Iowa Science Teachers Journal

Volume 28 | Number 1 Article 3

1991

Meeting Iowa School Accreditation Standards through STS Science

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The National Science Teachers Association (NSTA) has declared that the goal of science education "... is to develop scientifically literate individuals who understand how science, technology and society influence one another and who are able to use this knowledge in their everyday decision-making" (NSTA 1982). Strategies aimed at achieving this goal have been endorsed and promoted by a variety of groups. Yet, in many Iowa schools, the science curriculum is driven by traditional textbooks that emphasize narrow academic goals.

Iowa school accreditation standards list specific requirements for the science program in grades 1-12. In addition, seven horizontal infusion areas must be included throughout all areas of the curriculum, including science.

Analysis of opinions of twenty elementary and secondary teachers indicates that a curriculum designed to meet the science/technology/society (STS) goal conforms to Iowa school accreditation requirements while the traditional textbook-centered science curriculum does not.

STS Science

The science/technology/society goal of developing scientifically literate individuals requires tactics and strategies of teaching that are appropriate for the goal. One such effort to develop an STS approach is the Iowa Chautauqua Program, directed by the Science Education Center at the University of Iowa and funded by the Iowa Utility Association and the National Science Foundation.

Through the Iowa Chautauqua workshops, teachers learn how to develop and use their own teaching modules which are focused on issues that involve the impact of technology on students in their homes and communities. Students learn science concepts behind the technology, but they never lose sight of the interrelationships among science, technology and society. The modules also require students to develop and use decision-making skills as they deal with individual and social impacts of science and technology.

While teachers using this approach may "cover" less science content, students are likely to remember more because they are motivated and involved. Chautauqua teacher Veda Flint writes: "My students come to class excited about science. My classroom now provides an environment where students can practice decision-making strategies that can lead to action on real-life problems." (1988)

STS teaching strategies in other projects or the classrooms of individual teachers all share this attention to the interaction of science, technology and society, along with the development of everyday decision-making skills.

Traditional Science

The science curriculum in many classrooms is determined by the textbook, and textbooks generally include very little material on technology or on the impact of science and technology on society. In one typical, popular high school series, the amount of social impact material ranged from 40 pages on health and environmental problems in an 800-page biology text to only one page on energy resources in the 700-page physics text by the same publisher. All too frequently, even the small amount of STS material in the textbook is omitted by the teacher.

Iowa School Accreditation Standards

State standards for science instruction in grades 1-6 and for grades 7 and 8 are as follows:

Science instruction shall include life, earth and physical science and shall incorporate hands-on process skills; scientific knowledge; application of the skills and knowledge to students and society; conservation of natural resources; and environmental awareness.

With the substitution of "biological" science for "life" science, the wording of the science standard for grades 9 through 12 is nearly identical to that for grades 1-8. Five units of science must be offered and taught in grades 9-12, including full units of physics and chemistry, although physics and chemistry may be taught in alternate years.

In addition to the requirements above, seven more topics must be infused into all curricular areas including science. They are career education; multicultural, nonsexist concepts; the understanding and use of current technology; global perspectives; higher order thinking skills; learning skills; and communication skills.

The concept of a "standard" suggests an absolute measure: either a school meets the standard or it does not. It is important to remember, however, that the degree of compliance with any given standard may vary. For example, one school may "include" physical science in the curriculum for grades 1-6 by teaching one physical science unit in fifth grade and nothing more, while another district may have a balance of life, earth and physical science at every level.

A Comparison

The following is a comparison of how well STS and traditional science meet Iowa school accreditation standards. The "Rating" columns show the degree to which state standards will be met by using

each approach, STS or traditional. This was estimated by the author (ratings in parentheses) and a group of twenty elementary and secondary teachers who participated in an Iowa Chautauqua Program at the Marshalltown site. The teachers rated the two approaches during the Spring 1990 workshop session (after they had taught STS modules they had developed through the Chautauqua program). The survey instrument used was a questionnaire asking the teachers to rate the degree to which, in general, each of the state standards would be met using each approach (STS and traditional). The following scale was used for the rating:

1 = Considerable curriculum work will be needed to meet this standard.
2 = Some curriculum work will be needed to meet this standard.
3 = This standard will be met through this approach, but some curriculum work in this area would be helpful.
4 = This standard will be met thoroughly and effectively through this approach.

Five of the six phrases from the state science standard plus the seven topics required for all curricular areas were each rated separately. The phrase "hands-on process skills" in the state standard seems to be a combination of two different ideas: 1) the use of hands-on science activities, and 2) the learning of process skills. These were considered separately in the comparison.

Numerical results and comments follow. A graphical representation of the data may be seen in Figure 1.

Discussion

The results of the ratings are a summary of the opinions of a group of experienced teachers participating in the Iowa Chautauqua Program, not an unbiased group. The teachers were asked to compare "STS" with "traditional" approaches without precisely defining either term. Because of their participation in the Chautauqua Program, it is reasonable to assume that, to the teachers, "STS" meant the approach advocated in the workshops and "a traditional approach" was the kind of curriculum with which they were most familiar through their prior teaching experience.

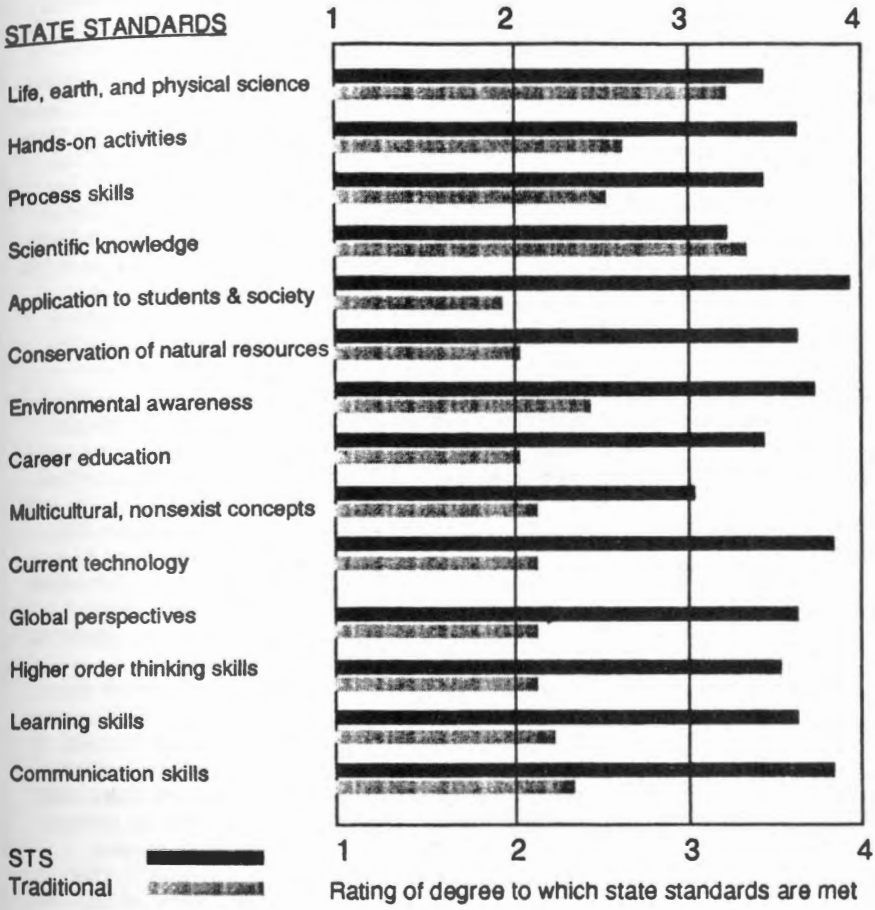

Figure 1
The degree to which state standards are met
using an STS approach and a traditional approach

Standard	Rating	Comment	Rating	Comment
Life, earth, and physical science	3.4 (3)	Content from all three areas will normally be encountered through STS projects. The approach should help students see interrelationships among the science disciplines. Some curriculum work may be needed to avoid major gaps or imbalances.	3.2 (3)	Elementary textbooks include material from all three areas. However, when teachers pick and choose from the texts, some imbalances may occur, in particular, physical science may be slighted. In grades 7-8 and in 9-12 some schools have found that they were missing one of the three areas in their discipline-centered courses. Secondary courses do a poor job of showing the interrelationships among the science disciplines.
Hands-on activities	3.6 (3)	Hands-on activities are usually part of STS lessons.	2.6 (3)	Modern textbooks usually call for some hands-on activities, but not as much as is common with STS lessons. Hands-on activities in the text are frequently omitted by teachers.
Process skills	3.4 (3)	Students are required to practice and use process skills. Some analysis may be helpful to make sure that all important skills are included.	2.5 (1)	The approach does not include learning activities focused on science processes, although there may be some lip service paid to science processes in the teachers' edition of the textbook.

Scientific knowledge	3.2 (3)	The approach is effective in teaching some scientific knowledge, but the coverage is not thorough.	3.3 (3)	"Coverage" is thorough, but may not be effective in terms of student learning.
Application to students and society	3.9 (4)	This is a major strength of STS science.	1.9 (1)	Applications are covered minimally, if at all.
Conservation of natural resources	3.6 (3)	This is a frequent subject of STS lessons.	2.0 (2)	Some elementary, life science, earth science, and biology textbooks include some minimal coverage in this area.
Environmental awareness	3.7 (3)	This is a frequent subject of STS lessons.	2.4 (2)	Some elementary, life science, and biology textbooks include some minimal coverage in this area.
Career education	3.4 (3)	Many STS lessons will involve the use of science and technology in a variety of careers.	2.0 (1)	Some minimal coverage of science careers is included in some texts.
Multicultural, nonsexist concepts	3.0 (2)	The STS focus on society makes the inclusion of multicultural and nonsexist concepts fairly easy.	2.1 (1)	MCNS concepts are not a natural part of discipline-oriented science.
Current technology	3.8 (4)	Technology is a major part of STS.	2.1 (2)	Technology is given minimal coverage in most science textbooks.
Global perspectives	3.6 (3)	Many of the social impacts studied in STS lessons are global in scope.	2.1 (1)	With the exception of biomes in biology, global perspectives are not part of the traditional approach.

Higher order thinking skills	3.5 (3)	Lessons generally require students to make use of higher order thinking skills.	2.1 (1)	Most instruction is at the knowledge acquisition level.
Learning skills	3.6 (3)	Students practice learning skills, such as the ability to find and use various sources of information.	2.2 (1)	Reliance on textbook and lecture methods, if anything, inhibits the ability of students to learn how to learn on their own.
Communication skills	3.8 (3)	Students frequently use written and oral communication skills.	2.3 (2)	Sometimes the only communication the student practices is circling choices on an answer sheet for a multiple choice test, although many teachers also use essays, lab reports, etc.

Summary

The consensus of a group of 20 teachers is that a curriculum based on an STS approach to science teaching will, without any special modification, meet all Iowa school accreditation standards.

A science curriculum driven by a traditional content-centered textbook will not meet most Iowa school standards without the addition of supplementary activities.

For 13 of 14 state standards identified for this analysis, an STS approach appears to better meet the standard than does a traditional approach.

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