Science interpretation in high school

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Abstract. *In cooperation with the "Hands-on science" network of the Socrates-Comenius programme, we have carried out an activity in interpreting science within the context of prehistoric archaeology, using as an example an ancient Palaeolithic site situated within the nearby geographic surroundings and called Chan do Cereixo. This activity was developed in a secondary school from Val Miñor (Pontevedra) and was aimed at pupils between the ages of 12-18 from the whole area. This essay presents the general basis of the activity and the methodology used as well as the more outstanding results.*

Keywords. Archaeology, Hands-on Science, Interpretation, Science education, Science Museum.

1. Introduction.

Interpretation as a methodology for the studying of heritage was defined [1] by professionals in the national parks of the USA [2] in 1957, as an educational activity which attempts to reveal meanings and relationships through the use of original objects, by first hand experiments and illustrative mediums instead of the mere communication of facts.

Within this context, the principles proposed are based on the relationships between the objects and the experience of the participant, involving an integrated transmission of the information by using diverse strategies and endeavouring to create incentives to awaken interest [3]. This informal tool of learning is used more and more in archaeological and nature parks, as well as in zoos, aquariums or museums [4].

One of the objectives of interpretation is to help the participant to develop a deeper understanding, appreciation and awareness of the activity in question and/or the values that are trying to be transmitted; thus converting the activity into an enriching and pleasant experience [5]. In general, the interpretation of heritage [6] is a creative exercise based on the knowledge of the interpreting process and of the matter to be dealt with, by putting into play resources with clear, short and attractive messages that create an impact on the participant.

On the other hand, the carrying out of didactic activities developed outside of the traditional academic framework, such as museums, interpretation centres, exhibitions, etc. prove to be highly beneficial for the comprehensive education of pupils, but specialized equipment and appropriate technical resources to ensure a service of quality is needed [7]. Its evaluation is complex and the methodologies need to be adapted to what is being considered in each case. There are some methodological proposals which tend to form generic models in relation to a specific discipline but they can turn out to be a good starting point [8].

Based on this philosophy, we organised an activity for pupils between the ages of 12–18 which attempted to divulge the scientific method applied to the study of Prehistory from a methodological and practical perspective: prehistoric investigation as an interdisciplinary science - archaeology, geology, biology, physics, chemistry, topography, etc.- and as an example of the application of a scientific method within the human sciences [9].

We selected an interpretive methodology so that in a pleasant and attractive manner, it allowed us the transmission of appropriate messages and the highest impact possible on pupils in relation to the knowledge to be transmitted [1,7,10,11]. Thus, we designed an active exhibition for a learning centre, looking

for participant's implication, and encouraged or guided by monitors with the main aim of fostering in pupils interest and facilitating their immersion into the subject of archaeology.

The main novelty of the proposal consisted in creating a tailored exhibition integrating interpretive principals and mediums for a perfectly defined public from a formal education and dealing with a theme not usually dealt with in interpretive activities. In the activity we also attempted to recreated, in the centre's entrance hall, the realistic environment of a Prehistory archaeological excavation, possibly the most known of tools used by archaeology, and to relate the contents of the activity with the curriculum of the pupils and their daily experiences. We also attempted to show the visitor the wonders of these special historic places and convert them into active defenders of Heritage.

Even though our experiences with school groups and the general public in the divulging of other disciplines in the human sciences, such as art, history, architecture, museums, photography, etc. [12] were normally based on principals and objectives of a didactic nature, our experience became an essential tool for assuming the challenge of applying interpretation in this area and with these characteristics.

The main sustaining elements of the interpretative and participation principal were the creation of several panels with thematic meaning, the disposition of hands-on elements, the construction of an archaeological crate which allowed us to take a plot of land from a real site to the school and the projection of an audiovisual in which was shown the site taken as reference and a demonstration of carving stone Palaeolithic tools.

In this manner the participants not only had to read, but they also could touch the earth, charcoal, bones, different stones, smell smells, distinguish dampness, manipulate, measure etc. offering a real possibility of understanding and living an archaeology investigation, an alternative that is not common in daily life.

In this essay, we present the methodology used in the assembly of this interactive set-up with the site in the educational centre. The analysis of the results of a voluntary questionnaire carried out on the majority of those who attended is shown, reflecting the degree of satisfaction and use of the activity.

2. The activity.

The cognitive and attitudinal aims of the activity were orientated on: clarifying concepts, presenting the Palaeolithic site of *Chan do Cereixo* (Gondomar, Pontevedra), a site not investigated of the earlier Palaeolithic era, one of the oldest in Galicia, according to the characteristics of the material recovered twenty-five years ago; increase interest in Prehistory; demonstrate archaeology as an interdisciplinary science and make society interested in the study and conservation of heritage.

The location available was the entrance hall of the Auga da Laxe Secondary School (Gondomar), one of five secondary educational centres in Val Miñor (Pontevedra-Spain), with pupils of between 12–18 years old, which included in its curriculum a prehistoric subject. The activity was organised by the *Instituto de Estudos Miñoranos* and was co-financed by the *Dirección Xeral de Investigación e Desenvolvemento* of the *Xunta de Galicia* within its activities of Science and Technology Week 2004.

The messages that were to be transmitted and the medium for its divulging was organised around the corresponding interpretive signs, audiovisual mediums, as well as hands-on and demonstrating materials. The space available was organised according to its functions: a reception area for groups of students, another for presenting an audiovisual, another explicative area in which was shown the interpretive panels with the material on show, objects which could be manipulated, etc. The pupils' visits were attended by specialised monitors who were part of the activity organisation and supported by voluntary pupils from the host centre. This was done in such a manner that the entrance hall of the centre became a combination of a small interactive museum and a real archaeological site as well as for the carrying out of normal teaching work.

The criteria for the preparation of the necessary material were methodologically ambitious, aiming for a complete vision of investigation and paying special attention to the

participants. Therefore, for this group from the public who are learning, we designed sheets-activity guides, for personal use and which they later to take to their classrooms, giving them an opportunity to continue to work within a formal academic environment, as well as serving as a means of reinforcing the activity. There were also samples in the hall, which were plasticized, for free use by those accompanying the group or the general public.

These sheets had the function of serving as a guide during the activity, clarifying questions and stimulating participation by presenting fourteen simple activities-games to be done during the visit, looking for the solutions within the actual interpretive set-up, whilst others were to be solved with the help of a teacher in the classroom. They also contained a selection of bibliography and links for those participants interested in knowing more about the contents of the activity.

Figure 1. Working on the site.

Once a date and time had been arranged, a group of pupils, of no more than 25, were received by a monitor who introducing him/herself and presented the activity; on having given out the sheets, the guide commenced the tour by presenting the Palaeolithic site of *Chan do Cereixo* with diagrams and photographs of two light boxes situated at the entrance, this being the first surprise, realising that a place known to them had, up until now, a value they did not know of- Palaeolithic sites in the open air do not show visible signs in the outside. Together with the monitor, the voluntary pupils of the host centre, acted as helpers, offering the material, explaining the handling of equipment, giving out and collecting surveys, etc.

Afterwards, the pupils became involved in the investigation of the site (Figure 1), beginning with its survey: understanding the meaning of terms and its methodology, using some of the necessary equipment: GPS, compass, aerial photographs, orthophotographs, stereoscopic photography which they could see with the stereoscope, diagrams, etc.

On having familiarised themselves with the site, they began their investigation which was based on the following elements (Figure 2):

a) The interpretive panels: were often used for analysing the scientific methodology used in the archaeological field. They were headed by a sentence – a subject that in a simple and attractive manner, gave the message which was intended to be transmitted by the panel. The comments and illustrations that followed: photos, drawings, sketches, diagrams, etc. were for displaying and closing - not amplifying - the message of the sentence - a subject, which was not longer than three lines.

   The subject matter displayed on the panels were: surveying, excavation, auxiliary sciences in the reconstruction of the natural environment, palaeontology, geology, palaeobotany, carpology, anthropology… and the question of chronology in its two perspectives: methodologies of relative chronology, archaeological method (typologies, stratigraphy, etc.), and methodologies of absolute chronology -C^{14}, dendrochronology, potassium, argon, palaeomagnetism, uranium – thorium….

b) Expositive elements in display cabinets, such as replicas of stone tools, samples of stone raw materials, work elements from the archaeological team, part of a tree trunk with growth rings which could be counted and a sample of a stratigraphic column for observing the horizons which the ground forms and a commentary on its differences.

c) In the central part of the space, an archaeological crate measuring 2 x 2m representing the development of an excavation was situated: the surface was divided into work units of 1 x 1m and identified by numbers and letters of the Cartesian system of coordinates, with the

remains of a Palaeolithic field site and archaeological work tools. Plan 0 was established to measure the depth of the objects, making available a complete topographic station and a telescope rod. Once the participants were familiar with the methodology of the fieldwork, they were able to take measurements using the equipment and integrate a set of concepts from diverse scientific disciplines.

Figure 2. Visiting the exhibition.

d) The visit ended with the projection of an audiovisual of the Palaeolithic site of *Chan do Cereixo*, in which was also shown a demonstration of Palaeolithic stone carving. This practical activity was previously carried out by pupils from the secondary school host centre (Figure 3), by designing a specific material which had been adapted and allowed them to follow the process: raw materials, origin, technique, products obtained, functionality…

Figure 3. Carving workshop.

Before the leave taking, they were asked to fill in a small questionnaire, individually and anonymously, which was used as a tool for judging different aspects related with the activity.

3. Analysis of the activity.

The questionnaires used for the evaluation of the activity were designed by the *Dirección Xeral de Investigación e Desenvolvemento* of the *Xunta de Galicia* for their own use and even though they referred to different parameters – divulging of the activity, satisfaction, participation, subject matter and organisation-, the excessive standardisation in the wording of the questions is confirmed.

We analysed the questionnaires of a population of around 500 participants, in which 94% of them defined themselves as a captive public for having to visit within the obligatory times of school hours. We will concentrate our essay on the results obtained from this group of pupils, which are of an average age of 14.75 years old.

The chronological distribution of the population in relation to educational cycles shows a higher frequency of secondary school students (Obligatory Secondary Education, between 12 and 15 year olds, both inclusive) (70.45%) than that of pre-university studies (from 16-18 years old) (29.55%). In the distribution by sex, we have a balance between women who attended (52.45%) and men (47.55%).

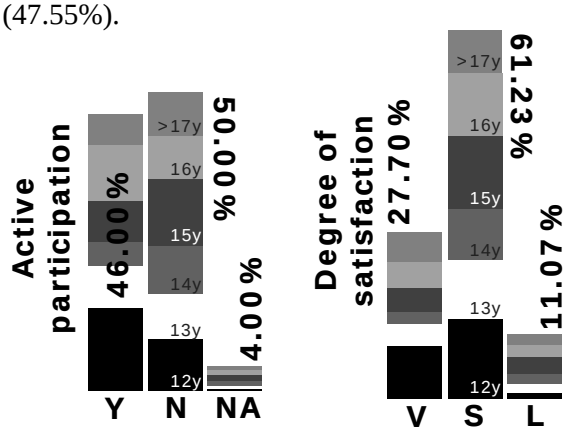

Figure 4. Active participation and general degree of satisfaction by ages.

The evaluation obtained from the degree of active participation (Figure 4), shows in general that 50.00% did not participate, against 46.00% that did participate and 4.00% that did not on considering that the activity did not allow it. The

analysis of participation by ages shows that the pupils aged 12 registered a higher percent of participation, the value falls progressively up to the age of 16, at which is registered again another peak of participation that is higher than 50.00%, in the remaining age groups, the participation barely reaches a third.

Undoubtedly, the factors related to this aspect are diverse and complex, but in general we consider the influence of the physical frame in which the activity was developed, very conditioning for the normal functioning of the centre, imposing serious time limitations on the duration of the visit, having to be out of necessity 50 minutes long, the same as the length of the school's classes, so that group changes did not cause problems.

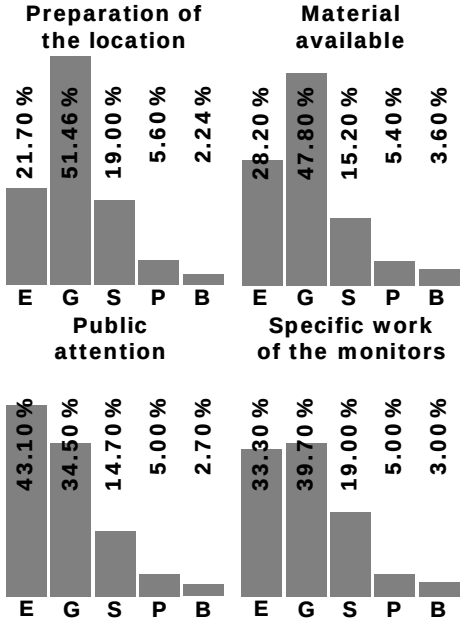

Figure 5. Evaluation of the staging and service given to the participants.

The evaluation of the staging and the service given to the participants were collected in questions in relation to the preparation of the location, the material available and the service given to the public. The results are reflected in Figure 5, and it is highlighted that 73.16% of the participants consider that the preparation of the location was Good or Excellent, 19.00% considered it Standard and 7.84% as Passable or Bad. In relation to the material available for manipulating, 76.00% considered it Good or Excellent, 15.20% considered it Standard and 9.00% as Passable or Bad.

Finally, a high percentage of the participants that considered as Good or Excellent the service given to the general public (77.60%) ratifies the high degree of general satisfaction found in the activity (Figure 4): 88.93% considered it Very satisfactory or Satisfactory, while 11.07% considered it as Little satisfactory. In relation to this, the individual high evaluation of the specific work of the monitors (Figure 5) who guided the activity (73.00% considered it Good of Excellent) is coherent with the degree of general satisfaction found of the visit and confirms important diverse methodological questions in the designing of divulging activities: an interpretive methodology is effective and valid for transmission and communication and implies an intermediation of a specialised interpreter, that is to say, it establishes a direct treatment between the subject, object and the interpreter, offering a high quality service which obtains a high evaluation by the users [7].

The evaluation of the support material, the abovementioned sheets-activity guides, shows that a high percentage of the participants acknowledge a certain utility (54.00%), being more than those who considered it Very useful (28.50%) and those who saw it of Little use (17.50%).

Finally, there was a parameter that tried to obtain information about the coherence of the contents with the general theoretical idea of the proposal, reflected in the title of the activity, and on the public's expectations. The results show that in 69.50% of the cases the expectations of the contents were satisfactory as Very Much and Enough, mean while the rest were only satisfied as Somewhat (22.00%), Hardly (3.00%) and Little (5.00%). This parameter is in relation to the level of previous knowledge that the public has of the subject, considering that the results evidence an important degree of divulgation of archaeology, even though there is a new factor in this activity: an open scientific and interdisciplinary focus that normally constitutes a side less known generally on a school and public level.

4. Conclusions.

The results obtained throughout this interpretive activity of prehistoric investigation are interesting and allude to different aspects of the activity and in general show highly

satisfactory results in regards to the objectives proposed initially, after having taken into account the abovementioned limitations. In particular the questionnaires reveal a high degree of satisfaction by the participants in aspects related to the election and proposal of the subject, the set-up of the activity and the services offered (interpreting monitors), which confirms the great effectiveness of a mediating agent which works in the interpretation of contents. This does not mean the explaining of concepts, but the transmission of messages, attitudes, values and sensations in relation to the material and the actual experiences of the public. Other parameters such as participation, were highly conditioned by the physical framework for carrying out the activity, in which was simultaneously produced a formal educational act enforcing environmental and temporal contributing factors in relation to the visit. It is well known, that the availability of a space specially designated for non formal educational activities is an essential condition for the correct development and the attainment of the objectives foreseen [13,14]. In our case, this important factor did not lessen our achievements of the activity. In accordance with the results, the activity seems to have awakened the interest of the participants and they generally thought that the experience was worth it.

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