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Science Education: Its Use and Usefulness m the Elementary School Curriculum*

Michigan Science Education Referent Committee

SCIENCE EDUCATION

Its Use and Usefulness in the Elementary School Curriculum*

The Problem

Science Education receives less than the professional attention it should in Michigan's public elementary schools and generally in elementary schools across the United States. Reading and mathematics education by contrast, clearly dominate early schooling and the thinking of parents, teachers and administrators. These prevailing attitudes and the practices and nonpractices they generate combine to ignore the intrinsic worth of science education and its value in the cognitive and personality development of children. Similar statements could be made on behalf of music, art, and, indeed, of the social sciences. Yet the Common Goals of Michigan Education state the schools "must provide on a continuing basis, to each individual, opportunity and encouragement to gain knowledge and experience in the areas of the natural sciences, the humanities, and the creative and fine arts so that his or her personal values and approach to living may be enriched by these experiences?[1]

Congruency between the Common Goals of Michigan Education and the Goals of Education

Further, the Common Goals of Michigan education tell lay persons, educators, and teachers that "Michigan education must foster the development of the skills of creative, constructive, and critical thinking to enable the individual to deal effectively with situations and problems"[2]. This is a goal which is addressed by science education, in the sense that contemporary science education is increasingly a vehicle for teaching the skills which produce such competencies as observing, comparing, analyzing, synthesizing, and evaluating.

To complete the summary of those goals of Michigan education which are related substantively to the purposes of science education, refer to Goal 1, which states in part, "Michigan education must assure the acquisition of basic communication, computation, and inquiry skills to the fullest extent for each student"[3]. Communication, relevant computation and inquiry skills are major concerns of science education. Indeed, it is a **primary aim** of science education to promote the development of critical thinking through the acquisition of inquiry skills.

The Common Goals of Michigan Education are laid aside

Note that an important characteristic of the Common Goals of Michigan education is their tone of imperative need, or indispensability, or requirement! Nonetheless, implementation of the goals is not insured simply by writing the goal statements as imperatives. The use of the terms such as **must provide, must recognize, must encourage, must develop, must respond,** and **must foster,** does not stimulate positive action because boards of education, school administrators, teachers, and lay persons find it extremely difficult, if not impossible, to conceptualize and appreciate the completeness of this set of goals, when all about them they hear the din of admonitions to improve reading and arithmetic scores only. In effect, the Common Goals of Michigan education are in juxtaposition with a distortion that forces a focus of time, energy, and funds on raising reading and mathematics test scores, which are, at best, uncertain indicators of achievement, and at worst, regarded as endpoints in the process of education.

A serious concern of The Science Education Referent Committee

A major concern is that science is too easily relegated to an "if there is time" position in the elementary school curriculum. The attitude which encourages such action comes apparently from a disregard for the understandings to be gained from experience and research in the classroom. For example, Matthews holds that "a major contribution of science in the elementary school curriculum is the enhancement of thinking in children . . . and . . . developing the ability to think systematically is more basic to learning how to learn than are the traditional basic skills of reading, writing, and arithmetic"[4].

John Goodlad adds, " . . . the curriculum of today's elementary schools must assure development of the full range of processes involved in the mother process, thinking"[5]. And from Almy in her interpretation of Jean Piaget: "Language is important, but for Piaget the ability to use language to express logic is an outcome of activity. Attempts to improve the child's logic solely through instructing the child in the use of language are not likely to be successful. Also, " . . . a program designed to nurture logical thought should contribute positively to readiness for reading"[6]. Ausubel joins by saying, "The emergence of simple abstractions or ideas about objects and phenomena must always be preceded by an adequate background of non-verbal experience"[7].

Research on reading readiness skills and science education

A study by Maxwell, on Waterford, Michigan children indicated that reading readiness is affected positively by the acquisition of skills from manipulation of materials[8]. Specifically, Maxwell found that the activities of a **consistent and manipulative** science program, during which children arrived at their own answers, are more effective than the activities of a regular reading readiness program alone. A similar testing of reading readiness achievement in relation to the use of a science program versus the regular reading readiness program was carried out by Kellogg and Stafford. The Kellogg-Stafford study showed similarly that children who spent more time in manipulative-inquiry activities, even though this meant less time for the regular reading readiness program, did as well as children who spent all their time in the reading readiness program. In addition, these children not only did as well as the children who did not participate in the science program, but also gained additional experiences, information, and skills in science[9].

The need for manipulative concrete experiences

The relationship between concrete objects and verbal representations is well recognized by publishers of reading materials. Reading readiness kits and materials direct teachers to provide manipulative experiences for children as pre-reading preparation. Interestingly such materials are often more expensive than the cost of an entire science program for the same grade level, and the science program likely would include many valuable experiences beyond those for reading readiness.

Hypothesis and concerns

Our hypothesis is that science, art, music, and the social sciences are access routes to reading and arithmetic, and to the "creative, constructive, and critical thinking" alluded to in the Common Goals of Michigan Education. The support for this hypothesis has powerful integrity and the field of educational research is rich in reproducible observations and reasonable assumptions. Our concerns are that these findings are overlooked, unknown to educators who do not maintain a scholarly relationship with the literature, difficult to translate into simplistic accountability models, and, worse, misinterpreted.

Science education and "compensatory" programs to improve reading

An important example of misinterpretation is the usual treatment of Basil Bernstein's writings on the **lack of curiosity** in children with a language deficit[10]. As a consequence of this error programs were developed and funded which aimed at remedying the language deficit instead of the curiosity deficit. His description of restricted language use was taken as a description of some deficit in concept formation, and the remedy proposed was to increase language teaching by the method of direct drill. In effect, the error tended to make language all important, and allowed experiential encounters to be severely reduced or eliminated.

Bernstein disowned this interpretation and the term "compensatory education." For said he, "How can one talk of compensatory education when the child has not yet been offered an adequate stimulating environment"[11]. A related argument is offered by Bloom, who said,s"if concrete object manipulation is necessary for the 'normal child' it is much more critical for the disadvantaged child who is at relatively low level of linguistic development and values things and activities which are concrete"[12].

Need for communication bridges

Another advocate of the use of a rich, dynamic environment as an important tool in language development is Mary Budd Rowe, who states quite succinctly, "For students with language problems – use science"[13]. She goes on to explain: "The communication gap produced by different histories of experience, and by variations in the semantic and syntactic structure of languages used by individuals, is especially marked between teachers and the children of minority groups. Educators rarely use the most obvious resource available to them for bridging this gap – early and regular exposure to a sequence of experiences in science"[14]. She emphasizes continuously that these experiences should be concrete so that the child can go directly to the objects for confirmation of meaning.

Re-emphasis: The help we can give children

To reiterate and simplify Bernstein's analysis, children and youth who cannot read and who cannot use numbers are often the same children who have curiosity deficits. It seems, then, that we are doing much to increase and perpetuate these deficits, if we deprive children deliberately of the enriching experiences afforded by science, the fine arts, and the humanities. Somehow we fail to see and, indeed, do not look for the help that these disciplines can give to the development of reading and number skills. We know of, but don't apply the principle, that it is only the intimate and protracted encounters with real things and events, which help and inspire children to form ideas and to learn to communicate them.

Science education and personality development

A concern equally as serious is **personality development.** Modern science programs seek to help children grow in self-confidence by allowing and encouraging them to check out their ideas in quasi experiments with real things and events. Children enjoy being genuine participants in seeking and making knowledge; therefore they appreciate weaknesses of their ideas by assessing personally the results of their investigations. Moreover, children like the freedom to change their ideas when predictions work no longer or when new information makes a conclusion untenable. This is to say, that authority for changing one's view comes from the learner's one-to-one relationship with concrete objects, rather than from the teacher or other authority. Incipient independence of this kind can lead to genuine feelings of self-reliance and self-worth. Each observation in this type of learning is real, therefore accepted honestly by the observer

(child) and the observer's peers and teacher, thus strengthening further the learner's value to self and perceived value to others.

Science education can help develop a sense of control of events and systems in one's life-space

Rowe and others support persuasively the practice that children be permitted to seek and invent knowledge with increasing independence as a means of constructing a positive sureness about one's life and future. She says "Science and prediction go together. The more I (the learner) know about a system, the more likely I am able to act on it in definite ways and expect certain results. Prediction rests on a belief that events are not totally capricious, that what I do to the system makes a difference in how the parts act. I (the learner) can in some way, act to control the fate of the system. Probably, she adds, the building of this belief represents the greatest contribution science can make to the education of any 'disadvantaged' child" 15.

Self-defeating guidelines of compensatory programs

One final matter that needs to be treated in this discussion involves the practice of removing the academically poor (children who are deficient in language and computational skills) from whatever classes these children have in science, art, music, and the social sciences in order to provide them with "remediation." Taking children out of classes for remediation purposes is a widespread practice, and, in some cases, the practice is even required by the guidelines of funded compensatory programs. The guidelines say, in effect, that remediation treatment must be **in addition** to the regular reading and arithmetic classes of the children.

Remediation should include enlarging the scope and variety of educational experiences

We do agree that academically poor children need reasoned help. However, our point is that remediation which necessitates removal of these children from other classes or precludes their being scheduled in these classes, deepens their deprivation and widens the gap between "normal" children and the academically poor children. We support the idea that remediation classes should be scheduled in addition to all of the educational experiences that these children should have, **not in place of them.** To make this addition possible, we suggest that alternative remediation schemes be considered such as varying the methods of teaching and/or designing more innovative treatment schedules.

Conclusions and Recommendations

In conclusion, it is important to bring the full dimensions of the Common Goals of Michigan Education to bear on the programs of Michigan schools. To do this we must provide an appropriate emphasis on inquiry skills, along with our present focus on basic communication and computational skills. The ability to perceive and subsequently deal with real problems is vital to a literate citizen.

One important way to deal effectively with the development of inquiry skills is through a sound science curriculum. Science education is not only an essential part of the general education needs of all society, it is a most important means to the acquisition of the other fundamental skills. We do not wish to downgrade the importance of other subjects, but to emphasize science as an example of learning which is likely to enhance one's self image, to stimulate creativity and curiosity, and to provide a rich environment of non-verbal and verbal experiences. Therefore, we wish to make the following recommendations:

1. The State Board of Education and the Department of Education advocate the inclusion of a science education curriculum in all school

programs especially in the early elementary grades.

2. The Department of Education be directed to identify and disseminate effective delivery system designs for science education.
3. The Michigan Educational Assessment Program include a state wide assessment of science performance which will yield every school data for pupils at the beginning of grades 4, 7, and 10.
4. The State Board of Education initiate a study of the effectiveness of practices and guidelines in compensatory programs which permit the removal of children from science and other activities to increase their reading and mathematics instruction.

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