# What is Scientific Literacy?

## What is meant by the term scientific literacy? Ian Milne from the University of Auckland explores this question in relation to the aims and goals of science education

This review identifies a number of international perspectives before finishing with a commentary from the editorial of the New Zealand Science Teacher (2004).

### An international perspective on scientific literacy

Two important purposes of science education in schools have been identified[1]. Firstly, science education is about educating and motivating students towards becoming involved in careers as scientists and technologists. Secondly, it is about "providing all children with the significant knowledge and understanding of the world around them to enable them to become informed citizens, able to operate effectively and make decisions about science related issues that affect all our lives" [1] The notion of "science for all" was encapsulated in "Beyond 2000: Science Education for the Future"[4] whose authors recommended that "the science curriculum from 5 to 16 should be seen primarily as a course to enhance general scientific literacy". In the same report[4], they also suggested that the outcome of school science education should be the "production of a populace who are comfortable, competent and confident with scientific and technical matters and artefacts". They state that "the science curriculum should provide sufficient scientific knowledge and understanding to enable students to read simple newspaper articles about science, and to follow TV programmes on new advances with interest. Such an education should enable them to express an opinion on important social and ethical issues with which they will increasingly be confronted. It will also form a viable basis, should the need arise, for retraining in work related to science or technology in their later careers"

Recently the Organisation for Economic Co-operation and Development (OECD) have initiated the Programme for International Student Assessment (PISA) Science and Technology assessment of how well 15-year-olds, nearing the ending of their schooling, are prepared to meet the challenges of society. PISA provides a definition of Scientific Literacy that refers to the individuals[3];

- Scientific knowledge and use of that knowledge to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science related issue
- Understanding of the characteristics features of science as a form of human knowledge and enquiry
- Awareness of how science and technology shape our material, intellectual and cultural environments
- Willingness to engage in science-related issues and with the ideas of science as a reflective citizen

Harlen[1] summarised these two perspectives and offered the following explanation of scientific literacy as "meaning a broad understanding of key ideas of science, shown in the ability to apply these ideas to every day events and phenomena, and an understanding of the strengths and limitations of scientific activity and the nature of scientific knowledge."

It is important to have a clear understanding of what we mean by scientific literacy when thinking about why we teach science[2]. The two main aspects of scientific literacy have been stated as thinking and working scientifically. Scientifically literate people:

- are interested in and understand the world around them
- engage in the discourse of and about science
- are able to identify questions, investigate and draw evidence-based conclusions
- are sceptical and questioning of claims made by others about scientific matters
- make informed decisions about the environment and their own health and well being[2]

## From a New Zealand perspective

In 2004, Scientific literacy was identified as one of five key aspects that should be considered by science educators who were seeking to establish goals for the science education component of the New Zealand Curriculum (2007)[5].

## The aims of science education

Science education in schools should aim to develop children's knowledge, skills, attitudes and values that will allow them to take an informed position on scientific issues that may face in their everyday lives. School leavers should be aware of and have an understanding of the scientific process and its values. They should have developed an enquiring attitude and the knowledge and skills that will allow them to find the answers to their questions.

The natural curiosity that young children bring to the process of exploring and understanding the world they live in should be a key aim of science education programmes. This process must be valued and enhanced, ensuring that these creative perspectives are retained into adulthood. Primary school science is about children working with the creative explanations they have developed to help explain their world. Children's own understanding of science must be valued as an integral part of science learning programmes in schools.

There are five overarching integrated aspects of science that those seeking to identify goals for science education should consider:

- scientific literacy,
- attitudes and interests towards the environment,
- doing science,
- science as a career, and
- communication in science

## Towards scientific literacy

The development of scientific literacy must be viewed as a life-long process. The notion of open-mindedness, the acceptance of alternative views that are based on evidence, and the tentative nature of explanation are examples of the attributes mature learners should hold towards explanations of a scientific nature. The overarching goal of science education must be to produce a scientifically literate society. It would be expected that members of the public should be able to make reasonable choices when making decisions of a scientific or technological nature. These decisions could be about the choice of tools or instruments or may relate to quantities or measures. It would be reasonable to expect that an informed citizen, making decisions about medication, would understand the importance of taking the correct amount. Similarly, you would expect a scientifically literate person to recognise the effects of changing quantities in cooking recipes.

## Attitudes and interests towards the environment we live in

Science can help people to develop an appreciation of the diversity of nature and the environment. The natural curiosity and wonderment that young children bring to their understanding of the world should be valued. Our education system should encourage all learners to retain these qualities throughout their lives. Becoming fascinated with natural phenomena implies that a person has been aesthetically affected by the experience. Feelings associated with awe and wonder are often ignited and a sense of anticipation may develop. This anticipation can lead to a desire to be further engaged in and motivated towards understanding the phenomena and how it relates to them. It is important that science education has aims and goals that foster aesthetic responses in the learners involved. These experiences will lead to the development of Wonder including "wondering at", "wondering about", and "wondering whether".

## Doing Science

"Wondering about" leads to question formation. An aim of science should be the development of both procedural knowledge and skills by the learners involved.

Students should develop the skills to plan processes that enable them to find a reasonable answer to their questions. Knowledge of the process of science is important for individuals when evaluating conflicting perspectives. The notion of acceptable evidence can be a cornerstone in the process of accepting or rejecting new or changed ideas and perspectives.

### Science as a career

Attracting enthusiastic, skilled and knowledgeable students to careers in science and technology remains an important aim of science education. All students must be given the opportunity to consider science as a worthwhile career. This will require programmes that introduce the scientist's world to all learners, both by asking the learners to do science, i.e., plan investigations to find answers to questions and then share their findings, and by bringing the scientist's world into the classroom through visits, talks, stories, etc.

### Communication in science

Science education should enhance children's awareness of the role that communication plays in the development of scientific understanding. Self-communication, as we rationalise and make sense of experiences and meta-cognition used to evaluate others ideas and thoughts, are essential valued competencies. The importance of developing the skills of communication in science activities cannot be underestimated. Similarly, having knowledge of communication tools available and their appropriate use is vital.

The overall goal of science education can be viewed as providing future adult citizens of New Zealand with the opportunity to develop the knowledge, skills and attitudes encompassed in the concept of scientific literacy. If this is achieved they will be able to participate in informed decision-making about scientific phenomena and issues that affect them and the society they live in.

### References

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