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UNIVERSITY OF IOWA MODEL FOR SCIENCE TEACHER EDUCATION

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Teachers can learn to assess their teaching performance and to use such information for improvement. Several observations and experiments have led to the formulation of a model at the University of Iowa which continues to grow and to be modified as experiences with it dictate. The model has evolved from over two decades of efforts. However, it has matured as a result of the NSF-supported Iowa-UPSTEP program (a teacher-education development effort which enjoyed ten years of support), and the NSTA Search for Excellence project which arose from a 1977-80 NSF research effort called Project Synthesis (Harms & Yager, 1981).

The model is tied to a definition of science that is generally accepted at a philosophical level — but one rarely applied in science teaching. It is a definition elaborated by George Gaylord Simpson (Simpson, *et al*, 1957; Simpson, 1963):

> Science is an exploration of the material universe in order to seek orderly explanations (generalizable knowledge) of the objects and events encountered: *but these explanations must be testable.*

The model is also tied to the position encapsulated in the NSTA manifesto:

> Science should be experienced by every student every day of every year he/she is in school (NSTA, 1982).

Project Synthesis

The model also ascribes to the four basic goal areas of the Project Synthesis research effort. The four justifications for school science are:

1) **Personal Needs.** Science education should prepare students to utilize science for improving their own lives and for coping with an increasingly technological world.

2) **Societal Issues.** Science education should produce informed citizens prepared to deal responsibly with science-related societal issues.

3) **Career Education/Awareness.** Science education should give all students an awareness of the nature and scope of a wide variety of science and technology-related careers open to people of varying aptitudes and interests.

4) **Academic Preparation.** Science education should allow students who are likely to pursue science academically as well as professionally to acquire the academic knowledge appropriate for their needs.

NSTA Search for Excellence

These philosophical positions provide the context for the University of Iowa Model for Continuing Teacher Education. The model also arises from observations and indepth case studies of the NSTA Search for Excellence in Science Education effort, 1982-86 (Penick & Yager, 1983; Yager, 1983):

1) Effective science teachers are extremely active and involved. Their work as teachers is difficult to separate from their other activites, actions, pursuits.

2) What teachers do (i.e., the instructional strategies they employ), is far more important in producing an exemplary program than are the materials/ curriculum they use.

3) Effective science teachers are never satisfied with their efforts. They constantly strive to improve, to find a better way, to experiment with their instruction.

4) The best science teachers (of the exemplary programs studied) have developed unique abilities to build teams — professional ones among other teachers, ones involving administrators and community leaders, ones involving their students. In a very real sense the best teachers are those who not only grow as individuals, but also in their abilities to work effectively with others.

5) The most effective teachers are the first (a) to admit to not knowing, to needing help and the ideas of others, and (b) to recognize that it is important — perhaps vital — to continue to grow professionally. They are confident enough to seek the ideas, the experience and the expertise of others.

6) The best teachers find change exciting — something to be welcomed. They find routine boring, and outside or administrative control of curriculum and instruction to be intolerable.

7) The best science teachers see their students as resources for ideas, work, involvement, detection. They welcome student interest, curiosity, involvement in the science enterprise.

University of Iowa Model

The University of Iowa Model for Science Teacher Education includes the following specific features:

1) It involves teachers in brainstorming sessions about what they do. Such sessions are free-wheeling discussions where all participants are encouraged to think aloud as problems are visualized and improvements and correctives are sought. The teachers identify emerging and/or potential classroom and school problems. They practice defining problems appropriately (ways which point toward correctives). They explore a variety of possible approaches. They take some actions which seem most likely to offer solutions. And they examine the effects of specific actions they have tried — often with some group consensus.

2) It involves teachers in action — real "hands-on" experience with specific instructional techniques, such as making assignments that meet specific objectives, asking questions that generate diverse responses, collecting evidence that must be processed and evaluating individual student growth. The teachers are encouraged to search for inconsistencies in their thinking, proposed actions and their actual classroom behavior. They are encouraged to question basic assumptions, to make predictions, to seek criticisms of their thinking and classroom behavior, to generate new ideas, to consider a wide range of possible alternatives.

3) It involves many people and resources such as local citizens, school administrators, other teachers, college faculty and government leaders. It is not

a matter of teaching students what one would have them do and believe. The ingredients for thinking and problem solving are enriched; i.e., ideas are sought out from writings and a variety of persons including local citizens with special interest and expertise with a particular problem or issue (scientists, engineers, previous students, parents and political leaders).

4) It includes the production of written materials, displays and apparatus, collected data and conflicting interpretation by teachers and others. These materials become the information and motivation for further trial, analysis, criticism and investigation. With a focus on such information collected and generated by students and persons they have sought out, the source of content for study becomes quite different from that encountered in the typical classroom. The teachers and students become intimately involved with such group products and processes. These in turn can be used as models for their own teaching with their own students.

Results of Model

The University of Iowa Model produces specific results which also help clarify its nature. The model, when successfully employed, produces the following:

1) It helps effective teachers to study and to understand their own characteristics and behaviors that make them particularly successful. They discover what works as they gain experience in relating their actions to student reaction.

2) It provides a conceptual framework for effective science education as indicated by the definitions, logic and analyses. Every teacher must match his/her student objectives with specific student response, performance and growth.

3) It provides self-assessment tools for individuals to use — tools that can be shared with colleagues. Such tools include audio tapes of classes they have taught and analysis of video tapes of their own performance in a classroom.

4) It provides experience with *using* a philosophical base to evaluate current practice and to stimulate moves in new directions. This base includes a working definition of science appropriate for all and justification of science required for all (Simpson's definition and Project Synthesis goals).

5) It involves a variety of in-service teachers as colleagues throughout the preparatory program. It involves the use of four to eight teaching models during the student teaching experience. The program provides direct experience with team building — the kind needed in local schools and communities if exceptional science teaching is to be more than an accident or a situation unique to an exceptional teacher and his/her classroom.

6) It exemplifies the strengths of collegiality — the give and take, the sharing, the support, the stimulation, the emergence of new ideas. It involves administrators, supervisors, community leaders, a variety of master teachers and a university staff in meeting some common goals.

7) It exemplifies one basic ingredient of science, namely that the enterprise is (should be) self-correcting, i.e., that change should result from trials, attempts and testing. It does not assume that there is one accepted teaching style, that an appropriate recipe can be provided or that a final and complete set of competencies can be presented and mastered.

8) It defines the most effective teacher as a stimulator, a guide, a source for

further curiosity — not as a task-master, a disseminator of information, a satisfier of student curiosity or one calling all the shots.

9) It encourages teachers as explorers, as humans anxious to grow in their own understanding of the universe, as persons able to experience and to appreciate the many dimensions of science.

10) It helps teachers to recognize their own uniqueness as students of science in the traditional sense and to understand that the focus on study as a means of gaining passage to the study of science in greater depth may not be necessary for everyone and may indeed be inappropriate for 98 percent of the students enrolled in schools K-12.

The University of Iowa Teacher Education Model utilizes exceptional and successful teachers as part of the staff. It includes extensive experiences in communities and schools. It does not focus upon textbook principles and traditional learning of currently popular methods. It provides an experience with collegiality in its finest sense. It encourages communication, curiosity, the testing of ideas, the collection and use of evidence concerning effective materials and practices. It includes the use of classroom observational information, student assessment of both attitudes and achievement, and follow-up of former students after they graduate. The primary aim of the Iowa Model is to build a growing team with all members vitally interested in continuing education.

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