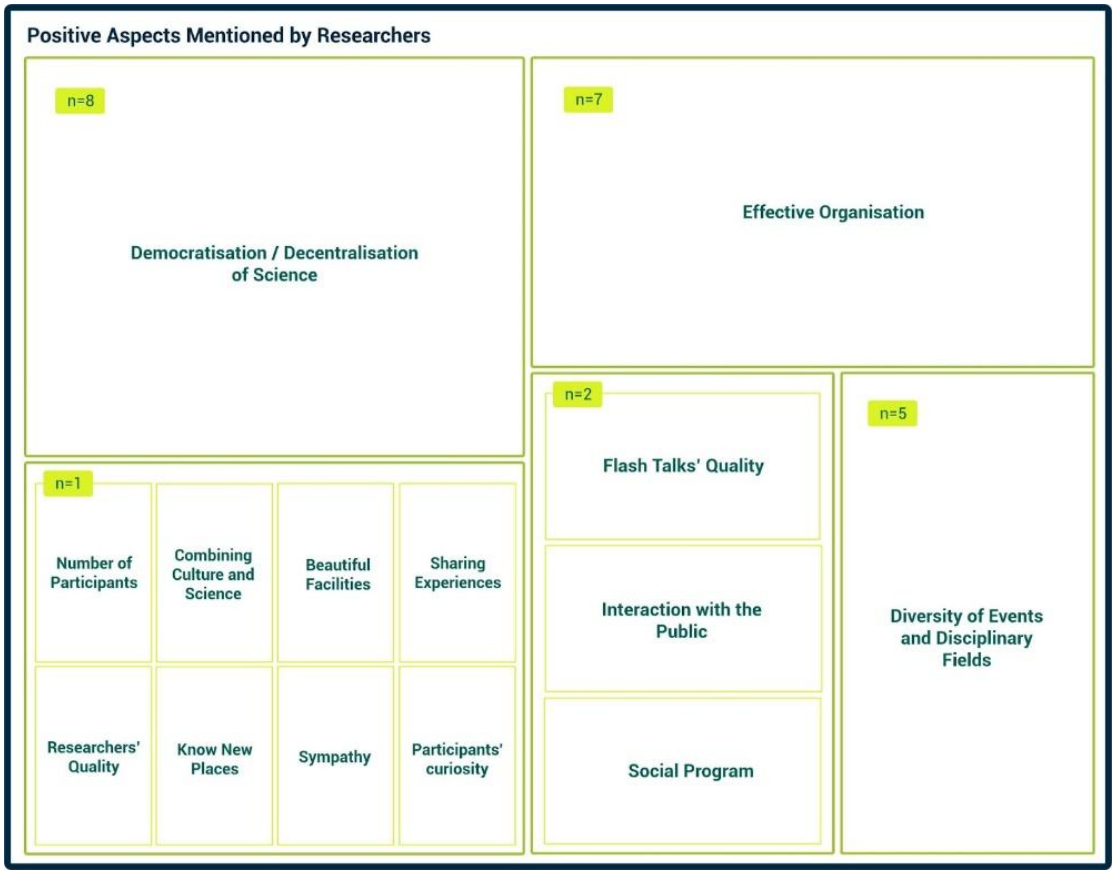

Figure 1. Positive aspects highlighted by researchers. 'n' represents the number of researchers who mentioned each aspect.

frequently cited by the researchers included the contribution of the event to decentralise and democratise access to science, its effective organisation and the diversity of disciplinary fields and events (see Figure 1). Additionally, interactions with the public, the social programme and the quality of the flash talks were also mentioned by more than one researcher.

According to the researchers, the less positive aspects of RERN-Armamar included the restricted time available for interaction with other researchers and the public, and also the limited space in the facilities (for a comprehensive list of less positive aspects see Figure 2).

In terms of potential areas for improvement for future RERN, the researchers identified the possibility of extending the duration of the event, including discussion forums, relocating the event to a larger facility, and enhancing the dissemination of the event (see more in Figure 3).

Several words used by researchers to describe RERN-Armamar (Figure 4) suggest that they associate this event with knowledge and learning ("science", "knowledge", "learning", "literacy", "curiosity"), community engagement ("community", "community interactions", "interactions", "sharing"), positive feelings ("happiness", "fun", "smiles", "enthusiasm", "inspiring", "hope"), to an innovative event ("historic", "disruptive"), good practice ("success", "good example"), and features of the region ("apples", "landscape").

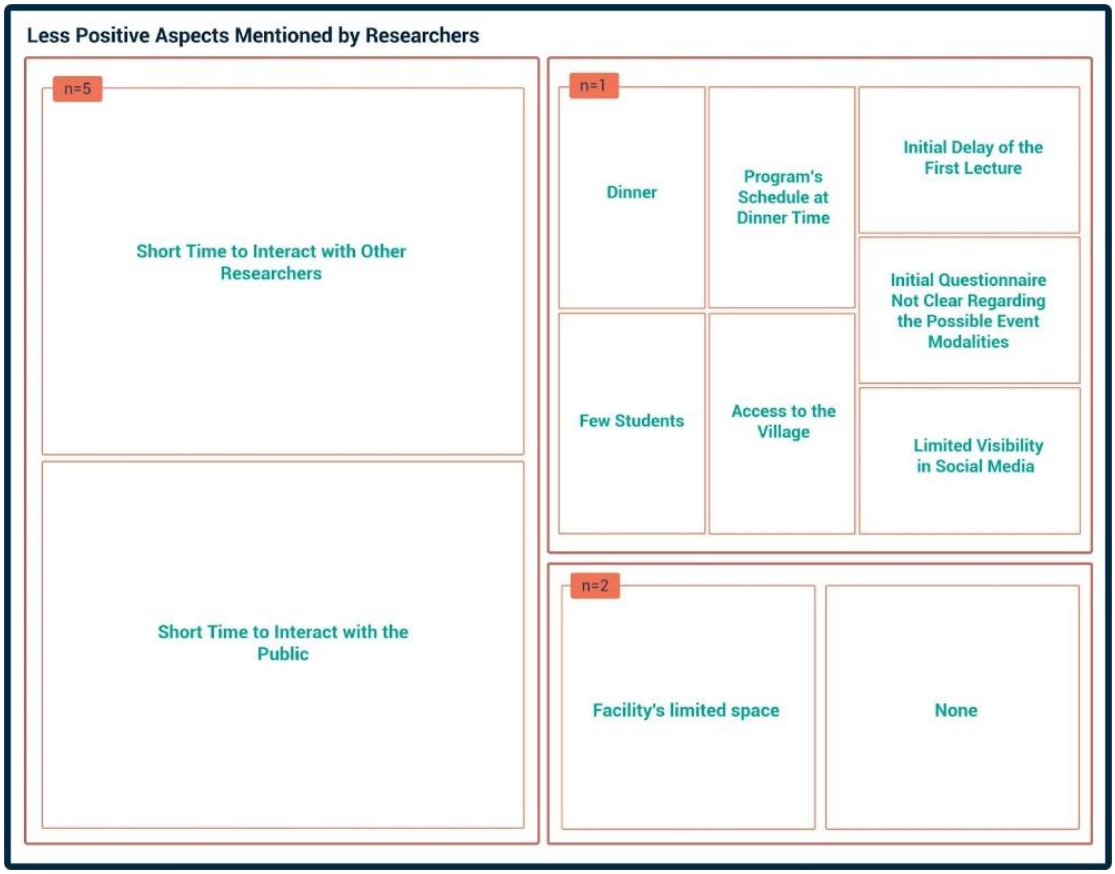

Figure 2. Less positive aspects highlighted by researchers. 'n' represents the number of researchers who mentioned each aspect.

3.2 ▪ *Community engagement and perceived impact of RERN-Armamar*

RERN-Armamar successfully engaged a diverse audience of over 207 participants, ranging in age from one to over seventy years old. Of these, 55 were local high school students who volunteered to co-organise the event.

3.2.1 ▪ *Participants' perceptions of RERN-Armamar*

A total of 121 valid questionnaires were collected from participants. The results suggest enhanced community engagement in scientific endeavours promoted by their participation in RERN-Armamar, with 97% of participants expressing a willingness to collaborate with researchers as active citizens following the event. According to the participants' perceptions, RERN-Armamar also contributed to the development of two important elements of science identity, with 98% of respondents agreeing that their interest in learning science was heightened and 89% of participants recognizing that their communities are home to numerous scientists.

Most of the feedback provided by the participants to the researchers and organisers of the event, in the flip charts, reinforced the feeling of enthusiasm and interest towards science (n = 17, ex: "I loved it! It was incredible") and the excellence of the initiative (n = 11, ex:

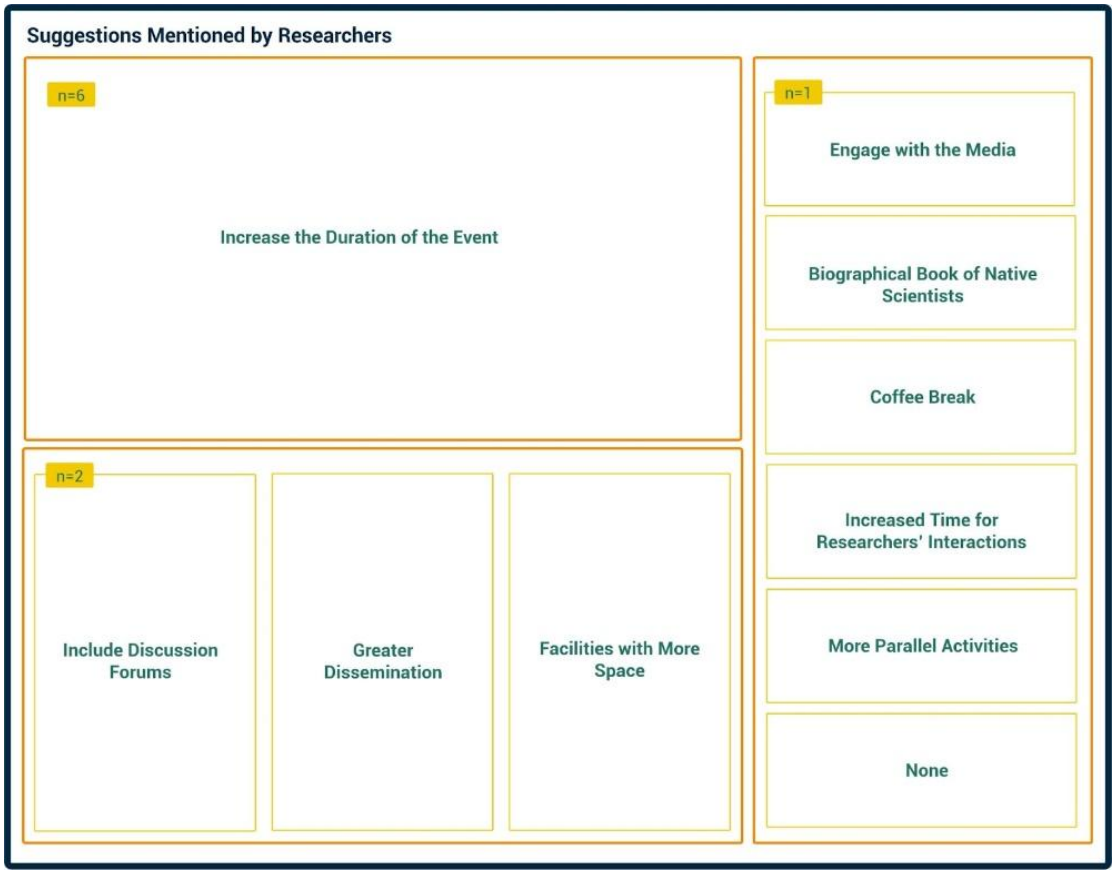

Figure 3. Suggestions highlighted by researchers. 'n' represents the number of researchers who mentioned each aspect.

"Excellent!"; "Great initiative"). Seven participants reinforced the importance of repeating RERN-Armamar or science-related events (ex: "Yes it was important, events of this kind should be repeated"). Two participants mentioned the effective organisation (ex: "It was very well organised") or its importance for science knowledge (ex: "Good and useful transmission of knowledge").

However, we should recognise that our evaluation focused solely on participants' perception of the event's impact, rather than assessing their actual learning, which would require a pre- and post-test approach. As we did not collect data on participants' initial level of science identity, it is unclear whether the event also attracted individuals with low interest and motivation in science or primarily engaged those who already had a stronger science identity, as reported for other science festivals [Kennedy et al., 2017]. In addition, no detailed socio-economic or educational background data of participants were collected, which limits our ability to assess the representativeness of the audience. These constraints were a consequence of logistical challenges and the informal and piloting nature of the event. Nevertheless, we recognise that such data holds significant value for future evaluations; therefore, future RERN editions could incorporate an approach for its collection, as well as implementing targeted outreach strategies to engage eventual underrepresented groups.

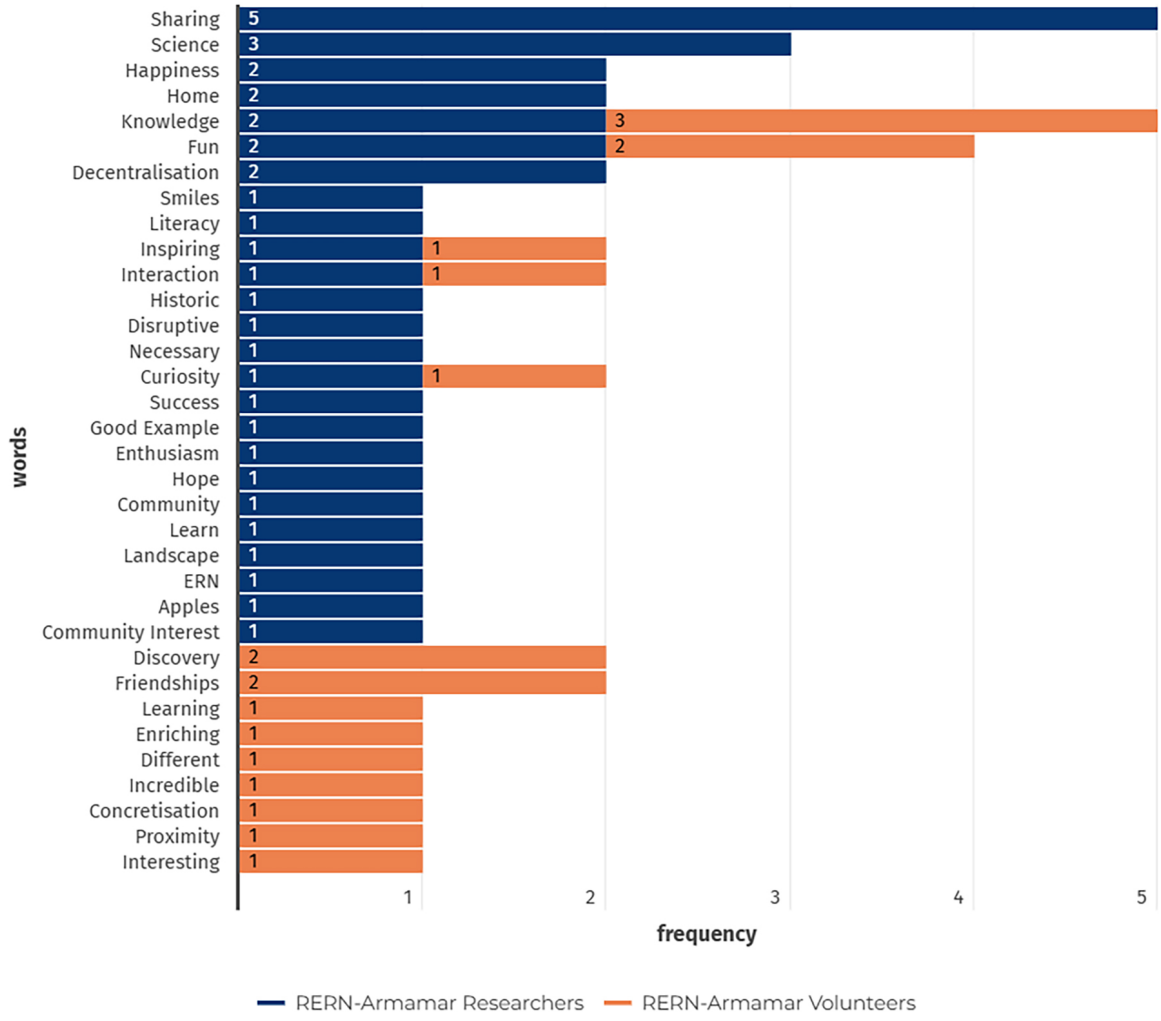

Figure 4. Bar chart representing what RERN-Armamar means to (blue bars) researchers and (orange bars) volunteers.

3.2.2 ▪ *Volunteers' perceptions of RERN-Armamar and their suggestions for the future*

The results from both the participants' and researchers' questionnaires align with those from the content analysis of the volunteers' focus group. When asked whether RERN-Armamar inspired them with ideas for science communication projects in Armamar, four volunteers emphasised the importance of ensuring the continuity of RERN. Three volunteers highlighted the need to broaden the range of research areas covered, with one explicitly mentioning the inclusion of more social sciences. Four volunteers also suggested increasing the number of events, recommending a focus on specific audience segments, such as senior adults (n = 2) or preschoolers (n = 1), and addressing topics like agricultural challenges (n = 1). They also proposed alternative formats such as science cafés, digital events (n = 1), or citizen science initiatives involving farmers (n = 1). Additionally, one volunteer pointed out the need to improve researchers' communication skills.

The terms used by volunteer-participants to describe RERN-Armamar (Figure 4) reflect the focus on knowledge and learning ("knowledge", "discovery", "learning", "curiosity"),

community engagement (“interaction”, “proximity”, “friendships”), positive emotions (“fun”, “inspiring”, “enriching”, “incredible”, “concretization”, “interesting”), and to an innovative event (“different”).

3.2.3 ▪ *Strengthening community engagement: challenges and adaptations*

The establishment of strategic partnerships with local institutions (e.g. schools, municipalities and other organisations) ensures that the event’s impact is extended beyond a one-time initiative. These stakeholders were actively involved from the planning stages, co-designing activities and contributing throughout all phases of the event. However, the process presented several challenges, which required adaptive strategies to facilitate engagement and promote long-term sustainability.

One of the primary challenges was logistical constraints, particularly the limited availability of key stakeholders, such as teachers and school students. To address this, participation was made more flexible by aligning key activities with existing school initiatives.

Another challenge emerged from diverging expectations among stakeholders, as these different groups approached the event with distinct perspectives. To ensure alignment, regular meetings were held to clarify objectives and foster a balanced approach that incorporated both scientific and community-driven perspectives.

Moreover, there was also an initial scepticism regarding the level of community participation, particularly concerning whether the event could truly engage a broad audience. However, as the planning process advanced, interest increased significantly, largely driven by the active involvement of students and teachers, demonstrating the community’s strong willingness to participate in science-related activities.

Ensuring sustained engagement beyond the event was also a key concern. To address this, a sense of belonging was cultivated among local ambassadors, encouraging them to take part in post-event science initiatives.

3.3 ▪ *Medium-long term RERN-Armamar results*

Beyond the immediate impact of RERN-Armamar, several medium- to long-term outcomes have emerged that reinforce the event’s impact on the community. One of the most significant post-event developments was the funding of a Ph.D. scholarship dedicated to research on open schools in rural areas, demonstrating how the initiative contributed to fostering new academic opportunities in the field.

Another key outcome was the publication of a co-created book [Branquinho et al., 2024], which brought together 62 stakeholders in a collaborative effort to document and reflect on the event. This book serves as a record of the collective experience and also reinforces the participatory nature of the initiative and further engages the community in discussions about science.

In addition, RERN-Armamar provided the basis for the creation of the NGO Arma-Sci, an achievement that highlights the sustainability of the event and its potential for long-term impact. By establishing a formal structure for the democratisation of science in rural

communities, Arma-Sci ensures that the connections and momentum generated by RERN-Armamar will continue beyond a single event. Since its establishment, Arma-Sci has already organised dozens of events that brought researchers to Armamar.

Finally, a second edition of RERN-Armamar was successfully organised in 2024, demonstrating that this initiative is becoming a recurring opportunity for science engagement in the region. With each iteration, the event strengthens its role in bridging the gap between rural communities and scientific institutions, ensuring that science remains accessible and relevant to the local community.

4 ▪ Key insights and pathways for future initiatives

The RERN-Armamar event exceeded expectations, attracting a considerable number of participants and generating overwhelmingly positive feedback, with many participants expressing a desire to see the event become an annual tradition.

Moreover, the results provide important insights to guide future editions of RERN:

a. Building strong partnerships
The success of RERN-Armamar was largely attributed to strategic partnerships with local stakeholders, crucial for planning and organising the event, as well as enhancing community engagement. This collaboration also laid the foundation for the creation of a network of local ambassadors, who played an essential role in engaging their peers and securing resources for the event. Moreover, this network proved pivotal not only for the event's success but also for maintaining long-term connections between the local community and academia (bridged by ARMA-Sci), also demonstrating that this model can foster long-term science engagement beyond the event itself, ensuring its sustainability.

b. Empowering students as drivers of engagement
Local school students played a central role in the event's success, acting as volunteers and as local ambassadors promoting community participation and extending the event's reach by bringing their families, friends and/or neighbours into the fold. They also had the opportunity to apply valuable soft skills such as teamwork, communication and leadership in a real-life context. The formal recognition of students' contributions through certificates and evaluation credits fostered a sense of ownership and pride in their roles, motivating them to remain involved in future science-related activities and demonstrating the value of their involvement in the event's overall success.

c. Foster researchers' engagement
The organisation of events as RERN-Armamar faces a significant challenge arising from the distance researchers must travel to reach rural areas, as well as the time and financial resources expended on these travels. This necessitates the provision of meaningful incentives to encourage researchers' participation, as highlighted by Calice and co-workers [2022]. Efforts such as training researchers in science communication, organising cultural visits and networking dinners, and offering opportunities for involvement in community-driven projects — like the collaborative book [Branquinho et al., 2024] — were introduced to enhance the appeal of participation in RERN-Armamar.

Despite these initiatives, our personal observations suggest that some researchers struggled to effectively simplify their presentations for non-expert audiences. This feedback

underscores the need for ongoing training to support scientists further in connecting with the local community. Offering specialised workshops prior to the event is expected to enhance their ability to present complex ideas in a more engaging and accessible manner and to engage in a proper and meaningful dialogue with the participants.

Moreover, feedback indicated that the one-day event format limited the depth of interaction between researchers and the community. Extending the event over two days would allow researchers and participants the time and space to build stronger connections, crucial to creating long-term collaborations. Additionally, partnering with local accommodations to facilitate overnight stays would mitigate logistical challenges, offer more flexible scheduling arrangements, and guarantee researchers sufficient time to recuperate and fully integrate with the local community.

d. Promoting long-term engagement and sustainability

Looking forward, one of the key challenges is ensuring these initiatives' long-term sustainability. For RERN-Armamar and similar events to have a lasting impact, they need to move beyond one-off events and instead foster ongoing relationships between communities and researchers through co-created projects and continuous engagement.

While RERN-Armamar can serve as a blueprint for other rural areas, it is essential to tailor the event to the unique requirements and contexts of each community aimed to be extended to expand. A collaborative model that incorporates local leaders, community members, educators, and researchers during the planning process could ensure the initiative effectively addresses local issues while enhancing scientific literacy and empowering community members to become actively engaged in scientific endeavours.

e. Events' evaluation

The use of quick-feedback methods (Supplementary material 2) and qualitative feedback boards proved effective in gathering input from youngsters and adults. In addition, the involvement of student volunteers in this task was instrumental in encouraging participants to share their thoughts, resulting in a higher response rate. However, it was found that younger children struggled with these feedback forms. Developing age-appropriate feedback tools will ensure that all voices are heard, especially those of younger participants. Furthermore, to ensure the long-term impact of RERN-Armamar, future initiatives should incorporate a structured evaluation framework that extends beyond immediate post-event feedback and participants' perceptions. As highlighted by Volk and Schäfer [2024], science communication events evaluations often focus on short-term indicators such as attendance numbers or participant satisfaction, which, while valuable, do not fully capture the depth of engagement or sustained impact. A more robust evaluation strategy should include holistic assessment models, combining quantitative and qualitative methods to measure not only outputs but also medium- and long-term outcomes. This could include participant tracking, follow-up surveys or interviews months after the event, and case studies to assess lasting changes in learning, perceptions, attitudes, and engagement with science. Additionally, implementing mixed-method approaches — blending self-reported surveys, in-depth qualitative interviews, and behavioural data — could help build a more comprehensive understanding of how science communication events contribute to long-term community engagement and scientific literacy and a more complete picture of the RERN impact. However, and as noted by Volk and Schäfer [2024], evaluations should also adapt their methodologies to the audience and event format, younger participants may require

interactive feedback tools rather than traditional surveys, while community leaders may be better engaged through structured focus groups.

Finally, establishing clear indicators for assessing long-term impact — including metrics related to sustained community engagement, partnerships formed, and the influence of events on local scientific literacy — would enhance the ability of future RERN editions to demonstrate tangible benefits beyond the immediate experience of the event.

Sustaining this momentum also requires continuous identification and empowering of local ambassadors, a key strategy to driving future editions and fostering long-term engagement in rural settings. This strategy will help build a robust network of interconnected rural communities, thus collectively contributing to the democratisation of science.

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About the authors

Raquel Branquinho. *University of Porto, Faculty of Arts and Humanities (FLUP), Porto, Portugal. ARMA-Sci — Armamar Science Capital Promotion Network (Rede de Promoção do Capital Científico de Armamar), Armamar, Portugal.*
Raquel Branquinho is a microbiologist with a Ph.D. in Pharmaceutical Sciences and a researcher at the University of Porto (FLUP). She is co-founder and president of ARMA-Sci NGO and board-member of GOMA. Her research focuses on decentralising and democratising science in rural areas through community-driven initiatives that bridge academia with societal needs, exemplified by her coordination of European Researchers' Night in rural settings. Moreover, Raquel developed numerous public engagement and education initiatives to foster scientific literacy and promote inclusive access to science in underserved communities.
fraquelb@gmail.com

Inês Duarte. *ARMA-Sci — Armamar Science Capital Promotion Network (Rede de Promoção do Capital Científico de Armamar), Armamar, Portugal.*
Inês Duarte is a marine scientist with a MSc in Marine Sciences — Marine Resources from the University of Porto. As a board member of ARMA-Sci and GOMA, she promotes science literacy in underserved communities. Passionate about science communication and decentralisation, she has contributed to public engagement projects, including organising European Researchers' Night in rural areas. Having grown up in a rural context, Inês is committed to reducing barriers to science through education and community-driven initiatives.
ines.nogduarte@gmail.com

Cândida Sarabando. *Gomes Teixeira School Cluster (Agrupamento de Escolas Gomes Teixeira), Armamar, Portugal. ARMA-Sci — Armamar Science Capital Promotion Network (Rede de Promoção do Capital Científico de Armamar), Armamar, Portugal.*
Cândida Sarabando is the Coordinator of GOMA and a Physical Chemistry teacher at the Gomes Teixeira School Group, as well as a member of the Direction Board of the School Cluster, holding a Ph.D. in Education. She has pioneered developing formal and informal activities that promote the school's engagement with the Armamar community. Cândida also leads the European Researchers' Night in Rural Environments initiative for the school cluster and GOMA, fostering collaboration between academia and local communities to enhance scientific outreach and education.
candidasarabando@hotmail.com

Susana Ambrósio. *University of Aveiro, Research Centre in the Didactics and Technology in the Education of Trainers (CIDTFF.UA), Aveiro, Portugal.*
Susana Ambrósio holds a Ph.D. in Education and is a researcher at the Research Centre in Didactics and Technology in the Training of Trainers (CIDTFF) at the University of Aveiro in Science Communication in Education. She develops projects that bring society and the social sciences closer together. She was born in Guarda and lives in Viseu. She believes that being from the interior is a sign of quality but that it is necessary to continue creating conditions so that interiority is no longer an obstacle to access to education and scientific knowledge.
susanaambrosio@gmail.com @susanaambrosio

Cláudia Damião. *Municipality of Armamar (Department of Science, Heritage, Tourism, Youth, Social Action and Health), Armamar, Portugal. ARMA-Sci — Armamar Science Capital Promotion Network (Rede de Promoção do Capital Científico de Armamar), Armamar, Portugal.*
Cláudia Damião has been the Councillor for Science, Tourism, Cultural Heritage, Social Action, Youth, and Health in Armamar since 2005. A specialist teacher in Curriculum Development and Educational Management and Administration for primary education, she has extensive experience in promoting and coordinating community and cultural intervention projects. She also leads the European Researchers' Night in Rural Environments initiative for the municipality and oversees the Municipal Plan for Equality and Non-Discrimination, working to foster inclusivity and social equity in the region.
cjesus@cm-armamar.pt

Eduardo Teixeira. *Research Center in Physical Activity, Health and Leisure (CIAFEL), Faculty of Sports, University of Porto (FADEUP), Porto, Portugal. Laboratory for Integrative and Translational Research in Population Health (ITR), University of Porto, Porto, Portugal. CIDEFES — Lusófona University & CIFI2D — University of Porto, Porto, Portugal. Interdisciplinary Centre for Education and Development (CeiED), Lusófona University, Portugal. Sport Physical Activity and Health Research & Innovation Center (SPRINT), Portugal.*
Eduardo Teixeira holds a Ph.D. in Physical Activity and Health from the Faculty of Sports of the University of Porto (FADEUP). He is an Assistant Professor at the University Lusófona, and an Associated Researcher at the Research Centre in Physical Activity, Health and Leisure (CIAFEL), FADEUP, Portugal. He addresses two main research fields: 1) exercise and

sedentary behaviour effects on skeletal muscle quality in sports, health and disease, and 2) digital remote monitoring of physical activity, exercise and health-related physical fitness.

edsilvateixeira@gmail.com

Joaquim Duarte. *Gomes Teixeira School Cluster (Agrupamento de Escolas Gomes Teixeira), Armamar, Portugal. ARMA-Sci — Armamar Science Capital Promotion Network (Rede de Promoção do Capital Científico de Armamar), Armamar, Portugal.*
Joaquim Duarte is the Director of the Gomes Teixeira School Group and a historian with extensive teaching experience in Social Sciences and Humanities. He has a strong background in various pedagogical development projects that have had a significant social impact. Additionally, he is a member of the ARMA-Sci NGO, contributing to initiatives that promote scientific engagement in rural communities.

calheirosduarte@sapo.pt

Xana Sá-Pinto. *University of Aveiro, Research Centre in the Didactics and Technology in the Education of Trainers (CIDTFF.UA), Department of Education and Psychology, Aveiro, Portugal.*
Xana Sá-Pinto has a Ph.D. in Biology and is a researcher in educational sciences. Her research is focused on local and international projects that promote the articulation of researchers with non-academic community partners for the co-development of initiatives and monitoring/evaluation systems to address educational and sustainability problems and to produce scientific knowledge to answer new questions.

xanasapinto@gmail.com @xanasapinto

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Supplementary material

Available at https://doi.org/10.22323/1474202507101000026
Supplementary material 1 — Map displaying the RERN-Armamar agenda and the various activities available
Supplementary material 2 — Questionnaire provided to the participants that attended the ERN in Armamar
Supplementary material 3 — Interview script used in the focus group with ERN Volunteers from Armamar
Supplementary material 4 — Questionnaire provided to the researcher involved in the ERN in Armamar

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