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MUCH MAY BE MADE IF SHE BE CAUGHT YOUNG: HOW MUSEUMS CAN BEST EFFECT PUBLIC UNDERSTANDING OF SCIENCE

Jean Cooper and Roger Miles
The Natural History Museum, London

Introduction

In a pioneering report for the Royal Society, Bodmer et al. (1985) *concluded* that, "a proper science education for all must be the starting point for any attempt to achieve an adequate level of public understanding of science" (p. 32). They also asserted that "Museums are a major informal mechanism for effecting public understanding of science" (p. 27). We agree with this conclusion, but have doubts about the assertion as it applies to most lay visitors to museums.

We follow Neidhardt (1993, p. 341) in believing, "one thing can reliably be expected: public communication is communication with laypersons – and the more public the communication is, the more this is so." There is no evidence of significant learning among lay visitors to exhibitions (Miles, 1987; Miles and Tout, 1992). By significant learning we mean learning with understanding, i.e., learning accompanied by some insight into the ways in which the relevant principles and facts are related. This is qualitatively different from rote learning; or the retention of odd facts (e.g., the jumping ability of fleas) during a museum visit.

Some writers have argued against the conclusion that visitors learn little or nothing from museum exhibitions, by claiming that (a) the evaluation techniques are too crude to pick up the subtle learning that really does go on, and (b) learning from museum exhibitions is, in any case, of a different order from that found in formal education, i.e., it is concerned with affective learning and "experiences like social interaction, private reverie, and play" (Roberts, 1992, p. 163) rather than cognition. Whatever the force of these arguments, they are not immediately relevant to the role of museum exhibitions in the public *understanding* of science, and to the question of what museums can do to foster significant learning.

Research on museum visitors and museum visits shows why lay members of the public do not learn in science exhibitions. The typical visit is a leisure time activity, often providing an important opportunity for social interaction among families and friends rather than an opportunity for education. Scant attention is paid to most exhibits by most visitors, who remain constantly on the move in search of novelty, attempting to see everything in the museum before running out of time and energy (Miles and Tout, 1991; Falk and Dierking, 1992). The audience, like that for the mass media, is constantly searching for new stimulation (Treinen, 1993).

Thus it is clearly unrealistic to expect much significant learning to take place during the course of a typical lay visit. On the other hand, a good exhibition for the lay public can (a) open up a vista on the subject, showing its scope and significance; and (b) awaken a desire for knowledge, and give guidance on how to follow up and satisfy this desire, so that the visitor is launched on a path of learning. These can be significant contributions *towards* the public understanding of science. In their absence, exhibitions may typically function to increase the "knowledge gap" between those who have a grounding in the subject and can use the occasion of a visit to revise and update their knowledge, and those who don't and who make only limited contact with the exhibits (Miles, 1989, Treinen, 1993).

Some authors on the educative potential of museums and science centres (e.g., Boram, 1992) have stressed that during our lives we learn much more outside, than we do inside, schools. But the implications of this for the public understanding of science are not obvious. Science is difficult, and it involves, as Wolpert (1992) has reasoned, "unnatural" (i.e., not ordinary) ways of thought and argument. So Bodmer et al. are correct to stress the crucial role of formal education in laying down the foundations of scientific knowledge, understanding and thinking. These foundations can be developed later from informal sources. The conclusion we draw is that, for those with limited entry knowledge, a visit to a museum can lead to significant learning only if it is carried out as part of a structured course of education. This leads to the question underlying this paper: What can museums do to maximize significant learning in connexion with school visits?

The National Curriculum

Bodmer *et al.* (p. 32) reached a number of conclusions about formal education in science which have been taken up in the National Curriculum for England and Wales introduced in 1989. Science education is compulsory for all, from five years of age up to the age of 16. The programmes of study contain the experiences that all students should have, while attainment targets provide the learning objectives. Emphasis is placed on the processes of scientific thinking as well as the acquisition of scientific knowledge. Museum visits by school groups should fit into this framework.

The Museum's Response

The education programmes at The Natural History Museum, London, ensure that teachers are offered support in integrating a museum visit into their programme of study, and therefore into the formal structure of science education as defined by the National Curriculum. This integration is crucial in determining the contribution of the visit to the development of students' scientific knowledge and thinking. It also plays an important role in optimizing the degree of novelty for the students, between the extremes of "boring" and "threatening", during their time in the Museum (Balling and Falk, 1980).

Ausubel (1963) argues, in common with other cognitive psychologists, that concepts and memories are not kept in the mind in randomly arranged, discrete units but are organised into a structure. A new piece of learning only becomes meaningful when it has been integrated into the existing structure. Then, and only then, is the learning effective and can be used with other concepts held within the mind to handle new problems.

The target audience for The Natural History Museum's main exhibitions assumes the mental ability, reading age and general knowledge of a typical 15-year-old (Miles 1986). There is an obvious mismatch between the cognitive demands of the exhibitions and the cognitive abilities of many of the students (spanning five to 16 years). Not only has the new material to fit into the structure of the National Curriculum, but also it has to be selected and presented to the students in such a way that they can subsume it into their cognitive structures. The Museum's education staff use their professional expertise, and knowledge of the exhibitions,

to enable teachers make the most effective use of the exhibitions and fulfil their educational objectives.

1,200 students a day visit the Museum during term-time. Museum educators work directly with teachers and provide a wide range of support strategies for teachers using the galleries with their students. The emphasis is on students spending time in the exhibitions, not on working behind the scenes in classrooms.

Teachers are encouraged to make a preliminary visit to the Museum to plan their visit. Education staff are available in the Teachers' Centre to discuss the objectives of the visit and to advise what areas of the Museum could be used to achieve these objectives. Where appropriate, suggestions are made for both work before the visit and follow-up work in school. Printed materials for teachers are available free of charge. These include Teachers' Guides which contain information on the content of the exhibitions, access details, maps and the links with the National Curriculum.

We have developed a range of activity sheets for students, which help them focus on the exhibitions. For each sheet the cognitive level of the tasks, and the reading level of the small amount of text, is appropriate for the age and ability of the target audience. Each sheet embraces a series of teaching points by requiring the students to complete different tasks. There is a strong emphasis on observation; students are asked to think about their observations and record the information. A variety of recording methods is required, and students under 15 need not read the exhibition text to complete the activities. These sheets are intended to enhance both the learning experience and enjoyment that the exhibitions offer. All the sheets are copyright-free and teachers are invited to use all or part of them to meet their specific needs.

A programme of in service training courses, which relates to the National Curriculum, is available for teachers. Each course contains three elements in varying proportions, (1) information about using one or more of the exhibitions with school groups, (2) background information to support teaching a particular aspect of the National Curriculum, and (3) suggestions for classroom activities and resources relating to the course topic. Emphasis is placed on the effective use of the exhibitions to meet the specific learning goals of each school group.

Conclusions

The strategies used by the education staff are intended to enable teachers to maximize the significant learning that takes place in the Museum. This is done, above all, by linking the students to the formal framework of science education found in the National Curriculum, and by focusing attention on exhibits which meet their specific learning objectives. In this way, we suggest that we are making synergic use of the teacher's skills and knowledge of their students, and the skills and knowledge of the Museum's educators. Maximizing significant learning by students during school visits to a museum is a realistic approach to making museums educational, and effecting the public understanding of science. Evaluating their success remains an urgent task.

References

Ausubel, el, D.P. (1963) *The psychology of meaningful verbal learning: an introduction to school learning*. New York: Grune and Stratton.

Balling, J.D. and Falk, J.H. (1980). A perspective on fieldtrips: environmental effects on learning, *Curator* 23 (4) 229-240.

Bodmer, W.F. *et al.* (1985). *The public understanding of science.* London: Royal Society.

Boram, R. (1992). What are school-age children learning from hands-on science centre exhibits? In Benefield, A., Bitgood, S. and Shettel, H. (1992), *Visitor studies: theory, research, and practice*. Jacksonville: Centre for Social Design, Vol. 4, 121-130.

Falk, J.H. and Dierking, L.D. (1992). *The museum experience.* Washington, D.C.: Whalesback books.

Miles, R.S (1986). Museum audiences. *The International Journal of Museum Management and Curatorship*, Vol. 5, 73-80.

Miles, R.S. (1987). Museums and the communication of science. In Evered, D. and O'Connor, M. (1987), *Communicating science to the public*. London: John Wiley & Sons, 114-122.

Miles, R.S. (1989). *Evaluation in its communications context*. Jacksonville: Centre for Social Design, Technical Report No. 89-30, 1989.

Miles, R.S. and Tout, A.F. (1991). Holding power: to choose time is to save time. *ASTC Newsletter*, Vol. 19, (3) 7-9.

Miles, R.S. and Tout, A.F. (1992). Exhibitions and the public understanding of science. In Durant, J. (1992), *Museums and the public understanding of science*. London: Science Museum, 27-33.

Neidhardt, F. (1993). The public as a communication system. *Public Understanding of Science*, Vol. 2, 339-350.

Roberts, L. (1992). Affective learning, affective experience: What does it have to do with museum education? In Benefield, A., Bitgood, S. and Shettel, H. (1992), *Visitor studies: theory, research, and practice*. Jacksonville: Centre for Social Design, Vol. 4, 162-168.

Treinen, H. (1993). What does the visitor want from a museum? Mass-media aspects of museology. In Bicknell, S. and Farmelo, G. (1993), *Museum visitor studies in the 90's*. London: Science Museum, 86-93.

Wolpert, L. (1992). *The unnatural nature of science.* London: Faber and Faber.