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The key role of

Evaluation in an Elementary Science Program

"SHALL we build a science curriculum for our school?" The moment this question is posed, evaluation begins. For this question, as well as the many questions it raises in turn, involves choices.

The choices have to do with purposes, with curriculum design, with facilities, and with potentials for pupil growth. The evaluative process cannot be relegated to an end position. It must not be made synonymous with a final examination, a review of progress. Rather, evaluation needs to be envisioned as playing the key role in an elementary science program from the inception of that program.

Evaluation of Purposes

Let us assume that the answer to "Shall we build a science curriculum for our school?" is positive. There follows the query, "Why?" or "For what purpose?" The ensuing selection of purposes, or goals, is a process of placing value, of evaluation.

Several basic purposes for including science in the elementary school curriculum must be examined and then discarded or accepted. Among such purposes might be these: to satisfy our state's requirements, to have our school represented this year in the local science exhibit, to satisfy the demands of parents, to prepare our children for junior high school science, to aid our children in exploring and interpreting their natural environment.

In placing prime value on such a purpose as the last one, the others might be satisfied also. But to place prime value on any one of the first four is to approach the design and execution of an elementary science curriculum with the eye of a cynic. And there is no place for cynics as leaders of children, because educational cynics exploit children, rather than serve them.

Scrutiny reveals that the acceptance of such a purpose as aiding our children in the exploration and interpretation of their environment provides us with enormous challenges. If we *aid* children, we help and we guide; we do not dictate nor do we coerce. *Our* children are all the children in schools in this country, a country committed to democracy and the worth of each individual.

To *explore* and *interpret* one's own environment involves an intimate association by each child with the living things, with the inanimate objects, with the

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natural forces of his surroundings. To read about natural phenomena is not enough if one accepts a purpose such as the one proposed. To explore and interpret our environment scientifically involves selecting and building those science attitudes and behaviors which are compatible with citizenship in this country. One such attitude would be that of open-mindedness to the theories and hypotheses of others. One such behavior would be evidence of growing responsibility in using one's environment wisely.

Evaluation of Program Design

Let us continue to assume that a purpose of an elementary science program is to provide for exploration of environment. An evaluation of the design of a science curriculum purporting to achieve this purpose should give evidence that children have opportunity in each succeeding year for exploration of the broad areas of environment in greater and greater depth. Further, evaluation would reveal opportunities for building and applying science skills in exploring this environment, for individual and group action in solving problems related to it, and for considering and practicing attitudes and behaviors in and toward it.

For example, a science curriculum designed to provide a well-rounded look at environment might suggest that at every grade level at least one study be undertaken in some depth from each of the following broad areas: plant and animal life on Earth; natural forces such as gravitation, electricity, sound and magnetism; the planet Earth, its interior, its surface features, its atmosphere; our solar system, the bodies within it and relationships among them, and the relationships between our solar system and other bodies in the universe.

But the mere selection of specific topics for study at each grade level is not enough. There must be on-going evaluation of each topic in order to select the best sequence of concepts for development with a particular group of children at that grade level. To select science topics for each grade and illustrate each with a sequence of possible concepts to be developed is worth while. To publish such a compilation as a curriculum guide also is worth while, but it is only a beginning.

Failure to carry on this constant evaluative process is apt to be the cause of the collapse of even the most carefully designed science program. We must constantly act upon our knowledge that each group of children is different from every other group. Consequently, carrying out the goal of aiding children in interpretation of environmental phenomena involves an awareness that no two groups will ever be able to follow precisely the same pattern in the exploration of a science topic. Thus, if we act upon what we know about children and the ways in which they build concepts, it follows that the design of a science curriculum must undergo continuous evaluation in order to permit each group of children the use of their unique abilities.

Evaluation of Facilities

A program purporting to further certain science skills through their use would reveal, upon evaluation, that certain facilities must be available. Time and equipment are two facilities which must be available in sufficient quantities. If it is important for children to think carefully about environmental phenomena, certain provisions must be made with regard to time. There must be time

to observe, time to listen, time to test one's ideas, time to challenge another's proposals, time to seek new information, time to reflect and consolidate.

If accuracy in the use of the materials of science is held to be important, there must be opportunity to practice this skill. It is necessary to provide materials and equipment which allow accurate observations to be made. In designing a program with the skill of accuracy in mind, one might well challenge, for example, the use of milk-carton "barometers" as substitutes for accurate weather instruments.

If it is important that children explore their own environment at firsthand rather than merely exploring a facsimile of it in print, provision must be made for such exploration. The windows of classrooms are gateways to study of some natural phenomena. From this point, clouds may be observed and the yearly cycle of a tree may be followed. But much study should take place in the out-of-doors. Often, a necessary outdoor experience cannot be scheduled a week in advance. The school grounds may be considered as an extension of the classrooms in a building, an extension which provides laboratory facilities impossible to duplicate. As such, it will be used if a purpose is that children grow in ability to interpret environmental phenomena.

Then there is the matter of learning to check one's own interpretations or explanations against those of others. It should be possible for children to work independently and then share the results of their findings. But there must be other facilities for checking also. Books must be available. Not one book but many should become a part of the science library to be found in each classroom as well as in the school's central library. Ready references aid children in consolidating ideas, in opening new avenues of exploration, in discovering divergent or corroborative opinions.

Evaluation of the facilities available may lead to a consideration of who shall guide children in their pursuit of learning in science and when this learning should occur. In evaluating with the purpose set forth in this article, it is doubtful whether a special teacher of elementary science who works with children only during certain periods of the week would be able to guide children effectively. For children interact with their environment every day. They need guidance in using the skills of science every day. They are involved in solving problems every day. Attitudes, appreciations and behaviors related to science operate all the time, not just in three periods each week.

Children need a classroom teacher who is able to provide guidance when conditions are optimum for initial learnings. Such a teacher is an indispensable asset. Children are due a teacher who is able to provide guidance in using science information, skills and behaviors in other curriculum areas. It is the classroom teacher who makes this possible, the teacher who is available as a resource to children all day every day. This is the teacher who is aware of possibilities of children's interweaving their ideas and skills from one curriculum area to another. Such a teacher would use the help of a science consultant who can provide materials, make suggestions or act as a source of information to children. Making such a science team available would be to provide a considerably enhanced facility for elementary science.

How good is the elementary science program? Probably the answer lies in individual pupil progress toward those goals or purposes found to be acceptable

for the program. If the purpose is that children at specified intervals should give positive evidence of having acquired certain science information, the task of evaluation is easy. A series of tests is standardized and the performance of children on such tests is analyzed. There could even be remedial science teaching based upon such evidence.

Evaluation of Pupil Progress

If the purposes of the elementary science program are growth in ability to explore and interpret environmental phenomena, in making use of certain science skills, and in giving evidence of certain attitudes and behaviors, then paper-and-pencil tests of information may be helpful to some extent. Such tests may be useful in diagnosing a child's difficulty in interpreting phenomena, since such tests might reveal incorrect information. Also, their use at the beginning of a study may aid a teacher in assessing the background information of individuals in a group. More constructive planning may then take place.

But to measure almost entirely, or entirely in some cases, in terms of specific recall of science facts would not reveal individual pupil growth or progress toward the purposes which have been stated. To be sure, this kind of growth is difficult to assess. However, it is still possible to secure evidence of pupil progress.

To do this, a teacher becomes a listener. He listens as children verbalize solutions, as they pose questions, as they bring evidence to bear on the problem. He listens at the beginning, throughout, and at the end. He listens for evidence of growth on the part of an individual. Perhaps a tape recorder is used as an aid to listening, or notes may help him to recall what he heard; for what is heard must be evaluated as evidence of pupil progress.

A teacher also becomes an observer. He observes children as they select and use equipment. He observes them as they record pertinent data. For example, he observes their actions toward environment for indication of desirable behavior which reveals knowledge of good conservation practices. Again, he makes some record of such evidences of behavior, for these records aid him in assessing individual progress over a period of time.

Such evaluative practices as these must be employed if each child's growth is held to be important. Further, they must be employed continuously if we are to guard against the incongruous action of first stating our goals in terms of acquisition of broad understandings, growth in certain skills, and demonstrations of desirable attitudes and behaviors associated with science and then assessing only in terms of recall of specific science facts.

Evaluation plays a key role in an elementary science program from the moment choices are made with regard to purposes or goals, since their very selection is a process of placing value. This process of valuing purposes must be intimately tied to program design and execution. And certainly, if the purpose is to serve children rather than to exploit them, value must be placed upon progress of individuals.

What is the purpose of an elementary science program? How shall this program be implemented? Who is to benefit and in what ways? No answers are possible at this juncture unless evaluation is accorded a key role.