

MSEA and STRIDE: A COOPERATIVE EXPERIENCE IN SCIENCE EDUCATION

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INTRODUCTION

With her rich soil, the Mississippi Delta is home to some of the most productive farmland in the world. In spite of the Delta's implied agricultural potential, the struggle and deprivation of her people are chronicled throughout her history. In the last fifteen years, however, the region has made improvements in educational, economic and social outcomes. In fact, Doolittle and Davis (1996) state: "To the extent that education is the key to economic opportunity, the Delta adult population made gains in the eighties that should improve their chances for higher paying jobs in the future...In fact, education was one of the very few areas in which the Delta gained on the remainder of the state."

The commitment to improving education in all areas of Mississippi is evidenced in the following statement by Dr. Tom Burnham, Superintendent of Education for the State of Mississippi. His department's vision is for a "quality education for every child." The State Department of Education is committed to "providing teachers with the tools and knowledge needed to equip Mississippi students for the 21st Century" (Burnham 1997). The project described herein offers an opportunity to connect science, engineering, technology, and agriculture while developing skills needed by Mississippi students as they prepare for future educational experiences. These research experiences enhance the teacher/student teams' knowledge in scientific methodology through participation in projects already in place in the Mississippi Delta. Such projects have been designed to study the agricultural effects on water resources and ecological processes at three Mississippi Delta oxbow lake sites.

Research experiences provide students with skills they need to compete in today's world, skills required by employers for jobs requiring a range of educational background. Industry leaders consistently state that skills needed by their workforce include communication, creative problem solving, working in collaboration, decision-making, mathematical skills and computer skills. Involving students in conducting ongoing research enhances their opportunity to develop these skills while providing teachers with experiences that they subsequently transfer to the classroom.

The primary objective of this project is to train teachers and students in research data collection and analysis techniques through real scientific research experiences. Through their experiences, teachers understand the role of research in the classroom and enhance their scientific content knowledge. Students in upper middle schools in the Mississippi Delta receive meaningful interdisciplinary research experience and learn how to design and evaluate best management practices for improving water quality and ecology in the Mississippi Delta. Participants increase awareness of environmental and management issues relating to the Mississippi Delta rivers and lakes. STRIDE participants also increase their awareness of careers in science and engineering.

The Mississippi Delta Management Systems Evaluation Area (MSEA) is part of a consortium of Federal, State, and local agencies providing a unique opportunity for research experiences for students and teachers in the Delta region. The project focuses on three watersheds located in west central Mississippi in the Delta counties of Sunflower and Leflore, each utilizing a different farming system. The three practices are structural and cultural best management practices (BMPs), only structural practices, and no BMPs initially. The four major objectives of MSEA are: (1) to develop alternative farming systems for improved water quality and ecology in the Mississippi Delta rivers and lakes; (2) to increase knowledge of the design and evaluation of economical environmentally-sound best management practices (BMPs) as components of farming systems; (3) to assess the effects of agricultural activities on surface and shallow ground-water quality; and (4) to increase awareness by farmers and landowners of alternative farming systems to reduce adverse agricultural effects on water resources and ecological processes. Ongoing research projects, in which teachers and students participate, are being conducted by scientists who are employed by the various agencies and institutions associated with the MSEA project.

This paper describes the Student and Teacher Research Institute - the Delta Experience: Targeting Mississippi Schools and the Environment (STRIDE) which is a cooperative effort between the Mississippi Delta Management Systems Evaluation Area project and Mississippi State University, funded in part by the National Science Foundation. Designed to introduce

research methodology to middle school teachers and students by working side-by-side with MSEA scientists on existing projects, the student and teacher teams assist with different aspects of research from collecting and recording data to analysis. This paper also describes one of the ongoing collaborations between one of the STRIDE teacher/student teams and MSEA investigators.

MATERIALS AND METHODS

Teacher/Student Participant Recruitment and Selection

Teams of one teacher and two high-potential/high-ability students from schools in the Mississippi Delta were selected to participate in a research experience with scientists from the MSEA project. During the summer of 1998, ten teachers from Sunflower, Leflore, and Washington counties, and twenty-two of their academically talented/motivated students, participated in the first of three summer institutes funded by the National Science Foundation. The superintendents of the identified school districts and school principals were asked to nominate from each school a middle school teacher, whose primary responsibility is the teaching of science, and two students, who have exhibited high potential/high ability in science. Teacher nominees were to demonstrate ability in science teaching, commitment to hands-on experiences for students, and leadership qualities. Evidence of students' ability and potential included grades in science, science fair participation, aptitude/achievement tests, and/or essays on their interest in science and reasons for wanting to participate in this program. The project staff, with significant input and guidance from the school systems, selected the teacher and student participants. The schools' input was important in the selection process as they can best assess the potential for maximum benefit to the school system and the local area. Schools participating in the project committed to allowing research experiences to be implemented into the local curriculum and to allow teachers to present inservice training to their faculty on the research collection and analysis and to the connection to the classroom.

Participating Agencies and other Partners

More than 14 agencies and fifty researchers contribute to make STRIDE a success. Primary research participating agencies on the MSEA project are the USDA Agricultural Research Service, the U.S. Geological survey, and the Mississippi Water Resources Research Institute. Cooperating agencies/partners/supporters include USDA-ARS National Sedimentation Laboratory, Mississippi Department of Environmental Control, USDA-Natural

Resources Conservation Service, Mississippi Soil and Water Joint Water Management District, Delta Council, Mississippi Farm Bureau Federation, U.S. Fish and Wildlife Services, Delta Wildlife Foundation, USDA-Animal Damage Control, Mississippi Department of Wildlife, Fisheries and Parks, USDA-Farm Service Agency, USDA-Natural Resources Conservation Service, Yazoo Mississippi Delta Water Management District, the University of Mississippi and Mississippi State University.

Several faculty and staff from Mississippi State University played a large role in STRIDE 1998. Sandra H. Harpole, Ed.D., Professor of Physics and Director of the Center for Science, Mathematics and Technology, was the Principal Investigator and serves as the Project Director. She was responsible for the overall management of the project and the coordination of Mississippi State University activities. Jonathan Pote, Ph.D., Professor of Agricultural and Biological Engineering and Associate Vice President for Research, coordinated the interaction between Mississippi State University and MSEA. Giselle Thibaudau, Ph.D., Assistant Professor, Department of Biological Sciences, assisted with on-site management of the project in the Delta and participates in academic year follow-up workshops. M. Lynn Prewitt, Ph.D., Senior Research Assistant, Forest Products Laboratory, provided valuable laboratory experiences at Mississippi State University. Taha Mzoughi, Ph.D., Assistant Professor, Department of Physics and Astronomy, was responsible for the technology training and dissemination of project information and materials through the web. Jean Bailey, Project Coordinator for the Center for Science, Mathematics and Technology, was responsible for the administrative coordination of STRIDE. She served as a valuable liaison with the research scientists, school district personnel, and university personnel and assisted with the planning of the summer institute and all follow-up meetings. Frank Gwin, Jr., Project Coordinator for the Mississippi Delta MSEA Project, was responsible for the tremendous task of establishing coordination and collaborations between farmers, research scientists, school district personnel and STRIDE personnel.

RESULTS

During the four-week institute, participants conducted research at three Mississippi Delta oxbow lakes: Deep Hollow Lake, Beasley Lake, and Thighman Lake. In addition to working at these watersheds, they also worked with scientists in the various MSEA labs associated with the three watersheds.

Activities of the first week of the summer program took place in the Mississippi Delta at research sites associated with the MSEA project. During orientation sessions, all participating scientists were introduced to teacher/student teams. A discussion of the overall project and the contributions of various research components were provided. The group was then divided into two groups of five teams that visited laboratory and field sites of each of the scientists to learn different collection analysis techniques. Teacher/student teams were exposed to each area of research in order for them to experience different data collection techniques and to understand the experimental design of the project and how each component fits into the overall experimental design of the MSEA project. They also gained an overall picture of the impact of the MSEA project on the local area and its economy. By the end of the first week, each team was assigned to a scientist and, in collaboration with them, they were given a basic research problem associated with the researcher's project. Teams worked with these different scientists during the last two weeks of STRIDE.

Week two of STRIDE was spent at Mississippi State University interfacing with scientists and engineers to increase awareness of careers in science and engineering, to learn to use technology as a tool of research, and to learn laboratory analysis techniques associated with state and university laboratories. The research focus of several on-campus laboratories deals with environmental issues. Participants were divided into four groups to rotate through labs in order to learn different research methods. Teacher/student teams worked with scientists from the Forest Products Laboratory, the Department of Agricultural and Biological Engineering, the Department of Industrial Engineering, the Diagnostic Instrumentation and Analysis Laboratory, the College of Veterinary Medicine, and the State Chemical Laboratory. Presentations on conducting ethical research were made to the group by the Human Subject Regulatory Officer, Radiological Safety Officer, and the Laboratory Animal Regulatory Officer. In addition, participants attended sessions designed to teach them how to use the Web and to conduct library background research, to use scientific graphing packages for data analysis, and to use e-mail and mailing lists.

For weeks 3 and 4, teacher/student teams returned to the Delta in order to work with MSEA scientists on location. The schedules differed for each group but a subset of places visited and activities performed during these two weeks are presented here. Groups went to the USDA-ARS National Sedimentation Lab or met the scientists in the field to participate in studies designed to determine shallow ground water quality in edge-of-

field and within-field filter/processing systems (e.g., buffer strips, grass hedges, grassed waterways, and slotted board riser impoundments). They also learned to evaluate the ability of such systems to trap sediment and process pesticides. Teams also examined and evaluated watershed ecology and lake water quality. They learned to evaluate the effects of riparian zones, forested wetlands, and best management practices on physical/chemical stresses imposed on agricultural pollution. In addition, they investigated the impact of MSEA on fisheries characteristics and ecology on the Mississippi Delta oxbow lakes. Fisheries data collected to assess the ecological health of the lakes included growth rates, condition factors, length-frequency distributions and other stock-assessment measures. Studies in the field also included the evaluation of interacting effects of fall deep tillage, gypsum application, cover crop burn down date, and soil type on the growth and yield of cotton planted into a desiccated winter wheat cover crop without spring tillage. Students took sediment core samples and penetrometer resistance samples to test water infiltration. Teams traveled to the US Geological Survey in order to process data collected in the field. Storm runoff samples were used to assess how agricultural activities affect surface-water quality and evaluate management practices that may reduce nonpoint source pollution. Researchers from the Yazoo Mississippi Delta Joint Water Management District (YMD) taught teachers and students the uses of GPS/GIS mapping equipment. Teams used GPS units to map fields and surrounding areas within the different watersheds being investigated. Teams later imported this information into the GIS software and learned to manipulate map information while at the YMD. While at the Southern Weed Science Lab, teams participated in data collection and analysis involved in the determination of weed infestation levels, weed species identification, shifts in population levels over time, and general plant communities in different cotton and soybean production systems. They were also exposed to new application technologies for more efficient methods of applying herbicides in crop production areas.

Four Saturday workshops were held throughout the following academic year. Teams met with Project Coordinators and research scientists to update their particular project, learn of new research data, design new potential experiments, and be exposed to various forms of scientific presentation. Teachers and students discussed implementation of the research experiences in their local curriculum and have planned to design and publish a STRIDE newsletter.

One example of the collaboration between teacher/student teams and MSEA scientists that has

occurred through the individualized research projects is research done by Helen Beamon, science teacher at Moorhead Middle School in Moorhead, Mississippi, and her two students, Monique Cocroft and Reginald Williams. Beamon, Cocroft, and Williams are working with Sammie Smith, Jr., Research Chemist and MSEA Project Leader at USDA-ARS-National Sedimentation Laboratory. Their study investigates the comparison of basic water quality in an oxbow lake versus a commercial catfish pond. The objective of the project is threefold: to measure and evaluate basic water quality parameters in Thighman Lake and in the adjacent commercial catfish pond; to compare measurements and reach conclusions about overall water quality of each water body; and to compare measurement results taken with a commercial surface water quality test kit with results of testing with high-tech instrumentation at the USDA-ARS-National Sedimentation Laboratory.

Beamon and her students collected water samples and recorded data once a month from November 1998 through April 1999. Using a commercial surface water quality testing kit, Thighman Lake and adjacent catfish pond water samples were taken. Measurements were recorded for turbidity, dissolved oxygen, pH, and temperature in the oxbow lake and nearby pond. Measurements were made in triplicate to ensure quality control. Data collected was then compared with data collected by scientists at the National Sedimentation Laboratory.

Beamon has transferred her STRIDE experiences into the classroom. She has taught units on research methodology and has used the data collected to teach graphing skills to her students. Her students have also conducted literature reviews in water quality and the measurements collected on the water samples. Her continuing association with the scientists at the National Sedimentation Laboratory has been a valuable resource for development in curriculum and hands-on activities. She reports that her students have strengthened their skills in critical thinking (making generalizations, evaluating information, problem solving and decision-making inquiry) and have enriched their entire thinking process (observation, organizing information, communicating, and inferring relationships).

DISCUSSION

Evaluation of the project is an ongoing process. Focusing on the assessment of implementation and outcome objectives, the evaluation of the project is being handled by The SouthEastern Regional Vision for Education, SERVE, Inc., Greensboro, North Carolina. Specifically, SERVE is assessing the project for

implementation of workshop and academic follow-up through the administration of interviews and survey instruments. Project staff and participating students and teachers have input into the evaluation process. Outcome objectives are being assessed on two levels: changes to students, from an increased awareness of science to attitudinal change to knowledge acquisition, and to teachers, from an increased awareness of environmental issues to acquisition of research and analytical skills. In addition to interviews and surveys, SERVE will also evaluate teacher notebooks of classroom lesson plans and activities impacted by their STRIDE experiences.

Preliminary data obtained from the 1998-99 participants has indicated the project is achieving stated objectives. A majority of the teachers interviewed stated that their students were given a solid foundation in science to build on throughout high school, college, and career. Teachers identified improvements in skills such as critical thinking, cooperative learning, communication, and research. Teachers were impacted in terms of having research scientists who are a resource in the sharing of knowledge, technology and equipment, and in gaining content knowledge in data collection and scientific methodology. Teaching has been impacted through an increase in the use of cooperative work groups in the learning process, an increase in focus on research, an inclusion of field trips to provide opportunity for observation and hands-on activities, and science fair participation. Students indicate that they have an increased awareness of career opportunities available through the study of science and have a better understanding of the processes involved in conducting research. Students have also improved their communication skills through poster presentations at the STRIDE banquet this March. Students and teachers also have indicated an increase in the appreciation and knowledge of their local area and the agricultural practices that are environmentally friendly. They have information to build on and ultimately make better-informed decisions about agricultural and environmental activities in the Delta.

LITERATURE CITED

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