INQUIRY LEARNING IN SCIENCE, WHERE TO NOW?

AN EXAMINATION OF THE IMPLEMENTATION OF THE 1980 K-6 SCIENCE CURRICULUM, INVESTIGATING: SCIENCE, IN NSW PRIMARY SCHOOLS

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HISTORICAL BACKGROUND

Process-based, inquiry learning dominated curriculum reform from the early seventies. This new emphasis in curriculum design resulted in radical changes to documents developed by State authorities for implementation in primary schools around Australia.

In 1980 the curriculum policy statement, Investigating: Science K-6, was released for implementation in NSW primary schools. This policy replaced the Natural Science syllabus and brought an end to the 'nature study only' era of science in primary schools. The policy was released with six support documents as part of a new vision of curricula, designed to encompass many primary experiences under three areas:

. INVESTIGATING - Science, Social Studies, Mathematics
. COMMUNICATING - Language, Reading, Writing
. EXPRESSING - Music, Art, P.E.

The development of the policy and support documents also ushered in a new phase in the curricula development process itself. The curriculum development process involved a large number of classroom teachers, consultants, school executives, administrators and academics over a period of several years.

It was an extensive, expensive grass roots exercise in curriculum development.

Nature of the Investigating: Science K-6 Policy

The 1980 policy statement represented a significant change in thinking about the nature and scope of science education for primary students. The previous "Natural Science" curriculum was
replaced by a policy that defined science for primary children as

... a way of learning about themselves and their environment which will emphasise first hand experiences, inquiry and problem solving.


Understandings were to be developed through investigations in the areas of the Living Environment, the Physical Environment and People and the Environment. In the process of investigating, children would also develop a specified range of learning skills and acquire appropriate feelings, attitudes and values.

The new policy emphasised hands-on experiences and inquiry learning, where children should be encouraged to pose and solve their own problems as they come to grips with the environment around them. Inquiry and problem solving through firsthand experiences was so crucial to the successful implementation of the curriculum that specific directions were given in the policy. Inquiry and problem solving will involve pupils in:

- identifying problems and posing questions;
- gathering, organising and analyzing information and ideas;
- finding relationships and suggesting possible solutions;
- testing possibilities;
- communicating and applying outcomes.


In keeping with the shift in emphasis away from teacher-directed learning to pupil-centred learning was a specific approach to science education which:

- provides opportunities for enjoyable learning through stimulating firsthand experience;
- provides worthwhile opportunities for children to develop independent thought and responsible action;
- contributes to achievements in other curriculum areas through firsthand experiences;
- helps children to understand and influence the impact of science and technology on themselves and their environment;
- provides a foundation for lifelong interests in the environment and in leisure activities.
IMPLEMENTATION OF THE POLICY

Successful implementation of the new policy presented major challenges for schools and classroom teachers. These challenges included:

1. The need for schools to determine what learning experiences were needed for the objectives of the curriculum to be achieved;
2. The need for schools to organise these learning experiences into a school plan that provided guidance for teachers in terms of scope, sequence and teaching method;
3. The need for teachers to employ inquiry methodology as their major teaching strategy;
4. The need for teachers to integrate science experiences into the total curriculum where possible.

The responsibility for distribution of documents and for the provision of support in the implementation process rested with the regional directorates. The strategies used varied widely from region to region. Geographical differences, the availability of consultants and the allocation of resources were all factors contributing to the variety and effectiveness of the various strategies used by the regions to assist teachers in the first years of implementation of other curriculum policies necessitated a re-ordering of priorities and the allocation of resources to support those newer curriculum initiatives.

BACKGROUND TO THE EVALUATION OF THE 1980 POLICY

In accordance with the NSW Department of Education's plan for reviewing curriculum policies on a ten-year cyclical basis, evaluation of the Science K-6 Policy commenced in 1988. The evaluation was deemed significant, as recent moves to organise the total primary curriculum into six broad learning areas impacts heavily on science which is to be incorporated into the area designated as Science and Technology. The evaluation of the implementation of the 1980 policy would provide the foundations for the new Science and Technology syllabus due for release in 1991, as well as providing insights into teacher understanding of process approaches to learning and the type of support such approaches require if they are to be successfully adopted by teachers.
EVALUATION OF INVESTIGATING: SCIENCE K-6

After due consideration was given to factors seen to be fundamental to the implementation of the policy, the following issues were identified as the focus of the evaluation:

1. **The Teaching of Science**
   - Teacher use of policy documents in the preparation of teaching programs.
   - Level of teacher acceptance of the policy.
   - Understanding of the learning theory on which the science policy is based.
   - Appropriateness of teaching strategies employed.
   - Teacher confidence in the teaching of science.
   - Time spent teaching science.
   - Use of specialist teachers (such as the part-time or the teacher providing face-to-face release) for the teaching of science.
   - Difficulties faced by teachers in implementing the science policy.
   - Teacher perceptions of the quality of learning outcomes.
   - The degree to which teachers have integrated the teaching of science into the total curriculum.

2. **School Plans and Policy Implementation**
   - Availability of school plans.
   - Appropriateness of school plans in relation to policy.
   - Teacher use of school plans for programming.
   - Quality and effectiveness of school plans.
   - Characteristics of school plans.
   - The development of school plans.

3. **Primary Students and Science**
   - Student enjoyment and interest in science.
   - Student perceptions of their achievement of selected key curriculum objectives in skill and attitude areas.
   - Student perceptions of the nature and presentation of science lessons.
   - Other findings.

4. **Resources for Teaching Science**
   - The adequacy of resources available to teachers.
   - The value and availability of departmental resources.
   - The use and value of commercially developed resources and materials.
   - Teacher opinion of available resources.

DESIGN, PROCEDURES AND DATA ANALYSIS
Apart from the survey of district inspectors, the basic sampling unit used in the evaluation was the school. The final sample consisted of 400 schools, stratified to be representative of all primary, central and schools for specific purposes. Table 1 shows the dimensions of the sample.

<table>
<thead>
<tr>
<th>SURVEYED GROUP</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principals/Teachers-in-charge</td>
<td>400</td>
</tr>
<tr>
<td>Teachers</td>
<td>582</td>
</tr>
<tr>
<td>Y6 Teachers</td>
<td>100</td>
</tr>
<tr>
<td>Y6 Students</td>
<td>2,200</td>
</tr>
<tr>
<td>District Inspectors</td>
<td>79</td>
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<td>------------------------------</td>
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<tr>
<td>TOTAL</td>
<td>3,361</td>
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Five questionnaires were developed to ensure a wide coverage of perceptions regarding the implementation of the 1980 policy in primary schools. High response rates were obtained for all surveys. The schools sampled showed particular interest in the evaluation and were especially pleased to involve students. Fixed-choice answers and numeric responses in the questionnaires were analyzed using SPSSX PC + V2.0. Specific emphasis in the analysis was placed upon the effects of sex, years of teaching experience, region and type of school. The Chi-square test for statistical significance was consistently used to determine the existence of relationships between variables.

RESULTS

1. The Teaching of Science

   The vast majority of principals and teachers accept the underlying philosophy of the policy. A gap exists between teacher acceptance of the policy and its translation into appropriate teaching practices. As expected, a relationship was found to exist between understanding of the learning theory underlying the policy, familiarity with the documents and frequency of use. Male teachers were more likely to be familiar with the policy than female teachers.

   Results indicate that the stated classroom practices of teachers are often inconsistent with the philosophy of inquiry learning and problem solving. Strategies involving the inquiry process and problem solving are less consistently employed and lessons appear to be frequently dominated by teacher planning, direction and demonstration.

2. School Plans and Policy Implementation

   Just over 70 percent of schools had developed a school based
plan for the teaching of science. School plans were most likely to specify content; some were specific in sequence; and less than half give any guidance or direction in methodology or the assessment of outcomes.

3. Science and Primary Students
The majority of the Year 6 students sampled find science enjoyable and interesting. This correlates with the perception of the majority of teachers and principals that students enjoy science. Year 6 students generally perceive that they develop positive attitudes as a consequence of their science lessons. However, few students appear motivated to pursue a career in science. Of the students who would consider pursuing science as a career, the ratio of boys to girls is 2:1.

4. Resources for Teaching Science
The resource perceived by teachers and principals as most essential to teach science effectively is a school plan with specific, sequenced content. To increase their expertise in science teaching, teachers request assistance with specific content, practical ideas and ways to help students learn science through an inquiry method.

FUTURE DIRECTIONS IN NSW SCIENCE CURRICULA - SCIENCE AND TECHNOLOGY K-6
Science and Technology is one of the six designated broad curriculum areas of the primary curriculum in NSW. Each of the broad learning area syllabuses will share a similar format, will be consistent with the other syllabuses in its use of terms, and will be based on a common set of six types of learning processes:

- Initiating
- Perceiving
- Exploring
- Organising
- Responding
- Reflecting

The Science and Technology K-6 Syllabus
The aims, objectives, learning experiences and learning outcomes of this area are drawn particularly from the four components designated in The Primary Purpose:

- Science
- Technology Education
- Computer Education
- Mass Media Studies

The area also draws on relevant contributions from the other five broad learning areas and incorporates the intent of curriculum-related Department of Education policies (e.g.
Multicultural Education, Aboriginal Education, Girls Education Strategy, The Values We Teach).

Learning experiences in this syllabus are characterised by scientific and technological content and processes. The learning content in the syllabus is organised into four inter-related strands:

- The Natural Environment
- The Built and Managed Environment
- Products and Services
- Information and Communications

In keeping with the philosophy of the 1980 policy, students will learn science through actively participating in three types of activities:

- Investigating
- Designing and making
- Using

The syllabus will indicate significant content and a range of relevant learning activities, learning environments and learning resources. Teachers will draw on these when selecting and organising appropriate learning experiences for students, or when including material of their own. The integrated units to be included in the syllabus will provide a wide variety of such learning experiences.

The syllabus will recognise the need for schools to address community values and to be responsive to local community concerns. It will advocate that primary schools should actively promote close working relationships with parents and that they should strengthen their connections with the local community by seeking increased community involvement and participation.

Just as science education was defined in 1980, the 1990 syllabus defines its brief.

Science and Technology is the learning area in which all students learn actively about the natural and made environments through experiences which develop curiosity and which encourage investigating, designing, making and using.

Science and Technology K-6 Syllabus Project (1989:6)

The aims of the 1990 syllabus are a logical extension of those espoused in Investigating: Science K-6. The syllabus sees to guide students' development of the knowledge, understandings, skills, attitudes and values which will lead to:

- an enriched and more exciting view of themselves and the natural environment;
- competence, confidence and responsibility in their interactions with science, technology, society and the
environment.

The 1990 syllabus will then elaborate upon:
- learning in science and technology;
- learning outcomes;
- links with other broad learning areas;
- planning and programming.

CONCLUDING REMARKS

The curriculum process, begun in the late seventies with the release of the Investigating: Science K-6 policy, has continued and will further evolve in the development of the 1990 syllabus in Science and Technology. An attempt will be made to take cognizance of the findings of the evaluation of the 1980 curriculum policy and ensure that wherever possible the deficiencies in the previous implementation process will be rectified. What appears to be definitely established is the understanding that children learn best through inquiry and a hands-on approach to problem solving.

REFERENCES

Sydney: Government Printer

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NSW Dept. of Education (1989) Science and Technology K-6 Syllabus Project
Unpublished background briefing paper

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