Journal of the Minnesota Academy of Science

Volume 49 | Number 1 Article 6

1983

Issues in Teaching Science

M. Ediger
Northeast Missouri State University

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ABSTRACT — Vital issues in the science curriculum include: 1) product versus process goals; 2) inductive versus deductive learning; 3) a psychological versus a logical curriculum; and 4) subject centered versus activity centered units of study.

Each student needs to achieve optimally regardless of the position(s) taken by science teachers on any one of the above named issues.

There are diverse issues in the teaching of science. The purpose of this paper is 1) to make comparisons between two equally recommendable methods of teaching 2) to reveal the writer's beliefs that issues need resolving and 3) to recognize divergent philosophies in developing an effective science curriculum.

Product versus Process Goals. Creating worthwhile products can be a desirable goal in education. In this view, achieving an end or objective on the pupil's part is paramount. If products are to be salient in ongoing lessons and units, adequate effort must then be given in the selection of relevant objectives for students to attain. Also, the teacher needs to choose learning activities (means) to attain the objectives and to evaluate if the involved pupil successfully achieved the objective. Evaluation is based solely/largely on pupils' achieving the objectives.

Which end products, then, might learners achieve?

1. acquiring vital facts, concepts, and generalizations.
2. making science equipment directly relating to an ongoing unit.
3. completing art projects, such as murals, dioramas, friezes, and sketches pertaining to relevant science concepts and generalizations.
4. writing poems, stories, and plays, individually or in committees.
5. making models and objects involving science phenomena.

Somewhat toward the other end of the continuum, some teachers and supervisors advocate process rather than product objectives. Which process goals might be valuable for learners?

1. working together cooperatively in a committee endeavor
2. identifying and solving problems in ongoing science units.
3. observing, classifying, and inferring science phenomena, responsibly and accurately.
4. taking notes, outlining, and summarizing.
5. reporting subject matter orally and effectively utilizing quality standards.
6. dramatizing relevant events from the lives of famous scientists.
7. reading science content involving proficient comprehension.
8. utilizing a variety of purposes in listening to facts, concepts, and generalizations in the science curriculum.
9. using methods of science to acquire and appraise data.
10. becoming skillful in the use of science equipment within a laboratory setting.

*Division of Education, Northeast Missouri State University, Kirksville, Mo.

Inductive versus Deductive Learning. Inductive methods can be utilized effectively in teaching science (3). To emphasize induction, the teacher needs to utilize a variety of activities in stimulating pupils to respond effectively to questions raised in ongoing units and lessons. The science teacher does a minimum of lecturing and explaining of subject matter to pupils. Rather than lecturing and explaining content, the teacher guides pupils to make discoveries and find out on their very own. Skilled teachers raise relevant questions so that learners may be guided to achieve viable generalizations. Inductive teaching emphasizes moving from specifics to the general to attain significant broad ideas.

Other science teachers stress deductive means of teaching pupils. Well planned lectures and explanations may then provide major learnings for pupils. Also, learners can obtain subject matter deductively from films, filmstrips and cassettes, single or multiple series science textbooks, tapes, illustrations, and demonstrations performed by the teacher. With deductive means of instruction, subject matter is presented by the science teacher for learners to acquire.

No science teacher, perhaps, uses either a pure inductive or pure deductive method. However, a teacher may lean heavily in the direction of using either method of teaching and learning. In each situation, learnings for pupils need to be meaningful, purposeful, as well as provide for individual differences. Learners individually need to achieve optimally in the science curriculum.

Psychological versus Logical Curriculum. A psychological curriculum emphasizes pupils' being rather heavily involved in sequencing their own learnings. For example, in an individualized reading program in science, each pupil generally selects which library books to read first, second, third, fourth, and so on. After each book has been completed in reading, pupils with teacher guidance may appraise progress of the former. Means of appraisal may also be determined by pupils with teacher assistance.

As a further example of a psychologically designed curriculum, a science teacher may develop a set of learning centers. There needs to be an adequate number of centers so each pupil might sequentially select tasks to complete, as well as to omit. The teacher is a guide and stimulator to encourage pupils to progress sequentially and optimally.

A logical science curriculum is developed with the teacher selecting ordered goals in ascending levels of complexity for learners to attain (4). The teacher also chooses learning activities to guide each pupil to attain measurable ends. The teacher must evaluate if a learner has been successful in goal

attainment. Each pupil that successfully achieves an objective may tackle the next sequential goal. If a pupil does not attain an objective, the teacher might then need to utilize a modified teaching strategy.

The teacher determines sequence for pupils, individually, in arranging objectives, from simple to increasingly more complex. A logical science curriculum is being emphasized in these teaching-learning situations.

Subject Centered versus Activity Centered Curriculum. Acquisition of vital subject matter can be a salient goal to emphasize in ongoing units and lessons. Understanding objectives then receives considerably more emphasis compared to skills and attitudinal goals. In learning much subject matter, pupils are guided to comprehending well from the utilization of single or multiple series science textbooks, related workbooks and worksheets, general encyclopedias, content centered audio-visual aids, and science encyclopedias, among other reference sources. Pupil achievement from the above-named activities may be evaluated through teacher directed discussions and observation, as well as by use of true-false, multiple choice, essay, matching, and completion items.

A project method presents a different school of thought. Subject matter then is learned only to develop and complete relevant projects. In project methods of instruction, pupils are active, not passive, beings. The learner-with teacher guidance-plans, develops, and evalutes each project. The projects might include making science equipment and models, as well as being involved in art and dramatization activities.

In conclusion, there are diverse issues to be resolved in the science curriculum. How much emphasis then should be placed upon:

1. product as compared to process goals?
2. induction and deduction as methods of teaching?
3. a psychological as well as a logically developed curriculum?
4. the learning of subject matter as compared to actively participating in selecting and developing diverse projects in ongoing units of study?

Whichever method or approach is being emphasized in teaching and learning, learners need to develop interest, purpose, and meaning.

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