

DEVELOPING A STRATEGIC PLAN FOR SCIENCE AND MATHEMATICS EDUCATION IN SOUTH CAROLINA

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ABSTRACT

The approach and methodology used to develop a set of "white papers" to supplement the State of South Carolina's systemic education revitalization plan are described.

INTRODUCTION

The South Carolina Universities Research and Education Foundation (SCUREF) is a consortium of the four major research universities in South Carolina: Clemson University, the Medical University of South Carolina, South Carolina State College and the University of South Carolina. The Foundation was incorporated in 1988 by the state supported research and academic institutions to pool their talents and resources and to develop special programs, technologies and expertise. SCUREF's mission is to conduct research and to enhance educational opportunities in the State of South Carolina. The four institutions have combined faculties and staffs of nearly 15,000, a total student enrollment of 63,000 (27% of whom are minority students), and annually attract over \$100 million in competitive research awards and other sponsored programs (see Fig. 1).

Building on the combined strength of the SCUREF institutions, the Westinghouse Savannah River Company (WSRC) negotiated a contract with the U.S. Department of Energy (DOE) to establish one of only three Pilot Centers for Environmental Restoration and Waste Management Research in the United States. This Center focuses on four principle themes: research related to environmental restoration and waste management, the creation of a Technology Transfer Program, a Distinguished Scientist Program, and a high-leverage program of science and mathematics education initiatives designed especially to attract women and minorities into technical disciplines.

The State of South Carolina also provides resources for SCUREF activities by providing partial support for Pilot Center activities and by supporting a parallel and complementary program focused on research and remediation of hazardous waste problems existing at other sites within the state. Beyond State support, it is expected that Pilot Center activities will complement and leverage other SCUREF grants and contracts supported directly by DOE and other Federal agencies such as NSF, DoEd, DOD, and EPA in the center's four areas of major concentration.

SCUREF/WSRC PROGRAMS

In the Spring of 1991, SCUREF and WSRC entered into a joint effort to begin to develop concepts for K-12 science and mathematics initiatives which could realistically be implemented into the school system of the state of South Carolina. Concepts to be developed would, initially, fall into one of three categories (see Fig. 2).

- **Teacher Support Programs:** These programs will focus on building a science and mathematics teacher network which allows pre-college teachers to regularly interact with their college level counterparts as well as other discipline specialists. Through this program, pre-college curricula will be developed, demonstrations and laboratory experiments will be planned, and summer research and symposia participation for pre-college teachers will be developed. Separate tracks will be focused on math, biology, chemistry, and physics.
- **Student Experience Programs:** These programs will focus on stimulating excitement for junior high (or younger) students through experiences with professional scientists and engineers. Ranging from one-day trips (perhaps an ocean-going biological/ecological monitoring/sampling day for students who earn the reward) to full summer camps at a participating campus. All such programs would include instruction by both the pre-college teachers and professional scientists.
- **Telecommunications Programs:** By taking advantage of the premier educational television system in the United States, South Carolina's Educational Television (SCETV), and the existing links to schools throughout the State, a variety of TV series designed for the pre-college student will be developed. All such initiatives will focus on exciting science programs existing anywhere in the world -- including, especially, the DOE laboratories -- each program of the series, presenting the history, state-of-the-art technology, and the wonder of where this discipline could lead humankind.

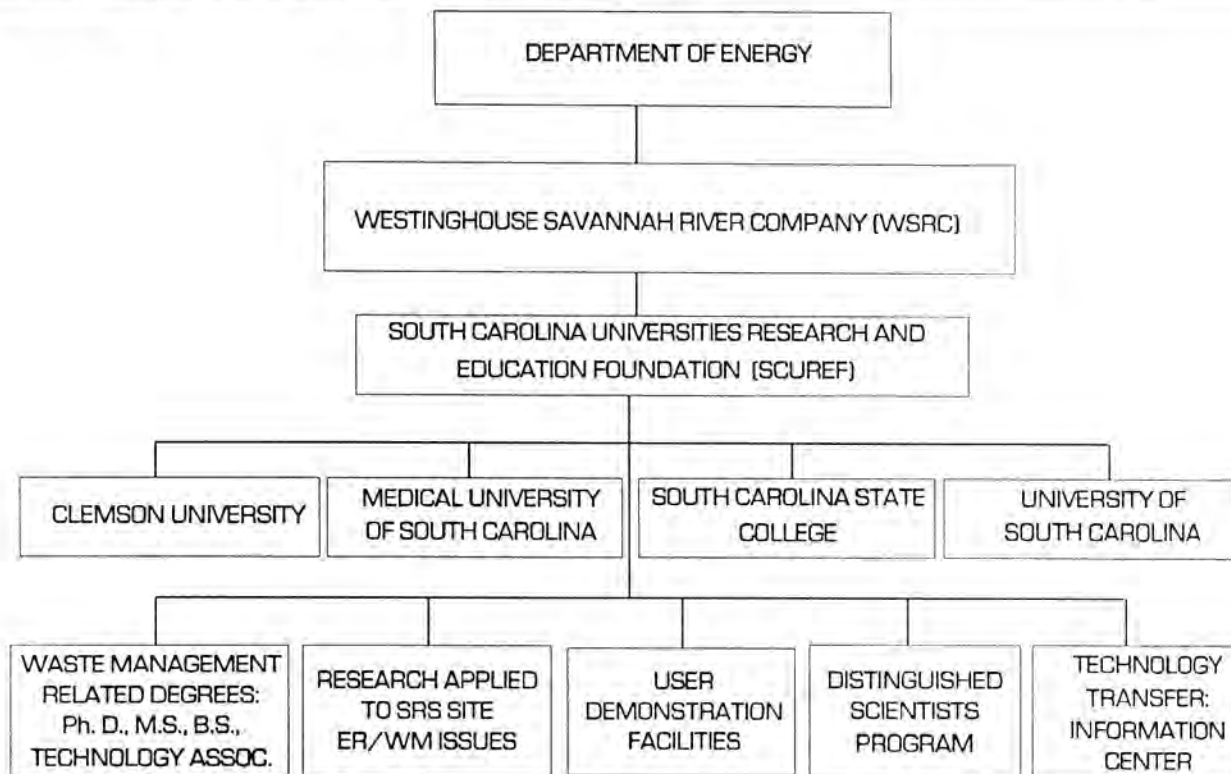


Fig. 1. Schematic of the SCUREF pilot center.

DOE/SCUREF Science and Math Initiative

Teacher Support Programs

- "a science and math teacher network"
- separate tracks for math, biology, chemistry, and physics

Student Experience Programs

- experiences with professional scientists and engineers
- one-day trips and full summer camps

Telecommunications Programs

- focusing on existing science programs
- the "Ascent of Women" series

with a special emphasis on women and minority students, drawing on all 12 campuses of SCUREF

Fig. 2. Guiding principles for SCUREF's science and mathematics planning process.

Inherent in all of the "calls for concepts" were to be the guidelines articulated in the proposal for **National Educational Goals** by the National Governors Association and the *President of the United States*. In particular, these concepts should seek to accomplish the particular Goal of: "By the year 2000, U.S. Citizens will be first in the world in science and mathematics." To achieve this goal, the Governors Association identified four strategic objectives:

1. Improve student performance.
2. Build a strong teacher workforce.
3. Provide an adequate pipeline for the science and technology workforce, including increased participation of under-represented groups.

4. Improve public science literacy.

The final programs developed through the SCUREF/WSRC Initiative would then identify major barriers to good science and mathematics education in South Carolina's school system, and also, would develop a cost-effective strategic plan for initiating a realistic subset of such programs. A key element of each concept paper would be a five year plan to permanently improve the statewide educational system with benchmark goals to monitor progress. Each of the concepts developed through the SCUREF/WSRC initiative would then be polished into white papers to be submitted to appropriate Federal agencies and other sources for funding, as a part of South Carolina's statewide strategic education revitalization plan.

SPECIFIC OBJECTIVES OF THE PROGRAM

To achieve the goals of the SCUREF/WSRC Program, six major objectives were identified.

1. Planning and implementing a series of meetings of persons with responsibilities for pre-college education in South Carolina, including but not limited to:
 - The South Carolina Improvement Council
 - The Office of the Governor
 - The South Carolina Superintendent of Education,
 - Other Appropriate Government Agencies,
 - The SCUREF Deans of Education,
 - Area School Superintendents,
 - Pre-college Principals,
 - Pre-college classroom teachers,
 - South Carolina Educational Television,
 - SCUREF Math, Science, and Engineering faculty, and

- WSRC and other private sector industries.
- 2. Developing a set of possible options for improving science and math education in South Carolina.
- 3. Organizing an educational workshop of teachers and administrators from throughout the State to develop the overall approach and projects that address the options.
- 4. From the options listed in (2), developing a series of White Papers which present the best and most cost effective opportunities to improve science and math education in South Carolina.
- 5. Distributing copies of the White Papers to all participating parties for feedback.
- 6. Coordinating the activities of the proposals contained within the White Papers with other programs supported by the Federal Government such as EPSCoR, NSF systemic initiatives, ETV projects...

The methodology followed to achieve these objectives involved the following major tasks.

Task 1. Appointment of an ad-hoc committee. SCUREF invited representatives of the interested State agencies, including the Office of the Governor and the State Superintendent of Education, the SCUREF institutions, SCETV, WSRC, and pre-college educators and administrators to serve on an ad-hoc panel to provide oversight and administration of the program.

Task 2. Issue a "Call for Papers." A subcommittee of the ad-hoc SCUREF committee was appointed to issue a "call for papers" to a broad audience of over 1400 college and pre-college educators, with suggested topics.

- Teacher Recruitment, Preparation, and Professional Growth
- The Science Curriculum, Issues and Alternatives
- Motivating and Preparing Students for Science
- The Organization and Administration of Schools and the Teaching of Science
- Science Learning Environments and Activities
- Assessment and Evaluation in Science and Science Education
- Science Education Centers and Model Schools

A three-to-four page concept paper on one or more of the topics was requested. Collaborative work in preparing papers was encouraged, and each concept paper was to include a clear description of the issue and its importance; a brief discussion of the relevant information pertaining to the issue and alternative approaches to addressing the issue; recommendations and an accompanying rationale; and a feasibility discussion including the needed expertise, time, and cost of implementation. Additionally, each paper was to address concerns for the appropriate use of new technology, the inclusion of historically under-represented groups, and the methods for evaluating success.

Task 3. Review the "best" papers from among those submitted. An external distinguished review panel representing professional educators, administrators, and scientists, met to review the papers submitted (59 in

number). The panel grouped the papers into five major categories and a lead author for each of the five papers was invited to present the paper at an educational workshop to be held in Hartsville, S.C.

Task 4. Convene a broad-based workshop and prepare a set of "Hardened Concepts". In August, 1991, a four-day workshop was held at the Governor's School in Hartsville, South Carolina. One hundred forty individuals from across the state participated, including representatives from SCUREF institutions, the S.C. Department of Education, SCETV, WSRC and other private sector corporations, and classroom teachers. At this conference, the five papers selected in Task No. 3 were presented and refined into a set of "hardened concepts".

Task 5. Develop a set of statewide "White Papers". After the conference, the lead authors with assistance from participants at the Hartsville conference rewrote the original concepts into the form of "White Papers" which followed the format defined by the NSF in its systemic initiatives Request For Proposals.

CANDIDATE CONCEPTS

The "candidate concepts" developed in the first year of the SCUREF/WSRC Initiative are interestingly different. *The Glass Classroom* promises to use modern telecommunication techniques to bring the excitement of modern science into the classroom, unhindered by geography; a classroom where students learn science from doing science and from people "who do" science for a living. *Reform and Articulation of Elementary (K-6) Science and Mathematics Curricula* would not only conceptualize modern curricula but field-test and disseminate the resulting "successful" curricula material throughout the State and elsewhere, as appropriate.

A Network of Science/Mathematics Education Service Regions is an ambitious approach to extending special science centers and increasing resident science and mathematics consultants that in-service, pre-college teachers can access for special, customized information, curricula material, and experiments and equipment. The early focus of the program would be regions of the less we-to-do residents that have not, historically, been able to provide sufficient resources to maintain high quality science and mathematics programs. *Sesame or, Specialists in Elementary Science and Mathematics Education* addresses the need for each of the schools to have a full time mathematics and/or science specialist who can prepare customized lesson plans and program descriptions for dissemination and presentations to local teachers, administrators, parents, business and community leaders.

Finally, a concept paper on *Changing Student Attitudes Towards Science and Mathematics* is evolving as a complex of individual efforts, each designed to attract a specific targeted student audience. Each of these efforts will stress a relaxed, supportive atmosphere, with extrinsic motivating factors such as rewards and grades de-emphasized. A variety of strategies are currently being explored including early intervention, mentoring of science and math projects by students, summer science for both teachers and students, and using sports and natural science activities of young people to show the utility and fun of science and math learning. To be useful as "model programs", each of these various efforts will have to develop a means of evaluating the success of the program agenda,

beyond the well-known Hawthorne effect, because of the human and financial resources required to implement such programs.

The "White Papers" are intended to be further developed into proposals which would be submitted to appropriate Federal agencies and other sources for consideration for funding as a part of South Carolina's statewide strategic plan. The latter, of course, can only be done within the context of the State's systemic (NSF) initiative which is far broader than the SCUREF/WSRC Program.

THE GOVERNOR'S SYSTEMIC REVITALIZATION INITIATIVE

Over the last two years, South Carolina has been evaluating its pre-college school system to determine what is necessary for revitalizing its educational system. Many of the educators taking part in the SCUREF/WSRC Initiative have worked for many years with the State's Commissioner of Higher Education and the State's Superintendent of Schools, those State officials charged with developing and implementing the State's plan. Some of these SCUREF people have now been appointed to a Governor's Advisory Committee, composed of business people, state officials, and academics, charged with hammering out an appropriate framework for the South Carolina's systemic initiative. The final form of the "SCUREF/WSRC proposals" will now evolve to fit within the framework established by this Committee.

The early meetings of this Advisory Committee have already established the goals of the Governor's plan and the methodology to obtain those goals (see Fig. 3).

The key in our State's statement of goals as it relates to the SCUREF/WSRC Program is the last: "...the State of South Carolina will enable and support teachers in all classrooms to deliver *stimulating*, meaningful and *fun* learning experiences in science and mathematics." We believe each of the programs developed in the SCUREF/WSRC initiative embodies all of these characteristics. And, in addition, they have been developed with the active participation of the pre-college educators of the State which insures that they are not only implementable but also will be of value to the "end user".

The methodology established by the Governor's Advisory Committee (see Fig. 4) insures that there will be an intercommunication among all the educators in the state including the State agency officials who are charged with implementing the revitalization initiatives. Thus, not only will current in-service

We have a dream to develop the very best creative and critical thinkers in the world, and to that end:

...every person will value science and mathematics as an integral part of life, from cradle to grave.

...every student will learn the core building blocks of science and mathematics as ways of knowing, appreciating, and reshaping the world.

...every student will have the opportunity to excel in science and mathematics as creators and producers of knowledge.

...the State of South Carolina will enable and support teachers in all classrooms to deliver stimulating, meaningful and fun learning experiences in science and mathematics.

Fig. 3. Goals of the state of South Carolina's science and mathematics revitalization program.

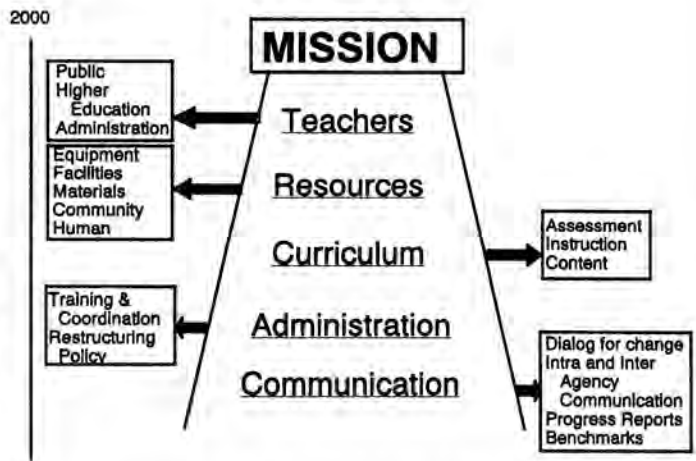


Fig. 4. Schematic of the methodology of the Governor's revitalization program.

education improve but also the methodology for educating new professionals for the State's school system will reflect these initiatives and produce a new cadre of educators trained in, and comfortable with, the new strategies evolved for teaching pre-college science and mathematics in the next century.