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Assessment of Primary Students Scientific Literacy

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Mark Hackling is an Associate Professor of Science Education at Edith Cowan University and was a co-author of the report on the national review of the status and quality of science education in Australian schools. Mark is currently involved in two national science education projects which are described in this article: The Science Education Assessment Resources Project which will develop an online assessment resource bank; and the Primary Science Assessment Project which is developing instruments for the assessment of primary students' scientific literacy.

By Mark W Hackling

Scientific Literacy

The national review of the status and quality of teaching and learning of science in Australian schools (Goodrum, Hackling, & Rennie, 2001) argued that the broad purpose of science in the compulsory years of schooling is to develop scientific literacy for all students.

Scientific literacy is important as it contributes to the economic and social well-being of the nation, and improved decision-making at public and personal levels (Laugksch, 2000).

An understanding of science helps people understand the world around them and helps them make informed decisions about environmental and health issues, such as the wise use of water and energy, and diet and vaccination.

Scientific literacy is a high priority for all citizens, helping them:

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

(Hackling, Goodrum, & Rennie, 2001, p. 7)

Assessment

It is now recognised that assessment should be used more effectively to improve the teaching and learning of science. Assessments can be conducted before, during or after the unit of work. Most of our assessment efforts occur after the learning, at the end of the unit, and are used for grading and reporting. These assessments occur too late for improving teaching and learning.

Assessment that occurs early in the teaching-learning sequence can reveal information about learners that can be used to guide the planning of teaching, so that it takes account of students' existing conceptions and beliefs. Assessments can therefore play an important diagnostic function, identifying naïve or alternative conceptions that need to be challenged in the teaching and learning of science.

Diagnostic Assessment

- Used at the start of a module to elicit common misconceptions so that teachers can become aware of the range of understandings held by students
- Teachers use the information to plan ways of addressing common misconceptions

Information from assessments conducted during a learning sequence can be "used, by both teacher and pupils, to modify their work in order to make it more effective" (Black, 1993, p. 49). Assessment information is used to identify differences between actual attainment and the next step in the developmental continuum, and to do something about closing the gap (Wiliam & Black, 1996). Therefore to be effective, formative assessment needs to be linked to a developmental model, such as profiles of learning outcomes or a progress map.

Formative Assessment

- Used during a module to elicit student explanations so the teacher can identify the level of conceptual development at which students are working.
- Teachers use the information to select the most appropriate activities and learning experiences that will meet the developmental needs of the students and may lead to differentiation of instruction.

Most attention is typically given to assessment at the end of a term or semester to gather information about the extent to which students have achieved the learning outcomes. This summative information is used by teachers and schools for grading and reporting to parents.

Summative Assessment

- Used towards the end of a module to determine the extent to which students have achieved the learning outcomes.
- Teachers use the information for grading or levelling and reporting.

Making judgements about students' levels of understandings and competencies in terms of science learning outcomes has proved to be particularly difficult for many primary teachers who lack a strong background in science. The report from the National Review of Science Education (Goodrum et al., 2001) therefore recommended that a resource bank of high quality assessment items be developed to support improved assessment practice in school science. The Commonwealth Department of Education Science and Technology (DEST) has now responded to this recommendation by funding a project to develop a science assessment resource bank.

The SEAR Project

The Science Education Assessment Resources (SEAR) Project will develop an online collection or resource bank of science education assessment resources for teachers across the compulsory years of schooling.

To achieve the purpose of the Project and address the concerns about current assessment practices the assessment resources will:

- support the assessment of outcomes that contribute to scientific literacy;
- support diagnostic and formative assessment in addition to summative assessment;
- support teachers who lack a strong background in science to make judgements about students' development of understandings and skills;
- support teachers who lack a strong background in assessment practices to use a wide range of assessment methods and techniques;
- model best assessment practice; and
- be available on-line from a user-friendly web site.

The Project will be conducted by the Australian Council for Educational Research in collaboration with Curriculum Corporation, Edith Cowan University, the Australian Science Teachers Association and the Australian Academy of Science. Further information about this project can be obtained from the Project Director Gayl O'Connor at ACER (oconnor@acer.edu.au).

Gayl O'Connor (Australian Council for Educational Research), Marian Heard (Australian Academy of Science), Jan Althorp and Peter Russo (ASTA), Mark Hackling (Edith Cowan University) and Helen Trotter (Curriculum Corporation) discussing the SEAR project in Hobart.

The Project will commence by developing a scientific literacy progress map that will map across the four conceptual strands and the process strand of science. Assessment tasks and items will be written to fit the map and these will be trialed in schools across three states. A web site will be then developed; this will be trialed by primary and secondary teachers from all states and territories and the feedback will be used to revise and improve the web site. It is expected that the resources will be loaded on the web site for use by teachers by early 2005.

When the site goes live, teachers will be able to search the item bank for assessment tasks and items by level, conceptual context (strand) and by domain (concepts or processes). A selection of items will then be viewed so teachers can select particular objective, extended response or practical items/tasks for diagnostic, formative or summative uses.

National Assessments of Scientific Literacy

The Commonwealth, State and Territory Ministers of Education have agreed that there will be national assessments of scientific literacy. Assessment of the scientific literacy of primary students will occur towards the end of Year 6 and it is anticipated that testing will occur in 2003. A sample survey approach will be adopted rather than full cohort testing and the tests will include objective, open-ended and practical tasks.

The tests, standards and reporting measures will be developed by the Australian Council for Educational Research in collaboration with Edith Cowan University, the Australian Science Teachers Association and the Australian Academy of Science. Further information about this project can be obtained from the Project Manager Chris Freeman at ACER (freeman@acer.edu.au).

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