Educational Leadership/ Service #25

STRAUS FOUNDATION PLANNING GRANT PROPOSAL
SPRING 1997

Title: Connecting Science and Citizenship: Teaching and Learning Science in a Science/Technology/Society (STS) Context at the University Level

Applicants:

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Background:

Many college and university students, science majors as well as non-majors, fail to appreciate the ways in which science and technology connect to their daily lives and personal decision-making. A Science/Technology /Society framework that promotes the teaching and learning of science in the context of human experience can encourage such connections while at the same time allowing science concepts and processes to be learned through application to real-world problems. The STS movement has been promoted for over two decades at the K-16 level. It has been endorsed by the National Science Teachers Association both as an appropriate science education context for all students, and as a means of preparing students for current and future citizenship roles. The STS emphasis is on responsible decision making in the real world of the student where science and technology are significant components.

In an ideal STS program, learning is student-centered and opportunities are provided for students to extend beyond the classroom to their local communities. STS students learn about science not by memorizing facts or algorithmic approaches to problem solving, but rather by identifying local, regional, national and international problems, planning for individual and group activities that address them, and moving to actions designed to resolve the issues they investigate. Research has shown that learning science in an STS context results in students with

improved creativity skills, a more positive attitude toward science, and the ability to apply scientific concepts and processes in their daily living and in responsible personal decision-making. A basic goal of STS efforts has been the production of informed citizens who are capable of making crucial decisions about current problems and issues and of taking personal action as a result of these decisions.

The goals of STS appear to be entirely consistent with the goals of the Straus Foundation. This proposal seeks to implement a planning process whereby UMBC can extend STS to the university level and provide a campus-wide framework for students to begin learning science in the context of human experience. It builds upon experience with new course development and existing science course reforms carried out in conjunction with the UM System's NSF-funded Maryland Collaborative for Teacher Preparation (MCTP) program. The planning proposal also seeks to build upon and extend to the campus level science teaching and learning approaches currently being applied in Biology 100.

Abstract:

STS is a set of teaching strategies that have been shown to be effective in leading students to approach and to learn about science in the context of their lives and through application of scientific concepts and principles to real-world problems. Over a period of almost three decades, STS approaches have been successfully implemented at the K-12 level, but are rarely found in colleges or universities. A multidisciplinary group of faculty and administrators needs to be assembled to develop an action plan to implement an STS program at UMBC so that STS might serve as an enabling framework for science learning across the campus. The current proposal is aimed at beginning the planning process by informing faculty and administrators about STS approaches through workshops and departmental presentations, and engaging a core group to develop a strategic action plan for STS implementation.

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P. G. Sokolove and S. M. Blunck

A. Project Description

Purpose of the planning grant.

To engage a core faculty drawn from multiple disciplines in developing a strategic action plan to implement a Science/Technology/Society (STS) learning program at UMBC.

Why STS?

Central to responsible decision-making in a democratic society is an informed citizenry. In a democratic society such as ours that is also science and technology based, responsible decision-making requires that citizens be scientifically and techonogically literate. Indeed, it could be argued that science and technology literacy is necessary for responsible decision-making at all levels, from the personal to the global. The question we face is whether all students who graduate from UMBC will have the background, training, skills, experience and confidence to identify and address as citizens problems where science and technology are important components.

Unfortunately, many college students are math and science phobic, and even those who choose to major in science, math or engineering subjects have little experience in connecting what they learn in the classroom with what they do in their daily lives. The Science/Technology/Society (STS) approach to science education has been suggested as a way to improve science and technology literacy for all students by beginning the learning process with such connections rather than by starting with science concepts and process.

> "The bottom line in STS is the involvement of learners in experiences and issues which are directly related to their lives. STS empowers students with skills which allow them to become active, responsible citizens by responding to issues which impact their lives. The experience of science education through STS strategies will create a scientifically literate citizenry for the 21st century." (National Science Teachers Association, 1993, p. 5)

What is STS?

STS is not a curriculum, but rather a set of strategies that can guide individual instructors toward effective ways of leading students to approach and learn about science and its relevance to their lives. Many of the characteristics of an STS course reflect and are consistent with the recent science teaching recommendations of the National Academy of Sciences and the American Association for the Advancement of Science. Yager and Roy (1993) have summarized the differences one finds in comparing an STS course with a traditional science course (see Table 1). What is striking about most of these strategies is the centrality of students and of student involvement in the learning process. Learning by assimilation of information from the teacher and the textbook is replaced by students actively seeking information that they need in order to understand a problem and propose solutions. Perhaps even more important is that students engage on problems that they, rather than the instructor, identify.

For example, in a recent freshman honors biology course at UMBC students were asked to pose a question or set of questions centered on a significant biological problem with local, statewide, regional, national or worldwide implications. In their team-authored final project they were expected: (a) to describe the current state of knowledge related to the problem (citing supporting evidence), (b) to suggest two or more options for dealing with the problem, (c) to discuss the societal implications of each option, including the social and monetary impact (costs and benefits), and (d) to select an option for future action to correct the problem along with an evidence-based justification of their choice. (Example question: Why has there been a drastic decline in the bluecrab harvest in the Chesapeake Bay in the last 100 years? What, if anything, can be done to restore the bluecrab population and to increase future harvests?)

STS strategies can be employed in existing science, math and engineering courses at all levels (Yager, 1996). They can be applied throughout a single course, in the context of a sequence of courses, or in only one or a few selected units within a course. They can also be used as strategies to explore science and technology issues in non-science/math/engineering courses including, for example, courses based in philosophy, history, sociology, anthropology, ethics, law, economics, political science and psychology. At Allegheny College, active, project-oriented learning that incorporates a number of STS strategies is used in a one-semester course on assessment and evaluation of environmental problems (Pallant, 1997). Questions (four on different topics) are posed with no clear right or wrong answers, i.e., Is the control of acid rain worth the cost? The course replicates the requirements of a professional analyst who has been asked to write a position paper for the government of a think tank. It has been successfully taught in different semesters by a biologist, a political scientist and an economist.

In addition, STS can serve as a enabling framework to link problem-based approaches to learning science with community service projects and workplace internships. For example, a community college biology instructor had her students volunteer for biology-linked community service projects such as restoration of a city park, or taking care of animals at the SPCA. Each student was expected to identify, research, and propose solutions to a problem that became evident in the course of their job, and to maintain a journal describing what they had learned each week in their extracurricular work (Phillips, 1997).

What do we propose?

Implementation of STS strategies cannot occur in the absence of faculty who have some understanding of what STS means, who see real value in the approach and who are willing to make an effort to more creative and resilient in their classrooms. A number of faculty members have already moved toward more student-centered, active learning approaches in their science and math courses as a result of involvement with the MCTP program. Others, including those in disciplines other than science and math, may also be interested in learning about effective ways to engage students more fully in the learning process, and to teach students more effectively to think, analyze, research, question, argue, evaluate, write and solve problems.

One purpose of the planning grant will be to identify and engage faculty from a variety of disciplines in "conversations on teaching" aimed at developing an action plan to implement STS across the UMBC campus. In addition to scheduling meetings with departments who indicate an interest in learning about STS, we will prepare and deliver two awareness workshops for faculty and administrators who wish to learn more about STS. These workshops will be designed to build interest, understanding and curiosity about the STS approach. Faculty in general, and particularly those who teach GFR courses that explore the interface between science, technology and society will be invited to participate.

During these workshops, we will be able to provide additional background information and examples of STS practice using the "case-study" approach for faculty development supported by the American Association for Higher Education (Hutchings, 1993). Workshops will serve as a forum for faculty who either already employ or are thinking of piloting STS strategies in existing courses that they teach. They will also provide opportunities for faculty and administrators to suggest ways to engage additional faculty in STS development activities and to propose strategies for building an integrated STS program at UMBC.

There are a number of possible models for an integrated STS program, although there are very few such programs to be found at the college/university level. The Worchester Institute of Technology in Massachusetts (where we recently

attended an STS National Conference) has an impressively comprehensive STS-style program for all of its students, but it would probably be inappropriate on this campus given UMBC's student body size and academic diversity. If we are to build a successful STS program at UMBC, many voices will have to be heard, and many alternatives considered. For example, one group of faculty might suggest that new STS courses be developed to meet GFR needs, while another might feel it sufficient simply to modify a few, current GFR courses for non-science majors. A third proposal might be to implement an STS approach in all introductory science courses including those for majors. A major goal of the initial planning process will be to assemble faculty members who have an understanding of what STS entails and who have a realistic view of how STS might best serve UMBC's mission.

Thus, at the conclusion of the planning period we will invite those who indicate a continuing interest in implementing STS to meet together in a one-day retreat in order to finalize a strategic action plan for a campus-wide STS initiative. It will be this core planning group who will determine the nature of the program model it recommends as most appropriate for UMBC.

Outcome evaluation.

The planning process for an STS initiative must involve more people than the applicants on this proposal. One outcome measure is thus the number of individuals who attend STS workshops. Another is the number of departments who invite departmental STS presentations. In addition, response surveys for departments and for workshop participants will be used to assess faculty and administrative reactions to the STS concept. The most telling assessment, however, will be the number of individuals who are willing to aid us in preparing an action plan for an STS learning program at UMBC. Details of such an action plan are impossible to predict at this time, since the nature of the plan will depend largely on the creativity, commitment and concerns of the core planning group. Moreover, the action plan is likely to undergo significant revision and refinement as the campus gains experience with STS implementation. However, given a committed core of faculty who are willing to devote time and effort to continuous improvement of university level science education, the potential is high for significant, long-term impact on the way we prepare students to engage the problems of the coming century.

References:

Hutchings, P. 1993. Using Cases to Improve College Teaching: A Guide to More Reflective Practice. Washington, D.C.: American Association for Higher Education.

National Science Teachers Association, 1993. Science/Technology/Society: A new effort for providing appropriate science for all. In, The Science, Technology, Society

Movement, R. E. Yager, ed., Washington, D.C.: National Science Teachers Association.

Pallant, E. 1997. Assessment and evaluation of environmental problems. J. College Science Teaching, 26:167-171

Phillips, M.W. 1997. Teaching general biology for nonmajors through community service projects. J. College Science Teaching, 26:253-257.

Yager, R. and Rustum, R. 1993. STS: Most pervasive and most radical of reform approaches to "science" education. In, The Science, Technology, Society Movement, R. E. Yager, ed., Washington, D.C.: National Science Teachers Association.

Yager, R. (ed.) 1996. Science/Technology/Society as Reform in Science Education. Albany, NY: State University of New York Press.

B. Budget

Applicant summer stipend support:

Phillip G. Sokolove	(0.5 month)	$ 5,015
Susan M. Blunck	(0..5 month)	2.965

STS workshops:

Stipends for participants who attend both workshops (25 @ $75)	1.875
Soda, cookies and coffee (appox. 25 -30 participants @ $6, at each of 2 workshops)	360

One-day retreat (10 participants estimated):

Morning coffee, rolls, pastries	(10 @ $10)	100
Lunch (10 @ $15)		150
Total		$10,465

Table 1

Standard	STS
Surveys major concepts found in standard textbooks	Identifies problems with local interest/impact
Uses labs and activities suggested in textbook and accompanying lab manual	Uses local resources (human and material) to resolve problems
Students passively assimilate information provided by teacher and textbook	Students actively seek information to use
Focuses on information proclaimed important for students to master	Focuses on personal impact, making use of students' own natural curiosity and concerns
Views science as the information in textbooks and teacher lectures	Views science content *not* as something that merely exists for student mastery because it is recorded in print
Students practice basic process skills—but don't apply them for evaluation purposes	De-emphasizes process skills which can be seen as the glamorized tools of practicing scientists
Pays little attention to career awareness, other than an occasional reference to a scientist (most of whom are dead) and his/her discoveries	Focuses on career awareness, emphasizing careers in science and technology that students might pursue, especially in areas other than scientific research, medicine, and engineering
Students concentrate on problems provided by teachers and text	Students become aware of their responsibilities as citizens as they attempt to resolve issues they have identified
Science occurs only in the science classroom as a part of the school's science curriculum	Students learn what role science can play in a given institution and in a specific community
Science is a body of information that students are expected to acquire	Science is an experience students are encouraged to enjoy
Science class focuses on what is previously known	Science class focuses on what the future may be like

Table 1 illustrates the conditions that exemplify STS classrooms as advanced by the NSTA position on STS. It also contrasts each of these conditions with the descriptions provided in the Project Synthesis final report of what typical conditions are like, especially pertaining to instruction. The Project Synthesis report included such contrasts in the areas of goals, curricula, assessment, and teacher education with respect to instruction. In

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UMBC

Department of Biological Sciences
Office of the Chair

MEMORANDUM

Date: March 31, 1997

To: Carole McCann

From: Dr. Lasse Lindahl, Chair
Department of Biological Sciences

Lasse Lindahl

Re: Sokolove/Blunck Straus Foundation Planning Grant Application

This is to endorse the efforts of Dr. Sokolove to reform science education at UMBC and to support him in the continuation of his very fruitful collaboration with Dr. Susan Blunck as demonstrated in their current proposal. The STS project outlined in their Straus Foundation Grant proposal has considerable merit, especially for teaching about science to non-majors, and, if asked, I would strongly recommend that it be funded.

It is evident that Sokolove and Blunck have put together a thoughtful, and I think appropriate plan to promote development of a multidisciplinary approach to science education on the UMBC campus. In addition to the human-experience focus of their STS approach, however, I would urge them also to include some way of showing students that scientific research itself is a curiosity-driven enterprise. Scientists' research questions are not necessarily, or even typically, questions that derive from daily life experiences. While it is reasonable to use students' daily-experience questions to get them interested and engaged in science topics and perhaps even to encourage them to do research on their own, it would be a mistake, I think, to leave them with the impression that this is how a research scientist normally operates.

On the other hand, it is also appropriate to recognize that students are most readily motivated to learn when what they learn has relevance to themselves and their own world. In this regard the STS approach suggested by Sokolove and Blunck is likely to help foster a long-term appreciation for science and for using a scientific approach to problem sloving. For many students, unfortunately, the traditional ways of learning science often fail to produce such a result.

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UMBC

Department of Education

March 31, 1997

MEMORANDUM

TO: Review Committee

FROM: David B. Young, Chairman
Education

SUBJECT: Aaron & Lillie Strauss Foundation Application

The UMBC Department of Education supports active and ongoing collaboration within and across campus departments. The department supports this proposal to further expand collaborative efforts focused on improving teaching and learning. Interdepartmental collaboration is highly valued in our department since our education students major in an academic area and in addition complete courses for teacher certification. The department is concerned with expanding all students to models of exemplary educational programs.

This plan will bring faculty together to create experiences that will enhance past secondary instruction. The Science Technology Society (STS) focus of this plan provides a real-world content for students to replace content areas, issues, and questions. This STS umbrella is most appropriate given our mission at UMBC and the fact that this instructional approach is designed to promote original thought and active learning across a wide range of academic disciplines.

The UMBC Department of Education commits to support this project and the accompanying research program which is needed to document its outcome. The teaching research that Dr. Susan Blunck and Dr. Phillip Sokolove have been doing through the Maryland Collaborative for Excellence in Teacher Preparation (MCTP) provides a strong foundation upon which this project can build. This project holds promise for improving teaching campus-wide and we look forward to helping make the plan come alive.

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