Science Communication, Information and Participatory Methodologies: Key Success Factors in a Public Debate on the Freshwater Crisis

L. Libutti* and A. Valente*

Institute for Research on Population and Social Policies (IRPPS), National Research Council (CNR), Italy

Abstract: The article considers how discrete disciplines such as documentary research, participatory methodologies and the public communication of science can, if used synergistically, provide the necessary elements for a public debate on a scientific issue of current interest. In this instance, the debate formed part of a CNR- British Council, Rome branch and the Civil Protection Department project for the communication of science to young people, and the theme chosen for discussion was the freshwater crisis. It is important to ensure that schools offer suitable learning environments and provide innovative teaching techniques to encourage students to explore the social dimensions of the scientific issues they are dealing with.

Keywords: Science communication, participatory methodologies, young people, information dissemination.

INTRODUCTION

Education and awareness-building are essential steps in the process of attracting young people to the world of science. Through participation, knowledge and the effective delivery of information, young people can become informed and active participants in a process to which they feel they belong.

It is vitally important to ensure that schools offer suitable learning environments and provide innovative teaching techniques to encourage students to explore the social dimensions of the scientific issues they are dealing with, ask questions, explore, collate experiences and form individual and group opinions. In this way, their science studies can be imbued with a new significance.

We need to attend to the way sciences are taught in school. The courses and teaching methods are mainly responsible for sapping the interest of young people in science subjects [1]. Interviews with pupils reveal an increasing sense of boredom and lack of interest in science. In schools today, giving pupils the capacity to follow the scientific method is treated as less important than imparting standardized definitions and procedures [2].

In the Perception and Awareness of Science (PAS) Project [3], the Italian National Research Council (CNR)[1] and the Rome branch of the British Council arranged a series of public debates on topical issues in which upper-high schools students took part in discussions with Italian and British experts.

In this article we intend to present the methodology defined and experimented in the PAS Project where innovative communication and teaching models have been tested in order to determine how the participating students perceived science and its values. The Project is the result of cooperation between experts from several different disciplines and drew on the specific skills of professionals from the fields of Science Communication, Information Science and Participatory Methodologies[2]. The Project sought to integrate new methods of teaching, instruction and learning with Information and Communications Technology (ICT). ICT, if properly used, is a highly effective modern tool whose strong appeal to young people makes it ideal for the communication of science to young people.

METHODOLOGY

A) The Chosen Topic: The "Freshwater Crisis"

The PAS project envisages the consecutive selection of various scientific questions of general interest. In past years, four initiatives were held in Bologna, Rome, Naples and Milan. The themes discussed at these events by students and experts from Italy and the UK have been GM organisms, electromagnetic pollution, space exploration and the impact of climate change on cities.

At the beginning and at the end of each initiative, students involved are asked to complete a questionnaire related to the perception and awareness of science and to the attitudes towards the chosen topics.

The topic of debate for the period 2007-2008 is the freshwater crisis. The initiative has been organized with the cooperation of the Italian Department of Civil Protection (DCP), a public body that for years has been studying the water crisis and possible solutions to it, and has promoted information and awareness campaigns for the responsible use of this vital resource[3].

The theme was chosen in light of the increasing urgency of the water crisis throughout Europe, and its frame of refer-

*Address correspondence to these authors at the Institute for Research on Population and Social Policies (IRPPS), National Research Council (CNR), Italy; Tel: +390649932742; Fax: +390685834506;
E-mail: a.vlente@irpps.cnr.it and l.libutti@irpps.cnr.it

[1] The CNR bodies taking part in the Project were the Irpps (coordinator) and Ceris in Rome; Irea in Milan. A. Valente project coordinator, L.Libutti specialist in Information science.

[2] All the phases of the PAS can be seen at: http: //www.irpps.cnr.it/com_sci/index.php

[3] Department of Civil Protection (DCP), Ed., *Dossier crisi idrica*, Roma 2007. Unpublished. Available: http://www.irpps.cnr.it/com_sci/index.php

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ence is the guidelines set by the European Union, in which awareness-building and education in environmental affairs are defined as priority objectives[4].

In addition to its function as an essential element of life, water is also used in households and industry. Managing the water crisis calls into play many different authorities, such as the Civil Protection Department (DCP), the water authority and quality-control divisions of the police, as well as the general public. By adopting virtuous practices, ordinary citizens can make a crucial contribution to water conservation and, generally, to the protection of the environment. Sustainable water use can be achieved by reducing waste and by recycling water used in manufacturing.

The freshwater crisis was chosen as a theme also because it presents a particular challenge to the discipline of documentary research. The theme is complex and spans not only a range of different types of knowledge, but also elements of uncertainty, characteristics that conform to Silvio Funtowicz's [4] definition of "post-normal science", where "facts are uncertain, values in dispute, stakes high and decisions urgent". It is not by accident that Funtowcz and Ravez started discussing of post-normal science in the context of the debate over environmental issues: in this case, not all the factors are knowable, it is necessary to cope with uncertainties, but in the same time it is of great importance to find a way to cope with this knowledge and to go on in the decision making process.

As the water crisis affects many different people, including people from outside the groves of academia, it is an issue that also fits in with Ziman's concept of "post-academic science" [5]. Further, it is a theme that concerns evolving as opposed to consolidated knowledge: what Latour, referring to the confluence of disparate and sometimes conflicting scientific approaches and the interaction between science and culture, defined as "science in action" [6]. The great challenge for Information Science is to find a system that manages to capture the full breadth and depth of scientific debate without sacrificing the authoritativeness and rigour of the scientific method. It is a challenge that has to be overcome, because a failure to retain the breadth and depth of science in progress risks trivializing the process of scientific communication. Conversely, it is only through the selection of authoritative and rigorous scientific documentation that we can lay the foundations for the participation of young people in the scientific debate and avoid the danger of exploitation and manipulation. In other words, Information Science must be a means for reconciling the "paradigm of science dissemination" with the "paradigm of dialogue and participation" [7].

B) THE PHASES OF THE PROJECT

1) From Tacit to Explicit Knowledge

During this preliminary phase, and with a view to enhancing personal involvement and participation the groups are brought into the Project through the "metaplan" technique. Using this technique, the groups discuss a theme proposed by the tutor — the freshwater crisis in our case. Through the exchange of ideas, which brings to the fore tacit knowledge that the group was unaware it possessed, and through the organization of the ideas that arise in the course of discussion, the group is encouraged to engage first-hand in analysing and discovering possible solutions to the problems under consideration [8-10].

Since the lay-out of classrooms is often unsuited to this sort of methodology, it is necessary to do some preparatory work. The students' chairs are arranged in a semicircle so as to diminish the institutional connotations of the meeting. Physical, visual and acoustic barriers dividing the groups and the solicitator are eliminated, and people are free to move about the classroom as groups subdivide and mingle.

2) Information and Communication

The delivery of the documentation marks the first real point of contact between the students and the scientific topic in question. The delivery can be subdivided into a number of sequential phases:

a) Documentation. At the documentation phase, the students studied the background material supplied by CNR.

In addition to traditional textbooks that either ignore the debate on science in progress or briefly treat it in a linear, non-problematic style, the classes receive other structured material.

The method used in our case was to collate, directly or indirectly, information and data serviceable for examining the many different sides of the freshwater crisis which is a multifaceted issue. In the selection of materials, the guiding principles were the precision, pluralism and international provenance of the sources [11].

It needs to be emphasized that, unlike consolidated scientific knowledge, science in action encompasses a wide array of different points of views, methodologies, methods of analysis, and carries a whole series of disparate environmental, social and ethical implications. Material produced by various institutions such as research centres, consumer associations and public and private bodies were therefore scrutinized with reference to divergent points of view, elements of uncertainty, differences in scientific sensibilities and the various pros and cons surrounding the issue.

The material selected by CNR was then compiled to form a virtual internet library, consultable by all the interested parties.

Obtaining information on the freshwater crisis mostly consisted of looking things up on the Internet, though traditional sources were also used.

In the PAS project, the Internet had a dual educational function, in that it is both a source of information and a means of communication.

During the communication phase, the groups themselves took on a central role, and have been encouraged to use email and blogs to exchange ideas.

b) Collaboration. In literature on the public understanding of science and participatory communications, much has been written on the various ways of setting up groups. Each

[4] European Water Framework Directive 2000/60, Available: http://ec.europa.eu/environment/water/water framework/index_en.html. [Accessed March 2008]

type of group has its own peculiar qualities and meets different criteria referring to, for example, the representativeness of the participants, their independence, the moment of their involvement, the impact of the theme, the transparency of the process. A comparative study of methods was carried out by Rowe and Frewer [12]. They found both advantages and disadvantages in using ad-hoc groups, as in the case of consensus conferences, rather than pre-existing groups. We preferred to use the latter option in the belief that a pre-existing group offers greater scope for generating interaction among its members and avoids the risk of decontextualization. For this reason, each group corresponded to a class or else was made up of students from the same school.

3) The Public Debate

The critical moment in the project is the public debate during which the students and experts swap views on the technical and scientific aspects of the issue as well as on its environmental, social and ethical implications. The groups put forward proposals and ask questions and the experts try to answer, with the attitude that no one view holds grater weight than others. Furthermore, participating in a public debate encourages young people to express their opinions and increases confidence in speaking to a large audience.

4) The Open Space Technology

In April 2008, two days were set aside for the teachers and students to take part in an Open Space Technology. The Open Space Technology, hitherto unused in a school context, is based on the principle that people interested in a central theme should simply meet and talk about it. The meetings are held in spaces set up on an ad-hoc basis, and the participants are free to move from one discussion group to another. Using this participatory method, it is possible to construct a shared agenda in little time.

The teachers can use Open Space Technology to create forums in which to discuss and reflect on teaching methods and, in particular, on ways of using participatory methods in schools. The idea is to use Open Space Technology to discover the ideas and observations of the teachers regarding the particular methodology used in the CNR Project and, more generally, their views on the use of innovative teaching techniques.

The seminar for the students, meanwhile, relates to the work they carried out. In this way, the thoughts, proposals and priority concerns relating to the freshwater crisis worked out in the course of the Project can be elaborated and shared. The young people can jointly put forward and discuss points to be included on the agenda, and, by dividing into small groups, with the help of moderators and experts from the Department of Civil Protection (DCP), delve further into issues that they have identified as being of priority importance.

PROVISIONAL RESULTS

At this stage of the project, we are able to register a number of provisional results:

1) The Metaplan Technique

The participatory method has evoked attitudes and behaviours that are characteristic of active citizenship among the young people, as well as stimulating their interest and enhancing their knowledge. The participants became disposed to ascribe value to the attitudes and behaviours that have emerged from private reflection and from the exchange of ideas within and between groups. What made this possible is that in addition to the normal interest in the new, students also could follow their natural bent towards that which represents parts of their being (beliefs, knowledge, values) or, to take a Sartrean perspective, that which re-represents these things. By beginning with each one's tacit knowledge and then proceeding with the explication of that knowledge, first at an individual level and then at a group level, students could became aware of their own perception, experience and knowledge in relation to the scientific issue under consideration, and then gave expression to them as part of the ongoing exploration of the issue. Every moment of recognition revitalized the knowledge that the participant gained and debated and discovering the different aspects of a topic, young people could ask themselves a number of questions, such as: who does the water crisis affect? How it affects and why? What are the consequences?

All questions posed by students at the end turned out to make sense, once integrated in the global knowledge representation scheme built by each group. Students also realised that they already had a basic level of knowledge, but were not aware of it.

2) Information and Communication

a) Documentation: During the information-gathering phase, the tutors/teachers had the important task of prescribing the methodology to be followed so that the young people could learn how to carry out their research properly. The tutors/teachers were free to leverage their own teaching experience to structure the methodologies for the project, in keeping with the principles of research-action. No predefined codes of practices were imposed on them by the researchers. The teachers therefore chose their own way of engaging the groups/classes and, based on their particular experience, skills and backgrounds (type of school, special subject, academic level, usual method of interaction in the classroom, educational goals) decided on what teaching, discussion or role-play methods to use.

Due to the variety of documentation provided and to the possibility to participate in the production of more documentation, the students understood that there could have been several different solutions to the same problem, and that every solution had to be put into the historical context that produced it. They also grasped that there may not be a solution to a problem, or that some solutions may be worse than the problem itself. Asking questions became more important than giving answers.

CNR adopted a methodology that had two aims: (i) to teach the young people how to organize their activities; and, (ii) to carry out effective research using ICT both at the information-gathering phase (when looking up sources) and at the communication phase (when disseminating the information in the manner suggested by the participants). The Project sought to instruct young people on the right approach to addressing a scientific theme, acquiring knowledge and developing individual research skills based on sound method-

ology. The Project encouraged not the reproduction of knowledge, but its production, by means of debate and the making of proposals. Furthermore, the use of different media increases a deeper awareness and understanding of science and scientific processes.

b) Collaboration. This second crucial phase has been made up of discussions, held among different groups in the one class or among different classes. Students acquired sufficient autonomy to begin a debate among themselves with minimal participation of the tutor. The groups discussed, exchanged ideas about the topic and made proposals. Having begun, first with the metaplan technique, then with a linear model by which the recipient/student receives information from the information professional/tutor, the participants could improve a bilateral model of communication, in which they formed their own ideas, discussed them with the group and attempted to put forward proposals.

3) The Public Debate

The groups, which had prepared themselves beforehand, took an active part in the debate, put forward proposals and asked questions that the experts, who had different perspectives on the issue, tried to answer.

The limit as been that not always both those posing questions and those answering were willing to change their minds and their communication habits. Not always single students' proposals or questions have been given the right consideration and not always students reached a sufficient level of self-esteem to feel really free to ask questions or proposals to experts. In these cases, the presentation by students of a work already prepared during the earlier stages of the project (eg: in the form of a powerpoint presentation) has proved to be useful to overcome some students' uneasiness.

4) The Open Space Technology

We expect that the engagement in a participatory methodology as the Open Space Technology will help to overcome these communicative problems. The limit is that it is not possible to allow all the students involved in the project in Rome and Milan to take part in this final phase.

We think, in fact, that very short one-day Open Space Technology sessions may be effective only when participants are high specialised or when dealing with small groups. Including hundreds of students in the Open Space Technology would have needed to plan several-days for this phase, and this was incompatible with school activities.

Once again, to prove their effectiveness, participatory methodologies have to find their way between at least two main constraints: number of people involved and time.

CONCLUSIONS

In the course of the Perception and Awareness of Science (PAS) Project, innovative communication methods were tested. They entailed the application of diverse techniques to secure the active participation of teachers and young people in a non-traditional educational experience. The teachers were given the opportunity to reflect on the educational techniques deployed, consider their subject from a practical as opposed to a merely theoretical and traditional perspective, and test out participatory methods that are new to the school context. Meanwhile, the young people were drawn closer to the world of science through a more modern and engaging way of participating in scientific debate.

Details on students' attitudes toward science will be available further on, when students' questionnaires will be processed and data will be compared with previous CNR local [3] and national surveys [13], as well as with the results of the main European Surveys in the field of science and technology [14-18].

In the PAS Project, traditional teaching is transformed into active instruction. The students are invited to take part personally in concrete and topical scientific issues. They learn about the problem and talk about it in groups and with experts, and room is given to acknowledge their feedback.

Nevertheless, some problems have been faced in the course of the project, particularly linked to the difficulty of changing roles and communicative habits in the relationships between students and experts. This may also lead to a drop of some students' enthusiasm and interest.

On the other side, we believe the best way of capturing the interest of students is to deploy several participatory methodologies, so enhancing a variety of teaching methods. The choice of methods needs to be extended also to educational promoters. For this reason, it is essential to leverage the experience of teachers who are already actively engaged in the testing of new participatory methods. School should no longer be a place in which pupils receive fixed notions, but, rather, a place where pupils can experiment, learn to work in groups, take decisions, plan ahead and communicate the results of their work. Teachers, students and researchers all form part of this creative process. Accurate methods of documentary research form the bedrock of this method. Without them, participation can come to be seen as a "new tyranny" [18], a form of witting or unwitting manipulation of the public and, particularly, of students. It is therefore essential to follow a rigorous method of documentary research that facilitates the informed exploration of a theme from a variety of scientific perspectives, and an informed analysis of the ethical and social implications of the themes considered.

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