Research Article

Gerard Remolins Zamora*, Juan F. Gibaja, Izaro Quevedo-Semperena, Miriam Cubas, Millán Mozota, Nidia Aliseda, Berta Morell, Marta Portillo

Engaging the Public Through Prehistory: Experiences From an Inclusive Perspective

https://doi.org/10.1515/opar-2024-0029
received September 25, 2023; accepted October 7, 2024

Abstract: The aim of this article is to advocate and raise awareness of the vital need for universal, barrier-free and inclusive scientific dissemination: outreach in which everyone is involved in the whole process, from the design of the activity to its assessment. It starts with some reflections and the practical process used to develop new activities and didactic tools. Three experiences with groups with difficulties in accessing knowledge are then presented. First, we describe a Neolithic cookery workshop for immigrant students with language difficulties, which enabled them to obtain a certificate of professional insertion. Second, we present an archaeological research simulator to explain the scientific method to people with different intellectual disabilities. Third, a giant board game was designed to entertain and make children undergoing cancer treatment experience the challenges of the Neolithic period. Finally, we assess the outcomes of the activities and draw some conclusions.

Keywords: inclusive dissemination, prehistory, didactic tools, neglected collectives, democratization of science

1 Prehistory: The Science of Materiality

Prehistory is the science that studies past communities before the origin and spread of writing. In this field, material culture is the only available evidence with which to approach it, although it can be explored from fieldwork activities to the laboratory. Therefore, materiality is the basis of the discipline, which has led to the development of a mosaic of different applications from several fields of study. Over the past decades, research has developed new approaches and techniques to address the study of the evidence uncovered at archaeological sites, from sediment to the recovery and identification of ancient biomolecules (Weiner, 2010).

*** Corresponding author: Gerard Remolins Zamora**, ReGiraRocs SLU, Recerca, Conservació i Difusió del Patrimoni Cultura i Natura dels Pirineus, AD700, Escaldes-Engordany, Principality of Andorra, e-mail: info@regirarocs.com
Juan F. Gibaja: Institució Milà i Fontanals (IMF-CSIC), Grupo Investigación y Divulgación en Arqueología, E-08001, Barcelona, Spain, e-mail: jfgibaja@imf.csic.es
Izaro Quevedo-Semperena: Institució Milà i Fontanals (IMF-CSIC), E-08001, Barcelona, Spain, e-mail: izaroquevedosemperena@gmail.com
Miriam Cubas: Área de Prehistoria, University of Alcalá, E-28801, Alcalá de Henares, Spain, e-mail: miriam.cubas@uah.es
Millán Mozota: Laboratorio Agroalimentario de Santander, Ministerio de Agricultura, Pesca y Alimentación, E-39011, Santander, Spain, e-mail: millanmozota@gmail.com
Nidia Aliseda: Dirección General de Patrimonio Cultural, Comunidad de Madrid, E-28014, Madrid, Spain, e-mail: nidiaalisedag@gmail.com
Berta Morell: Department of Archaeology and Anthropology, Archaeology of Social Dynamics (2021SGR 501), Institució Milà i Fontanals, Spanish National Research Council (IMF-CSIC), E-08001, Barcelona, Spain, e-mail: bertamorell@imf.csic.es
Marta Portillo: Department of Archaeology and Anthropology, Archaeology of Social Dynamics (2021SGR 501), Institució Milà i Fontanals, Spanish National Research Council (IMF-CSIC), E-08001, Barcelona, Spain, e-mail: mportillo@imf.csic.es

In this context, the systematic study of an archaeological site can sometimes be challenging as it may involve a huge number of researchers and specialists in different topics. However, this makes it the perfect subject to improve and to motivate the interest of different social groups. Like any discipline nowadays, one of the main goals of prehistory is to disseminate scientific knowledge and to create and motivate a scientific culture among diverse sectors of the society. In this regard, materiality is a powerful tool to develop new projects and methodologies to engage different sectors of the general public.

Public engagement initiatives are common in prehistory, with different strategies depending on the outreach event. However, most of them are isolated activities to engage just some sectors of society, and integral and systematic projects, which develop specific activities oriented to different social agents, are scarce. Article 27 of the Universal Declaration of Human Rights states that "Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits." With this objective in mind, in recent years, we have developed several scientific dissemination programs oriented to different agents and encouraged a wide range of activities.

Science in general, and prehistory in particular, has not always been accessible to the diverse range of profiles that make up the citizenry. This reality is difficult to understand if we assume that all knowledge generated by research should be freely accessible to everyone regardless of age, sex, religion, origin, educational level, or social status.

In this study, we summarize our experiences in scientific dissemination in the fields of prehistoric archaeology and heritage by taking into account different social sectors and audiences, in which the collaboration between researchers, teachers, educators, museum curators, and social agents has been crucial.

2 Design of Public Dissemination Tools

There are many initiatives for scientific dissemination of and through archaeological heritage, but inclusive knowledge-transfer actions are scarce or little known (Jardón, 2016; Parisi, 2022). Despite this, these projects enjoy a high level of success (Conci et al., 2020; Monzó et al., 2019). Part of their success lies in the persistence and development of a proposal specifically designed and implemented for the target group. Some references with a long trajectory are the inclusion of indigenous communities in archaeological research in Ontario (Doroszenko, 2022), or the co-construction of knowledge with the rural population carried out by the University of Oviedo (Fernández et al., 2022). The dynamics of the work and the materials developed are so specific that they can rarely be adapted to other groups, which means that inclusivity is not universal.

For this reason, it is necessary that all didactic activities and tools are designed and adapted from their conception to the heterogeneity of the capabilities (physical and intellectual) and interests of these different collectives that make up the society.

The diversity within society makes it difficult to develop a standardized theoretical corpus to guide the design of tools for universal, barrier-free, and inclusive scientific dissemination. This reinforces the need for the teams that carry out inclusive scientific outreach, which are certainly not few, to publish their experiences and results (Comendador, 2016, 2022). In an attempt to overcome these handicaps and provide a solid structure to guide the current and future design of didactic tools, four premises or working postulates have been established: experience, empathy, interdisciplinarity, and creativity (Remolins et al., 2022).

The first relates to the experience of the developers and mediators, with the practical knowledge gained providing the basis for anticipating the needs of future participants and the means to perfect the discourse and materials, making them more effective and inclusive. In addition, the experience should facilitate empathy between developers, mediators, and the participants. This second premise emphasizes that the design of didactic tools should be carried out from the perspective and position of the participants and users. This process is particularly important when working with people with different needs, such as those with physical or intellectual disabilities, mental illness, the elderly, or those with limited educational backgrounds. The aim is to ensure that the specific need of everyone is respected.

However, the ability to connect with the participants is not always self-evident, which is why interdisciplinarity is used as the third basic principle. Being able to count on the support and opinions of different professionals (researchers, teachers, educational psychologists, guides, social agents, etc.), in the public itself and in the people around them, is essential for the correct design of materials and activities (Gibaja et al., 2019). Finally, creativity is the principle for overcoming different challenges. It is helpful to continue to use scientific thinking to critically evaluate each action in the process of creation and dissemination, but also to use the heuristic method of trial and error to develop knowledge.

At the same time, it was considered that educational tools should have certain basic characteristics in order to meet the needs of dissemination and, in particular, to attract the interest of those groups that have traditionally been less drawn to science. Apart from the unquestionable ludic educational purpose of scientific outreach, educational tools must also be adaptable to any situation and environment. The materials must therefore be accessible, easy to store and transport, and quick and easy to assemble and collect anywhere (indoors or outdoors). At the same time, components must be reusable to ensure that activities can be repeated without additional economic cost and to contribute to environmental sustainability. In this sense, we are committed to a type of sensorial didactic tool that incorporates elements such as colours, sizes, textures, shapes, and smells; key elements that naturally encourage participation.

After years of work in dissemination, the design of new tools begins with an exploration of the possibilities they offer, in our case, in the field of Prehistory (archaeological parks, museums, didactic companies, etc.). To ensure a better understanding of the different alternatives, they are first experienced from the perspective of the participants and then implemented as mediators. In turn, an existing marketing-specific resource (Kaplan & Norton, 2004), the unique selling proposition, is reused and adapted for its analysis. It describes the characteristics of current activities and the benefits that new didactic tools should bring to users.

During the analysis and further development of the materials, particular attention is paid to the user's experience at an experiential, affective, practical, and useful level. This approach, which is currently used in the digital field (Tulli & Albert, 2013), guides the design of these tools to allow participants to interact with the material in a more intuitive way, ensuring easier and less time-consuming dissemination. Therefore, didactic tools should present challenges that are accessible to the participants, including the solution that can be achieved through practice, reflection, and critical research.

In the end, this approach aims not only to transfer universal knowledge but also to be a source of diverse educational experiences that engage society in the knowledge-building process. The materials are designed with inclusive and sensory engagement in mind. Activities are designed to stimulate deduction, critical thinking, collaboration, and creativity among the participants, and to encourage dialogue with the mediator. The disseminators act as simple intermediaries, guiding the reflection or giving clues when the group is stalling, or the tool is not working properly. This means that none of the activities are the same. It should also be possible to use these materials to deal with different topics, both at the level of values, such as solidarity and equality, and at the technical, methodological, and scientific-thought levels, according to the educational needs and interests of the participants.

3 Different Publics, Different Methods: How to Disseminate Scientific Research

As explained above, the heterogeneity of society makes it difficult to describe a rigid method for designing activities and materials. This implies the need to develop a dynamic methodology that allows the design of scientific dissemination adapted to each moment and to different audiences. To this end, a protocol is proposed as a way to approach an educational design in four phases or stages, which often overlap and complement each other:

– *Phase 0*: Exploration of the ideas and previous concepts known to the participants, as well as their interests and idiosyncrasies. It implies prior work with the collective in general, with its interlocutors and agents,

with any mediator that may exist, and, as far as possible, with the final recipients and particulars of the action. To begin this process, an initial meeting is held to gather information about the characteristics of the group, such as the number of participants, their interests, their usual activities, and the potential impact of any illnesses or disorders.

- *Phase 1:* Confidence and participation. The aim is to create a positive working atmosphere by promoting trust in equality, always based on respect and appreciation of the participating group. This facilitates the dedication and complicity of all the people involved. Together with the carers, the aim is to create an atmosphere of trust. Familiarity should create a sense of calm and ensure that the activity is relaxed and does not pose a threat to the participants' well-being. Obviously, the carer has a fundamental role to play in this initial contact.
- *Phase 2:* Reinforcement of a set of values through the activities. The aim is to enhance the participants' self-esteem, personal and collective empowerment, scientific curiosity, and critical thinking, and to put the ideas of equality, inclusion, and cooperation in a positive light. In this respect, the activities must be highly sensitive, demonstrating the ability to participate, assume, and interact in order to assimilate the knowledge transmitted, and stimulating the participants through a positive and collaborative environment.
- *Phase 3:* Transfer of knowledge, immediate and multiplied. Scientific dissemination implies an interaction with knowledge from two complementary aspects: one that is immediate, which directly involves the group of participants; and the other, defined as multiplied, as it serves to motivate these people to transmit the concepts, experiences, and knowledge they have acquired within their close environment. They are the ones who indirectly transmit what they have learned in their activities. In other words, they are the link to create new synergies with other groups and other entities.

However, this methodology requires a mediator to carry it out. The didactic tools should be a way to generate knowledge and a channel to interact with it, not an end in themselves. For this reason, even if a dynamic design method is available, and versatile, sensory or inclusive materials are developed, they will not be useful or meaningful if the mediator who guides the activity does not adopt an empathic discourse and flexible dynamic or create a context of equality with the participants (Freire, 2007).

The mediator's discourse and language should not be the first barrier for the participants. To avoid this, it is necessary to use clear language, focusing on specific concepts and using few technical or abstract terms (the minimum necessary). Examples, anecdotes or metaphors can often be used to improve understanding. It is important to note that simplifying language does not mean infantilizing or compromising scientific content and rigour. The aim is to adapt the language to each group of participants according to their interests and abilities, and to engage their attention in order to guide them in the construction, acquisition, and reinterpretation of knowledge. This can be achieved by adjusting the tone and rhythm and by exploring topics for which the participants have shown a preference. This is when debates are generated, and ideas are discussed. The key is to empathize and avoid those behaviours and topics that have not attracted interest in previous experiences. Throughout the process, we keep asking ourselves: how would we have preferred to learn?

The dynamics of the mediator should not create a sense of distance and separation from the audience. Instead, the mediator acts as a precursor to the scientific content, contemplating challenges and encouraging the participants to intervene, manipulate, and experiment with the didactic tools. When mediators actively guide the construction of knowledge through deductive activities and reflection, participants comprehend and retain ideas more effectively and for longer. Similarly, the surprise effect has been used to introduce new concepts, generate changes in opinion, modify the activity, or increase its complexity. It is understood that the dynamics should not be rigid, but should be reinvented within the session itself, not only to adapt to the participants' characteristics but also to incorporate the new approaches that have emerged.

Finally, the context in which the didactic tools are used has also been evaluated in order to ensure optimal dissemination, taking into account the specific needs of the audience. In this case, the mediator's friendly and approachable attitude creates a relaxed atmosphere even before the activity begins, so that the participants feel comfortable interacting with one another. The student/teacher or spectator/actor dichotomy was always avoided, promoting instead a context of equality. To this end, the participants were invited to express their concerns, interests, and prior knowledge in relation to the topic being disseminated. Even the mediator should

not be afraid to admit his or her limitations regarding certain questions that may arise and should appeal to the participants to work together to find answers and to come up with new ideas. Through shared reflection and facilitated activities using didactic tools, the participants gradually build up the knowledge they have acquired as a group and pass it on to their peers. Finally, they adapt the content to their own language and take ownership of the ideas in a context of trust, autonomy, and empowerment.

4 Case Studies

In order to illustrate the results obtained by applying this working methodology, its premises, and protocol, three of the activities and materials that have been designed are presented below. These scientific dissemination initiatives have been very successful and have been carried out with different collectives.

4.1 Neolithic Kitchen

Food supply, diet, and cooking are the current research topics in World Archaeology with direct relevance to everyday life today. The Neolithic represents a change in the way food was obtained through farming, but it also marks the beginning of long traditions in the way food is prepared, representing the origins of modern cuisine today. This makes it an essential resource and vehicle for the interaction and transmission of scientific knowledge. Nutrition, gastronomy, and food preparation are universal activities that have permeated and continue to permeate the daily lives of humanity. This makes them an essential resource and vehicle of interaction for the transmission of scientific knowledge. This activity has always been integrated as a complement to the professional cooking courses already organized and run by the groups themselves.

A clear example is the workshop carried out in collaboration with the employment integration cooperative Impulsem and two secondary schools in Barcelona: IES Milà i Fontanals and IES Consell de Cent. In these cases, the teacher and chef (Cristina Domingo) employed by Impulsem carries out cookery courses for groups of secondary school boys and girls who, for various reasons, are unable to follow and assimilate the usual educational curriculum. There are three main reasons why some of these students do not achieve their academic objectives. (1) A significant number of these students come from non-Spanish speaking countries (the majority are from Pakistan, India, Morocco, and Syria). Apart from the fact that the content is very different from that in their home countries, one of the most serious problems is that they cannot follow the lessons regularly as they are usually explained in Spanish or Catalan; (2) Many of these students have to work with their families or take care of their siblings outside school, which leaves them insufficient time to dedicate to their studies; (3) Some of these students come from families with social problems that hinder their ability to follow the educational plan. Nonetheless, all the students we worked with were very friendly and receptive. Language was not a barrier, as the communication was adapted to the knowledge level of each participant. The aim of this workshop is for the students to acquire various culinary skills and knowledge. The difference with previous courses is that this knowledge is accompanied by theoretical sessions in which researchers specialized in archaeology teach them about the origins of certain foods, as well as the methods of transforming, storing, cooking, and consuming them. These sessions focus on domestic and wild animals and plants, both terrestrial and aquatic, which were consumed by our ancestors, and which are part of our current diet. As the students come from many different countries, there is a constant debate about what is commonly eaten in their places of origin and what foods are unfamiliar to the different students in the group. This ultimately leads to the creation of synergies and bonds around food.

By the end of this 5-month course, students will have acquired sufficient knowledge to be able to work in a variety of catering establishments such as bars, restaurants, caterers, etc. In order to facilitate their integration, the Impulsem employment integration cooperative offers them a cooking qualification, which certifies their culinary skills. The activity concludes with a public presentation in which the participants give a brief

description of their experience, followed by a tasting of a balanced menu of delicious culinary creations. This menu includes multiple products of animal and plant origin, using different preparation methods and tools (Figure 1). To link prehistoric archaeology with cooking, the students and the chef were asked to create a menu using the same foods consumed in prehistory that they had learned about during the sessions with the researchers. For this purpose, the researchers provided them with a list of foods known to have been consumed in the past, as evidenced by archaeological documentation. During the tasting, the students demonstrate not only their acquired culinary skills but also their ability to present the dishes. They explain to the attendees the products used and how they were prepared. This presentation helps to empower the participants, who see the effort and work they have put into the workshop recognized. It is important to remember that many of these students typically receive poor grades, which can lead to feelings of frustration. A workshop like this, where researchers, teachers, students, and family members praise their work, can significantly boost their self-esteem both in and out of school. Moreover, as it is collective work, it allows them to interact with many colleagues with whom they have had little contact before. In this context, origin and language become positive assets rather than barriers. Finally, new friendships are made as a result of working together.

This workshop was carried out with students from two different secondary schools, which allowed us to assess whether the degree of satisfaction was similar in the two educational contexts. From a qualitative point of view, these sessions were photographed and recorded. In addition, interviews were conducted with everyone who took part in the workshop (students, chef, teachers, and cooperative coordinators) to assess their degree of satisfaction and hear their opinions. This interview is available online at https://www.youtube.com/watch?v=xM11D0_Ey3U. As can be seen, the responses were very positive and reflect the excellent atmosphere created around a cookery workshop focused on the consumption of prehistoric foods. Moreover, for the researchers, the degree of satisfaction was always very high, due to the friendly attitude of the students and the knowledge that the preparation of the menu was the end of a training course that they would apply in different catering establishments in the city, thanks to the cooking qualification they had obtained.

In conclusion, this workshop possessed not only an educational aspect for students with problems integrating in academic life in their secondary schools, but also an employment aspect, as many of them were able

Figure 1: The Neolithic Kitchen workshop held at the IMF-CSIC with a group of teenagers participating in a work insertion programme.

to start working. This is a double satisfaction that emerged from the collaboration between the different entities involved: the Higher Council of Scientific Research (CSIC), the Impulsem cooperative and the secondary schools of IES Milà i Fontanals and IES Consell de Cent.

4.2 ArchaeoLAB: Archaeological Research Simulator

Demonstrating how archaeologists reconstruct the life of past human communities is a necessary challenge for society to understand how the historical knowledge that gives meaning to our origins is produced (Santacana, 2018; Serrano et al., 2022). The explanation of the methodological and technical processes of archaeology is usually carried out with a sandbox, where participants excavate the sand to uncover different artefacts. This didactic tool, guided by a mediator, is very interesting and fun, since it allows participants to play the role of archaeologists, but it has many weaknesses. Another very interesting experience is for the participants themselves to excavate a real archaeological site, accompanied by archaeologists (Martín-Lerma et al., 2022; Phillips & Gilchrist, 2012). However, this initiative faces the mobility difficulties that the terrain poses for some people.

Consequently, an archaeological research simulator has been designed. This is an educational tool in which the participants take on the role of archaeologists and ask questions about an event in past societies, which must be answered on the basis of the evidence recovered during excavation; the analysis of objects in the laboratory; and through discussion and dissemination of their interpretations in a conference. The didactic tool integrates different components to reproduce as faithfully as possible the process of an archaeological investigation but designed and adapted to teach the methodology and technique in a controlled environment of deductive self-learning. The fieldwork is simulated by means of a set of PVC sheets (50 cm × 50 cm) with photo-realistic images juxtaposed and superimposed representing the surface of the ground and the subsoil (100 cm × 250 cm). Each layer has a photo-realistic textured vinyl attached to it that reproduces each of the stratigraphic levels. This represents a vertical view generated from real site photographs and computer-modified to give a sense of depth and volume (Figure 2).

So far, up to five different levels have been designed: the bedrock with fossils, two Neolithic burials with their grave goods (pit and cist tombs), a Neolithic lake dwelling settlement in an underwater context, and the current surface level. The vegetation cover has been simulated with artificial grass. This set of components and their combination makes it possible to recreate most of the sites, even adapting them to deal with specific themes. In addition, the superimposition of layers makes it possible to create more complex stratigraphies or to enlarge the excavation surface to increase the number of participants.

As a support material for the fieldwork, aluminium rails have been assembled to form recording grids (50 cm × 50 cm). In addition, the laboratory study is carried out on archaeological and anthropological replicas that will be recorded using Polaroid cameras, measuring tools, and cards.

The activity, although adapted with slight modifications, has always been divided into four stages, the same stages that make up an archaeological investigation: formulating the initial question, collecting data, analysing the information, and presenting the results. The last three stages can form a separate activity session in themselves, allowing the contents to be worked on more extensively. No special technical needs beyond the materials designed for the workshop are required. As a starting point, any concern of the participants serves to raise a historical problem and from their opinions about it, hypotheses emerge that must be contrasted. Hence, the need for archaeology and the need for participants to carry out an archaeological excavation.

In pairs or individually, they occupy each of the squares into which the archaeological excavation area is divided. Then the participants “excavate” the site by lifting and gradually removing each layer with their hands until they reach the stratum of interest that can provide an answer to the initial question. From this point on, the process of meticulously recording the data begins, which includes the identification of the elements and documentation by means of the work area. For this purpose, they are supplied with an archaeological record sheet with basic fields and a space to fill in with drawings, photos, and small annotations.

Figure 2: The archaeological research simulator during a workshop held in La Cooperativa TEB with young people with functional diversity.

The next stage is to analyse the data in the laboratory. To do this, the participants are divided into groups, each of which studies a different type of material, thus reproducing the work of the different specialists. With the help of the cards and the manipulation, measurement, and analysis of the different archaeological and anthropological replicas, they will obtain the information that will help them to resolve the questions and hypotheses that arose in the first stage or during the process of excavation and study of the materials.

Finally, in the third phase, the different teams will publicly present the results of their studies to their colleagues, simulating a scientific congress. To do so, they present, as specialists in a type of material or subject, the conclusions they have reached with their analyses. The aim is to encourage them to participate and interpret the information gathered, promoting a reflective and critical spirit. All of this, under the guidance of the mediator, leads the participants to cooperate in order to jointly interpret all the data with which to answer or reformulate their initial questions.

The archaeological research simulator has been successfully tested with a maximum of 20 participants simultaneously in minimum sessions of 45 min and from 5 years of age, in different contexts and with participants of different abilities. A clear example of the heterogeneity of the audiences that have interacted with this activity are young people with autism, Down's syndrome, or Asperger's syndrome from the TEB Cooperative.

The impact of this activity was evaluated by means of a questionnaire to which both the participants and those accompanying them responded. The questions assessed the perception of the activity, the topic, the explanations, and the materials. In addition, in order to measure whether the knowledge with which the participants have interacted has been understood, they were asked to draw a picture representing the facts they liked the most. The survey results show that the activity is perceived as very satisfactory, but the topic is of little interest. However, the researchers' explanations and the materials used are very satisfactory for the

participants. These results coincide with the drawings made, in which representations of the archaeological replicas, the camera, or even the recording grid and the plates with the photorealistic images predominate (Figure 3).

4.3 Ancestors: A Thousand Ways to Die in Prehistory

Describing what life and death must have been like in prehistoric times or the dynamics of Neolithic expansion is essential to shatter myths about the concept of progress and to understand the long road humanity has travelled, our fragility as a species, and the link we maintain with the environment. This can be an abstract and tedious exercise that is too often relegated to the imaginative capacity of the participants. There is a wide range of fun and simple board games on the market, suitable for all ages and with a prehistoric theme and aesthetic. However, most of them are competitive, small games for a maximum of six players, with fixed rules that often cannot be adapted to the needs of the participants. Furthermore, although they are games with a prehistoric theme, they lack scientific content and criteria and are not very realistic.

To this end, a "serious" board game was designed to allow learning through simulation about real historical processes with a large board and pieces to facilitate inclusivity and accommodate up to 20 players simultaneously. At the same time, the game dynamics are intuitive with a level of difficulty that can be adapted according to the needs of the activity and the participants, so it was essential to make the rules flexible. In it, participants take the part of individual characters in a Neolithic community that arrives in a virgin territory. Through different actions and strategies (collecting/producing resources, procreating, exchanging, instructing,

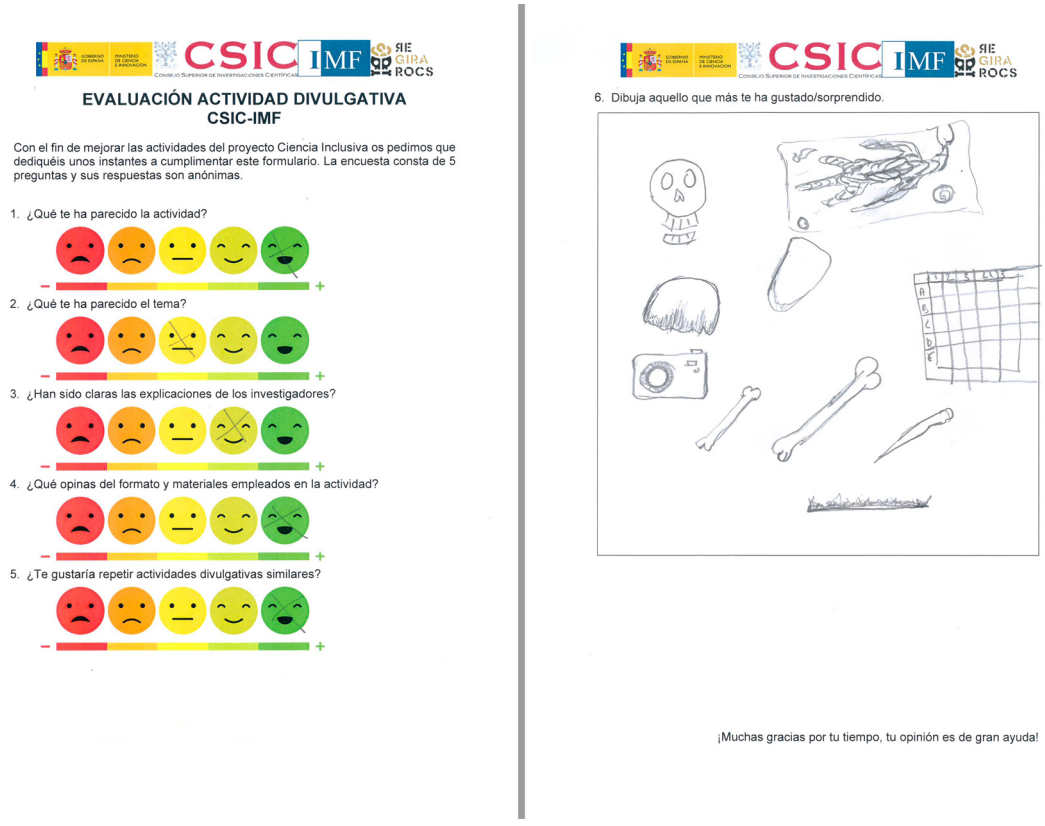

Figure 3: A questionnaire sheet with the drawings made by one of the participants in the activity, showcasing the elements they found to be most significant.

manufacturing, etc.) the players must ensure the survival and progress of the group (Figure 4). Conscious choices will determine the future of the activity and subsequent reflections.

The didactic tool is made up of a set of components which, according to certain guidelines (game rules), aim to recreate a territory (real or fictional) and the different ways in which the characters represented by the participants interact with it. For this purpose, the elements have been structured on three levels according to the physical space they represent (macro, meso, micro). The geography is reproduced by means of large-sized (25 cm) hexagonal foam board tiles with one side printed. This makes it possible to distinguish between nine types of terrain (mountain, forest, river or lake, meadow, field, wasteland, scrubland, mud, and marshland) with their respective associated resources (stone, wood, water, food, seeds, clay, and plant fibres). The arrangement of these tiles creates a wide diversity of territories with which to build a game board as large as desired. The use of large hexagonal tiles was conceived to guarantee the maximum number of combinations and habitats. At the same time, it aims to enable participants to easily identify the characteristics of the terrain and, if necessary due to the dimensions of the board, to be able to walk on it.

On the meso scale, a board has been developed to represent each community (21 cm × 30 cm) and the tokens of the characters (5 cm × 10 cm). In both cases, the pieces are also made of foam board. The former, through basic and intuitive iconography, helps the players to identify the actions that their characters can perform (collect, build, instruct, reproduce, exchange) as well as to visualize the state in which they are (rested, tired, wounded). The character cards, on the other hand, contain very schematic information, giving prominence to the face of the subject represented. In the header, there are icons, which can be used or not depending on the level of the game to be played. These define the character's characteristics and abilities (instructing, building, exchanging) making them all different and helping players to adopt a role and identify with it. An attempt has been made to represent all genders, ages, and conditions in the characters, as would be the case in prehistoric times.

Finally, at the micro scale, there are materials representing resources, events, weather, and tools. The first of these has been materialized with large polystyrene figures painted in distinctive colours, identical to the images on the tiles on the game board. The volumes schematically represent the elements to which they allude, for example, a blue drop to simulate water. This allows players to manage resources more easily in order to feed their characters, create tools, trade with other communities, etc. The events, weather, and tools are

Figure 4: Playing the "Serious Ancestors Game" during a workshop with children undergoing cancer treatment at the Casa de los Xuklis in collaboration with AFANOC association.

represented by means of large cards differentiated by colour. The upper half of each card shows a drawing of the element to which it refers, and the lower half shows the icons describing the effect on the resources or characters it causes.

The activity carried out with this didactic tool is divided into four stages: the presentation of the concepts, the start of the game, conflict management and the final reflection. The game phase can be extended over several sessions, if desired, allowing the key concepts to be explored in greater depth and introduce new mechanics and complexity to the game. Although the game begins on equal terms for the communities and their participants, the succession of turns leads to the emergence of differences between groups. A multitude of interesting situations arise for later debate, such as the death of characters, uncontrolled demographic increases and their impact on the future of the community, predation strategies vs production strategies, etc.

After an unspecified number of rounds, a very different picture emerges from the beginning of the game, both at the level of the territory due to the changes that have taken place (fields, constructions, etc.), and at the internal level of each group, at which point the game is concluded. Participants and mediator jointly evaluate the effects of the decisions on the development of the landscape and the communities. Some will have increased in population and developed their technological capacity. Others will be at the same starting point. In fact, implementing a subsistence model based on agriculture and livestock farming must not have been an easy decision in the past. Eventually, some communities will have collapsed with a decimated population, through either the death or migration of their members.

The use of this activity has proven to be effective as it allows participants, in all sessions and contexts, to make conscious choices through which they define, develop, and experiment with different strategies to ensure the subsistence of their community. These have guided reflection at the end of the game and have left the players with a desire to repeat the activity in order to apply new solutions to the problems they have encountered.

The game has been tested with a maximum of 20 participants simultaneously in minimum sessions of 90 min and from 10 years of age in heterogeneous contexts and with groups with different capacities. Among the diverse groups who have played the game, children undergoing long-stay cancer treatment received the initiative very well. The impact of this activity was evaluated using the same survey as the one used with the archaeological research simulator. The results are symptomatic, showing that the activity is perceived as very satisfactory, together with the subject matter. In fact, once the game is over, the participants show interest in returning to the game to apply new strategies learned during the activity. The explanations given by the researchers and the materials used were considered satisfactory. In fact, on this occasion, the participants' drawings focus on representing their characters and the landscape. This shows that the players no longer perceive the components of the activity as inert elements but identify with them and experience the game through them.

These results have attracted the interest of a publisher specialized in educational games (https://cienciainclusiva.wordpress.com/2024/04/26/uno-ano-mas-no-faltamos-a-la-cita-con-el-festival-del-joc-del-pirineu-en-la-seu-durgell/). We are currently redefining the rules, improving the dynamics and developing the graphic design, the only element that can be patented. Although it was never our aim, we hope that a smaller but more complete version, without the need of a mediator, will soon be commercially available.

5 Assessment of the Activities

It is easy to make the mistake of assuming that it is always easy to connect with the audience, that what has been transmitted has been understood, or that the materials used are the right ones. The reality is often very different, which is why it is essential to utilise an effective system for evaluating the activities and the disseminators themselves. It is then that the incidents that occurred during the activities are perceived, and the aspects that gave the best results can be strengthened and those that were unsatisfactory discarded or modified. In order to identify the pros and cons of the dissemination activities, from the general organization to the more specific aspects related to the discourse developed, the tools used or the space in which it was carried out, it is essential to design a method to collect all the information necessary to make a critical evaluation.

Experience has shown that didactic tools, dissemination activities, and the disseminators themselves should be subject to a triple audit, including

- On-site psycho-pedagogical evaluation. A professional evaluates the performance of the presenters in terms of explanation, discourse, group management, gesticulation, as well as that of the participants, assessing how the latter interact with the materials and whether they encourage reflection, and the intended solution to the questions posed. With all this information, a detailed report is drawn up that shows the successes and errors, as well as the margins for improvement in the activities. The results of this collaboration have been more than positive, given that during conferences and workshops, concepts or images may be used that are not understood by the audience, which usually leads to their disconnection from the discourse. Identifying these problems, as well as the way of expressing oneself, the gestures used or the type of presentation, depending on the audience to which the activity is addressed, must be taken into account in order to achieve optimal results.
- Qualitative and quantitative evaluation. Surveys and data collection systems are specifically designed and adapted for each activity and type of audience. In this sense, they are carried out in both physical and digital formats. In fact, the latter system has proven to be very effective with numerous advantages ranging from cost and time savings in printing to ease of transmission by sending, copying the link, or scanning a QR code. In addition, the digital medium is more versatile than paper in adapting the questionnaires to certain groups (size and type of font, contrast, colour, alignment, incorporation of images, drawings or pictograms, and response by voice message). For example, visually impaired people can enlarge the screen to read or answer the questions and blind people can use the screen reader to fill in the questions. The possibility of changing the size of the boxes or offering more space for writing are positive factors, especially for people who are visually impaired. In addition, some survey applications – such as Google Forms – facilitate the analysis of the results through quantitative assessments, graphs, etc. (Aliseda et al., 2022).
- In terms of qualitative evaluation, all activities were photographed or videotaped for critical analysis. From a quantitative point of view, over the years we have improved the surveys addressed to both the participants and the coordinators or tutors of the groups. The opinion of these professionals can provide a realistic view of the development, understanding and enjoyment of the activity by different peoples who make up the audience, as they are the ones who know them best. Recognizing that surveys often generate a certain degree of rejection by society and even mistrust about their purpose or usefulness, we have taken proactive steps to explain the significance of their collaboration and the potential impact of their feedback on future activities. At the end of an activity, participants – especially the younger ones – may quickly shift their focus to other matters, such as going home, making dinner plans, meeting friends, or carrying out recreational activities. Forcing them to focus on filling in a form can become tedious at this point. Instead, giving the participant this role of “importance” within the activity tends to empower them, make it more enjoyable, and generate more input and better ratings. It is quite different when the questionnaire is directed to people with intellectual disabilities or with some kind of cognitive dysfunction or illness. In these cases, it is usually better to work in groups and in their own centre with their educators and psychologists.
- Evaluation of the transmission of scientific knowledge by experts in the field. It is important that the materials and tools for dissemination are reviewed by experts in the different disciplines and scientific fields on which they are intended to be disseminated. This ensures that the tools possess a high level of scientific rigour, and that the knowledge transferred is fully up to date. For example, a psycho-educational consultancy specifically evaluated the didactic tool created for the board game. This panel of experts assessed the accessibility and suitability of the components for people with physical and intellectual diversity and produced pedagogical cards. Adaptations for different age groups and contexts were also suggested in order to facilitate a better understanding of the rules according to the type of participants.

6 Conclusion

Society is inherently diverse, with individuals experiencing a wide range of physical, social, economic, and geographical conditions that profoundly affect their daily lives. If we were to take a survey and ask: does

everyone have the right to enjoy science? Obviously, the answer would generally be yes. However, the reality is very different. Very rarely do we see certain groups, such as people with disabilities, Romani communities, and newly-arrived immigrants, visiting an exhibition, a museum, or an archaeological park. Often this absence reflects invisible social barriers and in other cases, the lack of adaptation of the space and the conditions of what is exhibited or what is to be transmitted to its physical particularities. They may assume that science is not intended for them, that they would not understand it, or that it is financially out of reach. This initial disconnection leads to a loss of interest and contributes to the perpetuation of inequalities in scientific engagement.

In this context, politicians, researchers, social agents, teachers, and the society as a whole must work to ensure that Principle 27 of the Universal Declaration of Human Rights, which states that everyone has the right to participate freely in the cultural life of the community, is upheld. In this sense, our work follows the guidelines of the Spanish National Plan for Education and Cultural Heritage and takes as its point of reference the postulates of the Faro Convention of the Council of Europe, which promotes inclusive, democratic, intergenerational, and intercultural dissemination of cultural heritage. The aim is to promote critical thinking within a more just, peaceful, and empathetic society based on mutual support.

Certainly, the diversity of heritage (archaeological, artistic, historical, etc.) makes it possible to address human diversity. However, this need not be limited to heritage, but to all areas of life. In fact, the criteria for ensuring the transfer of knowledge and interaction with society, as described in the National Education and Heritage Plan, are universally applicable. In terms of professional training, researchers have much to contribute to teachers, educators, and museum curators. In this sense, interdisciplinary work is a fundamental strategy. At the same time, we understand flexibility not only as the adaptation of content to human diversity, but also as the process of co-construction of the dissemination process itself with broad social participation. Therefore, in our opinion, inclusion is not a dual interaction between disseminators and participants, but a global interaction between all stakeholders (teachers, carers, doctors, family members, etc.) and in all phases of its development, from conception to evaluation.

Our experience in developing outreach programmes has shown that the results are more positive when they are carried out collaboratively, both in terms of participants' interaction with knowledge and the consolidation of the project over time (Fernández, 2020). At the same time, we do not see scientific dissemination as an additional task to our research work, nor do we see inclusivity as an obstacle to be overcome, but rather as an inseparable part of our daily work.

As archaeologists, we use this discipline to transfer knowledge, values etc. that are not limited to archaeology in a universal, barrier-free, and inclusive way. It is not about doing good, it is a question of rights. Years ago, we recognized our duty to bring science to society in its entirety. We undertook to make our conferences and activities as inclusive as possible and to adapt them to the needs of each person, including those who, due to conditions, could not leave their centres (hospital patients, prisoners, people with total or partial immobility). The work presented here is a small reflection of our model of scientific dissemination in which the methodology, teaching tools, and evaluation systems go through a process of reflection to ensure their adaptability to different audiences.

We still have a long way to go. Much of what we know, and practice today was not part of our formal training at university. Instead, it has been shaped by observing what other colleagues do, by the experience of people from other disciplines outside archaeology, such as teachers, educational psychologists, and psychologists, and, above all, by a committed process of trial and error. We hope that what we have learned and what we have discussed in this article will help other researchers to make their outreach as inclusive and participatory as possible, fostering a culture of knowledge-sharing and continuous improvement.

Acknowledgments: It has been 10 years since we started our scientific dissemination programme. This task has been carried out thanks to the collaboration of many institutions and companies: ReGiraRocs SL, Asociación de Familiares y Amigos de Niños Oncológicos de Cataluña (AFANOC), Ludia Asesoras, Grupo Cooperativo TEB, Cooperativa Impulsem, Casal Folch i Torres, Associació Carabutsí e Interacció. Many of these activities have been carried out with the support of FECYT-Ministerio de Ciencia e Innovación, la Fundación General CSIC and the Institución Milá y Fontanals de Investigación en Humanidades (IMF-CSIC) in

collaboration with other scientific institutions such as RED2018-102382-T, PID2020-112513RB-I00, and PIAR-2023-06.

Funding information: The authors state that no funding is involved.

Authors contributions: All authors accept responsibility for entire content of this manuscript and have consented to its submission to the journal, have reviewed all the results and have approved the final version of the manuscript. J.F.G. and M.M. initiated the popular science project by developing the body of theory presented in this article. G.R. designed some of the activities and prepared the manuscript with contributions from all co-authors. M.P and M.C. have promoted the Neolithic cooking activity. I.Q.-S. and B.M. carried out the archaeological research simulator and the Ancestors board game activities. Finally, N.A. developed the evaluation system.

Conflict of interest: The authors state that there is no conflict of interest.

Data availability statement: All data generated or analysed during this study are included in this published article.

References

Aliseda, N., Gibaja, J. F., Mozota, M., & Remolins, G. (2022). ¿Cómo mejorar nuestras actividades divulgativas?: Diseño de formularios para conocer la opinión del usuario. *Antrope*, *14*, 29–56.

Comendador, B. (2016). La transferencia de conocimiento en materia de Patrimonio Cultural e Innovación Social. *Cuadiernu*, *4*, 9–11.

Comendador, B. (2022). Experiencias metodológicas en la socialización del patrimonio y en el desarrollo de recursos para la educación patrimonial. In J. F. Gibaja, M. Fernández, & M. Cubas (Eds.), *Si te dedicas a la ciencia, ¡divúlgala! La transferencia de conocimiento en el marco de las Humanidades* (pp. 85–102). Ediciones Trea.

Conci, C., Caviglioli, M. R., Franzoi, M., Moser, L., & Roncador, R. (2020). Musei, Inclusione e Alzheimer. In D. Scarpati & M. Mandosi (Eds.), *Musei e territori. Persone, alberi e favole. Riflessioni in un tempo di pandemia* (pp. 169–181). Edizioni Phoenix.

Doroszenko, D. (2022). Shifting the narrative: Indigenous cultural heritage and archaeology in ontario. In J. Jameson & S. Baugher (Eds.), *Creating participatory dialogue in archaeological and cultural heritage interpretation: Multinational perspectives* (pp. 47–66). Springer.

Fernández, M. (2020). Ciencia en la aldea. Los niños que ayudaron a descubrir un monasterio medieval. *The Conversation*. Retrieved from https://theconversation.com/ciencia-en-la-aldea-los-ninos-que-ayudaron-a-descubrir-un-monasterio-medieval-130965.

Fernández, M., López, P., Peláez, N., Rodríguez, S., Villa, A., Menéndez, M., Alonso, G., Antón, X., Ilesies, R., Álvarez, M., Fernández, J., & Fernández, A. (2022). ConCiencia Histórica: La arqueología comunitaria como medio para la coconstrucción de conocimiento en un entorno rural. In J. F. Gibaja, M. Fernández, & M. Cubas (Eds.) *Si te dedicas a la ciencia, ¡divúlgala! La transferencia de conocimiento en el marco de las Humanidades* (pp. 133–150). Ediciones Trea.

Freire, P. (2007). *Pedagogía de la autonomía: saberes necesarios para la práctica educativa*. Siglo XXI.

Gibaja, J. F., Mozota, M., Remolins, G., Nieto, A., Oms, F. X., Higuera, S., Guzmán, V., Cubas, M., González, A., Mazzucco, N., Palma, O., & Valenzuela, S. (2019). La divulgación científica en prehistoria llevada a personas con discapacidad intelectual: Una experiencia particular. *Revista Pyrenae*, *50*(2), 151–167.

Jardón, P. (2016). La Prehistoria como medio de inclusión en la reflexión sobre usos del territorio y las relaciones humanas: El Salt (Alcoi). In M. Díaz-Andreu, A. Pastor Pérez, & A. Ruiz Martínez (Eds.), *Arqueología y comunidad: el valor social del patrimonio arqueológico en el siglo XXI* (pp. 169–190). JAS Arqueología.

Kaplan, R., & Norton, D. (2004). *Strategy maps: Converting intangible assets into tangible outcomes*. Harvard Business School Press.

Martín-Lerma, I., Garrido, E., Moratilla, L., & Martin, I. (2022). La inclusión a través de la ciencia: arqueología y discapacidad intelectual. *Arteterapia*, *17*, 189–198.

Monzó, R., Jardón, P., & Pérez, C. I. (2019). Análisis de una experiencia de ocio inclusivo para mayores afectados de demencia y Alzheimer en el Museu Comarcal de L'Horta Sud (Torrent, Valencia). *ENSAYOS, Revista de la Facultad de Educación de Albacete*, *34*(1), 149–162.

Parisi, M. (2022). La Cultura che fa bene. Un progetto di inclusione del Civico Museo Archeologico di Camaiore (Lucca, Italia) dedicato alle persone che convivono con l'Alzheimer. In J. F. Gibaja, M. Fernández, & M. Cubas (Eds.), *Si te dedicas a la ciencia, ¡divúlgala! La transferencia de conocimiento en el marco de las Humanidades* (pp. 181–196). Ediciones Trea.

Phillips, T., & Gilchrist, R. (2012). Inclusive, accessible, archaeology. In R. Skeates, C. McDavid, & J. Carman (Eds.), *The Oxford handbook of public archaeology* (pp. 673–693). Oxford University Press.

Remolins, G., Palma, O., Gibaja, J. F., & Mozota, M. (2022). Una actividad vale más que mil palabras. Creación y uso de nuevas herramientas didácticas. In J. F. Gibaja, M. Fernández, & M. Cubas (Eds.), *Si te dedicas a la ciencia, ¡divúlgala! La transferencia de conocimiento en el marco de las Humanidades* (pp. 133–150). Ediciones Trea.

Santacana, J. (2018). La arqueología y el reto de educar. In A. Egea Vivancos, L. Arias Ferrer, & J. Santacana i Mestre (Eds.), *Y la arqueología llegó al aula. La cultura material y el método arqueológico para la enseñanza de la historia y el patrimonio* (pp. 9–24). Ediciones Trea.

Serrano, B., Dorado, A., Peinado, M., Ruiz, C. M., & García, M. (2022). Aprender Historia a través de la Arqueología. El proyecto de innovación docente Didacteca. *Revista UNES. Universidad, Escuela Y Sociedad*, (13), 124–136.

Tulli, A., & Albert, T. (2013). *Measuring the user experience. Collecting, analyzing, and presenting usability metrics*. Morgan Kaufmann-Elsevier.

Weiner, S. (2010). *Microarchaeology. Beyond the visible archaeological record*. Cambridge University Press.