Tennessee State University

Research Horizons

2007 Annual Report

Division of Research and Sponsored Programs

Division of

Research

and SPONSORED PROGRAMS

TENNESSEE STATE UNIVERSITY

RESEARCH HORIZONS

TSU Publication Number TSU-08-0008(B)-361010

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From the Vice President

Tennessee State University (TSU) continues to contribute significantly to the welfare of humankind through new discoveries some of which are featured in this edition of Research Horizons. On behalf of the Division of Research and Sponsored Programs, I commend the outstanding efforts and contributions of our researchers, faculty, students and staff. The University continues to seek and exploit interdisciplinary, collaborative relationships with corporate, academic and government partners in areas that are vitally important to our community. Collaboration is critically important in continuing our success in research areas that represent our strengths as well as developing new research initiatives that will grow the research enterprise at TSU. We continue to leverage our expertise and research programs in engineering, environmental and life sciences, agricultural science, health, education, and others to move into new and exciting areas.

As the premier public research university in middle Tennessee, TSU is committed to supporting the scholarly activities of our outstanding faculty, researchers and students. The new Research and Sponsored Programs building opened during FY 2007 and provides state-of-the-art core laboratory facilities and research space to support new initiatives. Several other important programs and initiatives were not highlighted in this edition such as the outstanding research efforts in health disparities, astronomy, math and science education and teacher preparation, and digital media.

We continue to involve our students in research and other scholarly activities so that they might develop the necessary skills to make significant contributions in their respective fields. At Tennessee State, we believe research and scholarly activity is essential to excellence in education and enhances the learning experience of our students. The research enterprise at Tennessee State University continues to flourish, and coupled with our excellent academic programs, continues to provide exceptional opportunities for our students, faculty and researchers to make new discoveries and explore new horizons.

As always, I remain

Sincerely,

Marcus W. Shute

Marcus W. Shute, P.E., Ph.D.
Vice President, Research and Sponsored Programs
Tennessee State University

"Be the thinker that thinks the thoughts, that creates the things." ***African Proverb***

"Exploring the question brings more wisdom than having the answer." ***A Course in Miracles***

"Elimu (education/knowledge) is the key!!" ***Dr. Marcus W. Shute, SEI***

From the Associate Vice President

Fiscal Year 2007 marked the beginning of a new era in research at Tennessee State University. The opening of the Research and Sponsored Programs Building represents the university's commitment to research, a key component of our mission. We are fortunate to have a number of highly functional buildings on our campus; however, none is more pivotal in the future direction of the university than the new RSP facility. The importance of dedicated research space can not be overstated in today's highly competitive funding environment.

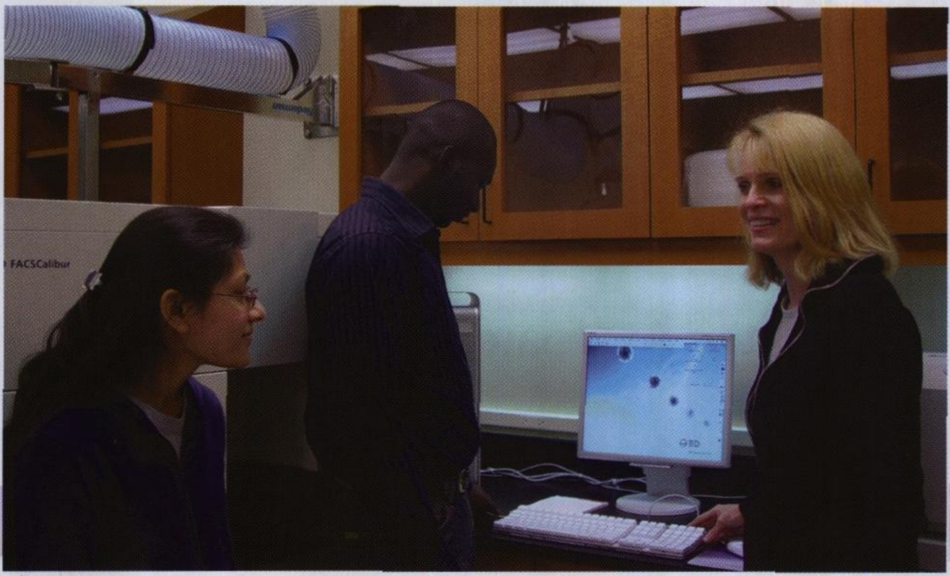
Since opening in March 2007, the Research and Sponsored Programs Building has been the venue for seminars given by nationally and internationally recognized researchers, the site where faculty train their students using state-of-the-art equipment, and has served as an incubator for multidisciplinary collaborations in the fields of life sciences, engineering, computer science and education, to name a few. Additionally, housing the vice president's suite within the centrally located facility greatly enhances research administration as our office staff is frequently present at the inception of research ideas and thus able to provide services with a full understanding of a project's unique needs. It is thrilling for me to witness the marriage of cutting-edge science and informed administrative processes resulting in one seamless entity with shared goals and objectives.

In closing, the purpose of this publication is to update our current and potential partners on the exciting projects conducted by our faculty, researchers and students. As always, we welcome you to visit our campus, meet our researchers and students and tour our facilities. We hope this report encourages you to contact us to discuss productive research partnerships.

Sincerely,

Maria Thompson, Ph.D.
Associate Vice President, Research Administration
Tennessee State University

Nanoscience and Biotechnology Core Facilities at Tennessee State University



Dr. Margaret Whalen (right), associate professor in the Chemistry Department, works with graduate students Fred Dudimah and Sabah Ghazi to process data from the core lab flow cytometer that makes a distinction among four different cell markers.

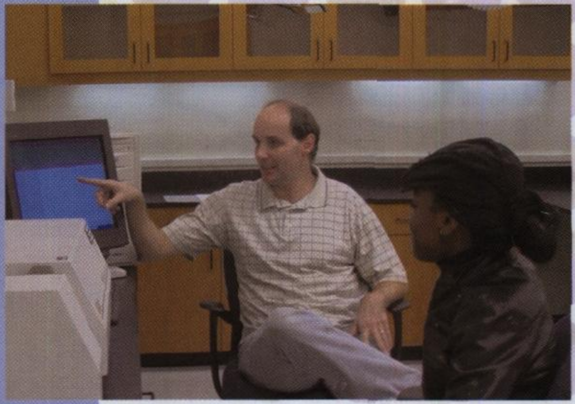
The labs constructed this year (2007) in the new Research and Sponsored Programs (RSP) building at Tennessee State University bring the total collaborative research space to approximately 24,000 square feet. The Department of Defense through the Air Force Office of Scientific Research provided the funding to build these dedicated laboratories as well as purchase multi-user equipment for nanoscience and biotechnology. These core laboratories bring researchers from numerous disciplines across campus and foster research in an environment similar to larger research institutions. Their productivity is further cultivated by two state-of-the-art seminar rooms as well as the administrative suite of the Division of Research and Sponsored Programs that houses the vice president and his staff. Plans have been drawn for an expansion phase, which will offer an additional 30,000 square feet of space as soon as construction funds are available.

Investigators using the core laboratories are drawn from a number of graduate and undergraduate programs including biology, chemistry, computer science, agriculture and engineering. Collaborative interaction in the new RSP building now includes the following entities: (1) the Nanoscience and Biotechnology Laboratories and Research Program, funded by the Department of Defense and Air Force Office of Scientific Research (AFOSR) and the state of Tennessee (approximately 7,000 square feet); (2) the Center of Excellence in Information Systems and Engineering Management, primarily supported by the National Science Foundation (NSF) and NASA (approximately 6,000 square feet); and (3) the Center of Excellence for Learning Sciences, funded by the NSF, the Department of Health and Human Services and the Department of Education, among other sources (approximately 10,000 square feet). These co-located research units provide instrumentation and competence in molecular biology and biotechnology, nanoscience, computational sciences, control systems and learning sciences.

The core laboratories complement and extend existing research capabilities in the academic departments as well. For example, the AFOSR funding was used to purchase a high-resolution scanning electron microscope which complements the confocal microscope presently located in the Department of Biological Sciences and the fluorescence microscopy system in our Institute of Agricultural and Environmental Research. In addition, the grant was used to purchase an x-ray diffractometer and a flow cytometer. The RSP core facilities also provide space and infrastructure to perform analytical procedures such as microscopy and imaging, as well as accommodate enhancement in synthesis, preparation, purification and separation procedures.

Centrally located core laboratories at TSU afford several benefits. They serve as a hub for research activity and leverage synergy of research efforts in biotechnology and nanotechnology by causing regular interaction among campus-wide researchers. As researchers (both faculty and students) return to their departments in various colleges and schools, research successes and challenges are circulated throughout the campus stimulating additional discoveries and breakthroughs. The economic value of core laboratories is best realized through the sharing and maintenance of equipment thereby increasing productivity, equipment longevity, and return on investment of major equipment purchases. Centrally-located core facilities reduce staffing requirements for technicians to operate and maintain the equipment, increase expertise and broaden the mentorship of each student.

This first phase of core laboratories stimulates growth of a coordinated program that promotes research, develops technical applications and creates more effective collaboration. As one of the nation's premier HBCUs with nationally recognized research and development programs in place, this support allows Tennessee State to maintain exemplary programs, while keeping pace with novel developments in biotechnology and in the rapidly emerging field of nanotechnology. ■



Chemistry Department assistant professor Koen Vercruysse and graduate student Dana Ivory use the core lab submicron particle size analyzer in one of their nanoscience experiments.

Locating Genes that Produce Hearty Plants and Possible Implications for Alzheimer's Disease

One can almost always find Dr. Suping Zhou working alongside students and associates on several of her projects in the Plant Biotech Laboratory located in the Institute of Agricultural and Environmental Research (IAgER) at Tennessee State University. She has long-term USDA funding for projects that expand the basic knowledge of plant genomics (the study of structure and function of genes in plants) while having immediate practical purposes.

One such project involves the genes expressed in response to temperature stresses in grasses. The optimum habitat for a given species of grass to grow healthy and stay green includes a particular temperature range. Certain species thrive in hot temperatures, while others thrive in cold. Dr. Zhou and her colleagues are searching for the genes that allow some grass species to be heat-tolerant as well as the genes that allow other species to be cold-tolerant. The findings from this project have been reported in the National Center for Biotechnology Information (NCBI) database.

In Dr. Zhou's lab, the tomato is a model plant for genetic study because of its sensitivity to aluminum.

Another of Dr. Zhou's projects concerns plant cell responses to aluminum (Al) in the soil. Al is the third most abundant natural element in the environment after oxygen and silicon; it is also found in cosmetics, deodorants, industrial products, and medicine compounds. It is not a regulated element in food supplies by the federal government. Aluminum is present naturally in most soils where crops are grown and its solubility is greater in acidic conditions. Under lower pH levels (under 5), aluminum becomes toxic to plants. Seventy percent of arable soils are acidic where aluminum can be released at lower pH levels in toxic forms that result in nonproductive crops that turn yellow and die. Tomato plant cell sensitivity to aluminum reduces crop production.

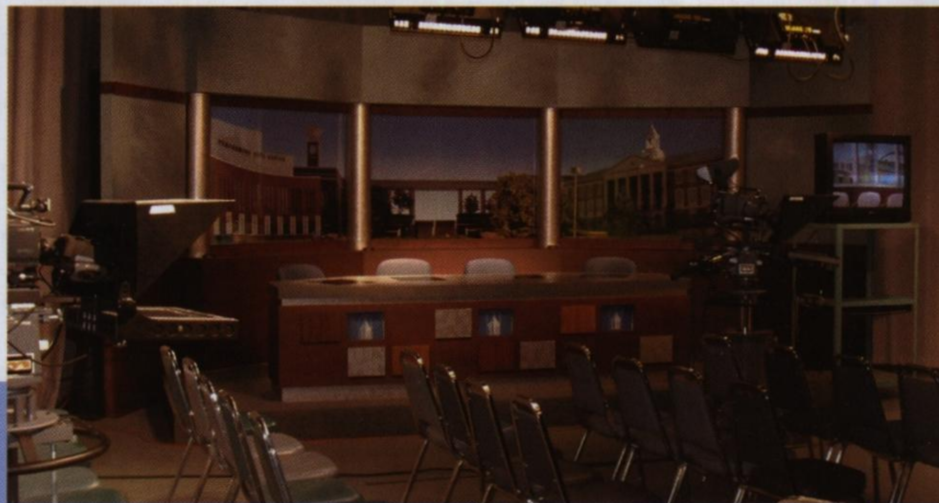
Dr. Zhou's lab is examining gene expression in tomato roots in an attempt to elucidate the molecular cause or result of this sensitivity to aluminum. The tomato plant is a model plant for genetic study because of its sensitivity to this element. Her research focuses on identification of genes in tomato plants that are involved in aluminum toxicity. If such gene(s) are identified, then it may be possible to eliminate them and preserve the health and growth of the plant. The goal of Dr. Zhou's research is to prevent toxicity in edible plants that are grown and made available for human consumption.

Since the 1960s, a number of environmental factors have been put forward as possible contributory causes of Alzheimer's disease in some people. Among other research, it has been considered that a high presence of aluminum in some way may be involved in the neurological changes that occur in a human brain in the progression of Alzheimer's disease. Dr. Zhou and her colleagues believe that increasing the basic understanding of aluminum toxicity in plants may also contribute to the prevention of Alzheimer's disease in humans through providing healthy foods. ■

Pictured L to R: Sarabjit M. Bhatti, research associate; Suping Zhou, lab director; Jessica Johnson and Gary Kelley, research assistants.

These grasses are tested for their survival of heat in the greenhouse where the temperature often reaches 40° – 45° C in the summer.

TSU's State-of-the-Art Television Studio and Multimedia Suites



TV studio with news desk set.

It has taken many years, but as of April 2007, it is a reality. The inauguration of the new Television Studio and Multimedia Suites was held at the Department of Communications' Open House on April 24, 2007, and this new facility may well rank among the top academic facilities in the mid-South.

The new media complex, housed within the Performing Arts Center on the main campus of Tennessee State University, consists of a fully-digital studio and control room, audio control, six multimedia editing suites designed for video editing, podcast and vodcast (video podcast) production, remote video equipment check-out, scene storage, and the most technologically advanced "smart" classroom on campus. The television studio has upgraded and expanded news, interview and demonstration sets, ChromaKey backgrounds, and floor space that supports custom scenes and a professionally-designed news desk. The backdrop for the news set depicts the Nashville skyline beautifully bridged to the TSU campus profile. At the Department's April inaugural event, Rita Kotey, Mass Communication student and Dr. Coreen Jackson, professor of Mass Communication, hosted the studio's first live interview program. Distinguished panelists included Dr. James Hefner, former president of TSU, Dr. Marcus Shute, vice president of the Division of Research and Sponsored Programs, and Dr. Robert Hampton, provost, who brought greetings on behalf of Dr. Melvin Johnson, president of Tennessee State University.

The studio is used for a variety of productions and performance courses ranging from radio/TV production and broadcast journalism to announcing, public speaking, and even children's theatre. According to television operations manager John E. Girton, Jr., "Our new facility has become recognized as an important part in both the goals and objectives of matriculating students and in furthering the strategic objectives of the university." Students, faculty and staff utilize available field production equipment and editing suites for live events, commercials, documentaries, news and university services programming. The podcast and vodcast productions suites supported Tennessee State University entries in this spring's Tennessee Sandbox Podcasting Tournament, an event coordinated by Bob Bradley, director of Technology Integration, and John Girton, co-chair of the statewide tournament.

Additional funds also provided for Apple computers, video editing software and sponsorship of a faculty summer media research award to Dr. Coreen Jackson.

According to the Department's interim chair, Dr. Donald Page, "We are excited about what we have already accomplished in the new facility, and are laying groundwork for even more ambitious activities in the next academic year." ■

Mass communication student Brett Wade operates the video switcher while John Girton directs in the control room.

Left to Right: Dr. Hampton, Dr. Shute and Dr. Hefner talk with show host Dr. Coreen Jackson on the interview set.

Dr. Lee Keel's Research Team Studies Coordinated Robotic Performance and Solarsail Spacecraft

Two research areas being investigated by Dr. Lee Keel, Director, and his research team in the Center for System Science Research Project (CSSR) are: (1) the control systems group that conducts theoretical research ranging from stochastic (non-deterministic) control to linear (relational) systems; and (2) an astronomy group that operates the largest number (12) of remote automatic telescopes in the world that are programmed and controlled in Nashville.

Research Scenario 1: One of the most exciting areas of research in modern engineering systems is the study of coordinated movement of a team of grouped agents (robots) to perform a common mission or cooperative control. Robots and unmanned aircrafts in search of rescue operations, military surveillance and attack missions, and an array of satellites that form a defined operation in space for a space telescope, are some of the well known applications of this kind of research. Supported by a grant from the National Science Foundation, the findings will be validated with experiments on a set of ten mobile robots, five of which are illustrated below (figure 1).

Agents of a cooperative system are often connected through a typically wireless network, which makes a cooperative system a networked control system. Consequently,

Figure 1: Five of ten experimental mobile robots (or "agents") used in TSU-NSF research to study coordination of grouped agents to perform designated missions.

the effect of network-induced instructions on the stability and performance of the system is the subject of Dr. Keel's studies. The key to the research is that each agent is identical and performs exactly the same pattern. For example, depending on its mission, the motion to be coordinated may be an exact formation or so-called flocking which is often seen in the motion of a flock of birds or a school of fish. The function of each agent must be as basic as possible so that the cost of production is low. No single agent (or team member) possesses knowledge of the overall mission; the intelligence to perform the mission is distributed among the team agents. Simply put, the objective of the research is to develop a system that performs highly sophisticated tasks with a set of agents that have primitive capabilities.

Research Scenario 2: In conjunction with scientists from NASA's Marshall Space Flight Center, the TSU team is trying to answer this question: Can the behavior of an extremely large (typically 100 m x 100 m), square, solarsail spacecraft be predicted by simple mathematical/computer models?

Solar sails (see figure 2) offer a safe, cost-effective and propellant-free mode of space transportation. These spacecraft are propelled by momentum gained when light is absorbed and/or reflected from its large membranes. For square solar sails, long light-weight structures ("booms") are used to support the tensioned membranes in the same way long thin rods support a kite's fabric. Due to their light weight and long length, these booms are highly flexible. When the booms are disturbed, their movement causes a loss of membrane flatness and deterioration of overall performance of the space vehicle.

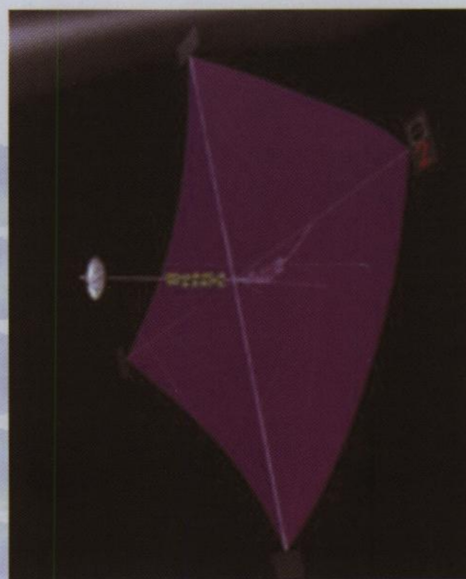


Figure 2

To realize the design performance operation of the vehicle, accurate mathematical models are required. Dr. Keel and his researchers are working to develop a mathematical model to represent the dynamic behavior of large flexible tensioned membranes. To validate and tune the models, a hexapod has been built (see figure 3) with an aperture of a three meter radius. It is now being tested in the vacuum chamber located in NASA's Langley Research Center. ■

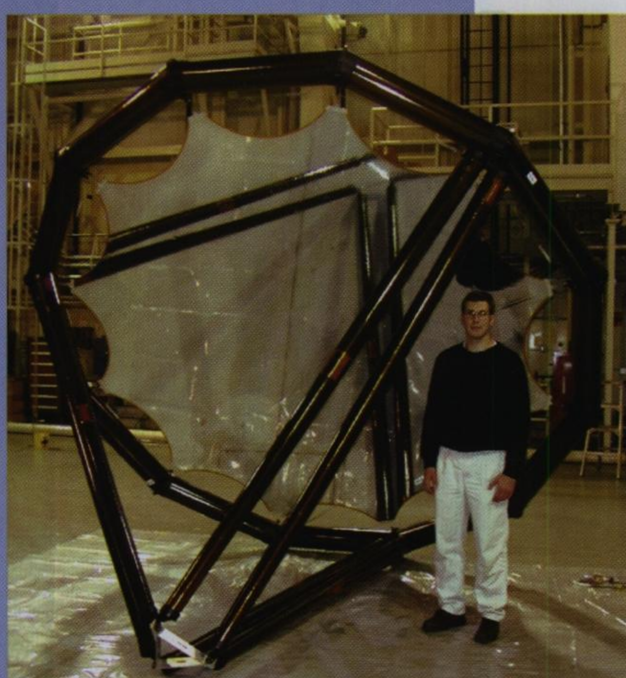


Figure 3

Multi-State Education Gold Standard Research Demonstrates Gains in Student Learning[1]

Learning Sciences as a research focus has emerged from studies that combine many disciplinary approaches to learning: educational research, psychology, computer science, philosophy, sociology, and other scientific disciplines. As researchers closely examine learning, several areas have been identified as essential: deepening conceptual understanding; focusing on learning in addition to teaching; creating effective learning environments; building on a learner's prior knowledge; and reflective practice.

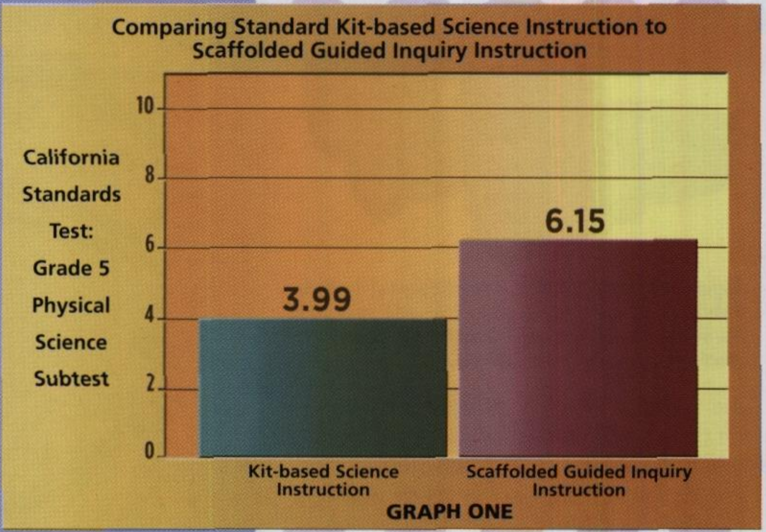
The Academic Achievement and Teacher Development in Science Project (AATDS) was developed in 2001 from a $5,000,000 Interagency Educational Research Initiative/National Science Foundation grant (REC #0114431). The research team has grown during the past six years to include researchers and educators from Tennessee (Principal Investigator: Dr. Rick Vanosdall, TSU, COE: Learning Sciences), Illinois (Co-Principal Investigator: Dr. Larry Hedges, Northwestern University, and Project Director: Dr. Kathryn Sloane Weisbaum), California (West Coast Project Manager: Dr. Michael Klentschy, San Diego State University), and North Carolina (Site Coordinator: Ms. Cathy Horn, Wake County Public School System). The current research team is an authentic collaboration to explore the impact of the inquiry-based "hands-on" science reform initiatives of the 1990s-2000s, extending beyond the instructional materials designed for "hands-on" or "activity based" learning that are available in the second generation of kit-based curricula of the 1980s and 1990s.

In the past, research has been spotty and inconclusive in examining the effectiveness of many of these reform efforts targeting improved student achievement. Utilizing assessment data generated during the 2001-2004 school years, the AATDS Project conducted a series of analyses that have demonstrated a positive effect on student learning as a result of the reform initiatives funded by NSF in both middle Tennessee and southern California.

Most investigative science instruction in today's standards-based classrooms is guided inquiry. Guided inquiry provides teachers with the opportunity to carefully plan classroom investigations that will both expose students to the required science content (standards) and plan the implementation of lessons that will integrate student science notebooks and classroom discussion as a means for students to develop a deep understanding of the required content. Ideally, there is alignment of the science content standards that should be taught (intended curriculum) with what is actually taught (implemented curriculum) with what is actually learned by students (achieved curriculum) (Marzano, What Works in Schools, 2003; Marzano, Pickering, and Pollack, Classroom Instruction that Works, 2001).

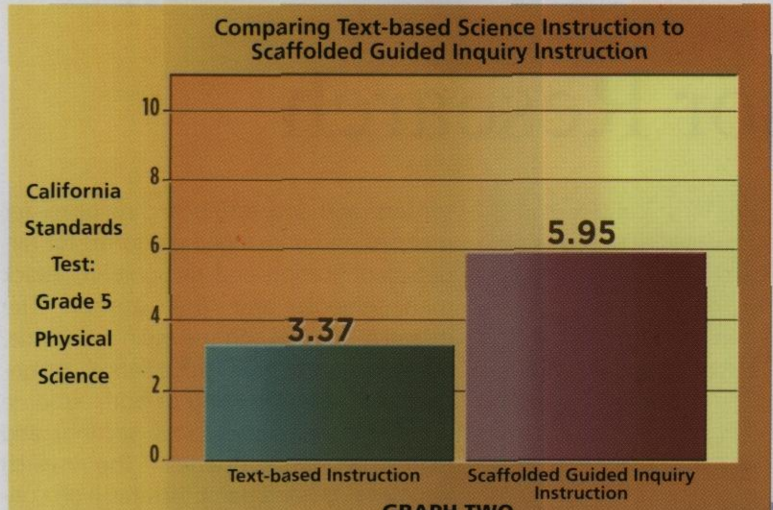
In the early years of the AATDS Project, the research team worked on adapting and integrating a series of teaching and learning strategies that have come to be known as Scaffolded Guided Inquiry (SGI). In 2003, AATDS began a series of randomized controlled trials in public school classrooms to provide stronger tests of the causal effects of SGI reform strategies on student achievement.

The constructs of SGI are briefly explained in the following way. Research on how students learn recognizes that the development of deep conceptual understanding in science takes time and is enhanced by providing supports, scaffolds or prompts to guide students to build their scientific reasoning ability. Thus, the classroom teacher needs to guide the inquiry process in order to develop deep conceptual understanding and scientific reasoning ability. But guided inquiry is a complex process because students and teachers may often lack content knowledge, inquiry experience and resources



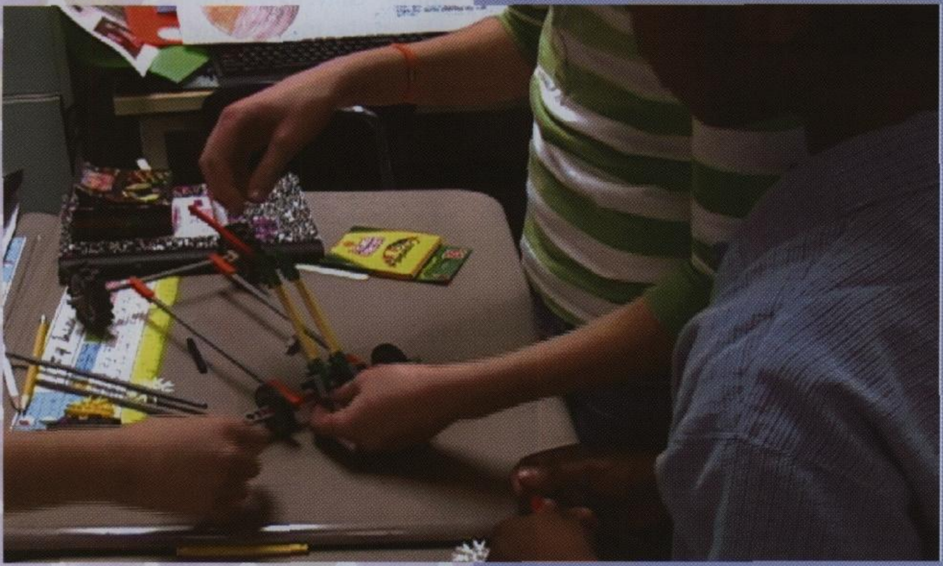
GRAPH ONE

1. From paper presented by Vanosdall, Klentschy, Hedges and Weisbaum at the Annual Meeting of the American Educational Research Association, April 2007



GRAPH TWO

and are unable to make meaningful inferences from data without adequate support. Therefore by adding scaffolds or supports for students within this level of inquiry, they are guided through the process of constructing their understanding of scientific concepts as they work through the lessons.



Students building a K'Nex vehicle as part of the Motion and Design curriculum.

Scaffolding occurs for teacher learning/training as well. The teachers' guides are modified in several important ways, to model for teachers the essential elements of effective standards-based instruction. First, the lessons in the unit are linked directly to specific standards in the state curriculum and assessment guides. Teachers know what standards are being addressed in each unit and lesson. Second, critical or "benchmark" lessons are identified so the teachers know which lessons are critical in the development of student understanding. Third, questioning, experimentation, and reflection are all modeled in order to support the teacher through classroom activities and interactions. Finally, the use of student notebooks is emphasized as a way for the teacher to assess student's understanding and to provide the feedback that is necessary for student learning.

Analysis of the first year of data from two randomized trials revealed evidence of dramatic gains in student learning as measured on the state's high stakes accountability test required by the No Child Left Behind Act. The results of these studies are currently under peer review. Dr. Rick Vanosdall, director of the Center of Excellence for Learning Sciences and principal investigator on the project, is currently discussing the findings and implications with local, state and national leaders. Findings demonstrate that Scaffolded Guided Inquiry dramatically improves student learning that is measurable on high stakes accountability tests (see graphs). These Scaffolded Guided Inquiry materials support the development of teachers, as they leverage what is known about how students learn, to provide guided inquiry learning environments. The research team is continuing to analyze the subsequent two years of data to examine additional aspects of the impact of learning through Scaffolded Guided Inquiry (SGI).

A surprise discovery was revealed during the analysis of the data. Previously, there have been a number of studies as well as broad based agreement from educational researchers and practitioners that implementation of inquiry-based curricula and instructional practices require significant investments in time and resources. The research team discovered that when teachers were trained and provided with the SGI materials, the students in classrooms implementing SGI materials performed equally well, whether the teachers had no experience with hands-on science curricula or many years and 70+ hours of professional development supporting their implementation of inquiry-based curricula. This provides strong support for teachers and school leaders as they make decisions to implement inquiry-based "hands-on" science materials with SGI. Dr. Vanosdall said, "My sincere hope is that SGI will provide a process for leading teachers, administrators, and policy makers to transform classroom teacher practices. Teachers and students learn through activating prior knowledge, developing deep conceptual understanding grounded in factual knowledge, organizing knowledge to facilitate retrieval and application, and utilizing reflective practices" (Bransford, Brown, Cocking and Brown, *How People Learn*, National Academy Press, 2000). ■

Sensor Research

Currently, Tennessee State University (TSU) is engaged in three projects in Automatic Target Recognition research (ATR Technology Thrust) and they are: (1) Development of Real-Time Algorithms for Moving Target Detection, Identification, and Tracking; (2) Image registration; and (3) Development of ATR test-bed. This project involves research activities to further the goals of the Sensors Directorate (SN) of the United States Air Force Research Laboratory (AFRL) at Wright Patterson Air Force Base in ATR research, Electro-Optics/Infrared (EO/IR), and Radio Frequency (RF). The work is a joint effort *with a multi-university* team in collaboration with two small businesses to address research issues in the area of sensors that are relevant to the Air Force. The universities include eleven (11) Historically Black Colleges and Universities (HBCUs), Minority Institutions (MIs), and six (6) major universities in the area of aerospace sensor technologies. TSU is the lead university and, in collaboration with five other universities (Louisiana Technical University, Michigan State University, Prairie View A&M, Chaminade University of Honolulu, and North Carolina A&T State University), is conducting additional research in Automatic Target Recognition. The ATR team is working in close collaboration with AFRL/SN scientists and engineers throughout the course of the program.

The integrating subcontractor is a Small Disadvantaged Minority Business (SDMB), Clarkson Aerospace, Inc. based in *Houston, TX*. Clarkson Aerospace initiated this program with support from several universities. The prime contractor is also a small business, Universal Technology Corporation. The research includes the entire spectrum of sensor technologies that are applicable to Air Force weapon systems in manned, unmanned, and space environments such as: aerospace sensor components; processing; sub-systems and system simulations and evaluations; algorithm development; and countermeasures techniques. The effort also includes educational aspects of training minority leaders and utilizing secondary teachers, professors (university level), and students at all levels by emphasizing their participation in the subject research, and by identifying opportunities for their participation in related AFRL activities.

UAV at TSU Campus

Target Identification

The ATR Technology Thrust focuses on developing and demonstrating aerospace sensors and processing *technologies for* manned and unmanned platforms for target identification *and* recognition, attack management, and fire control. The research focuses on providing anytime, anyplace, anywhere surveillance, reconnaissance, and targeting of both airborne (including low radar cross section) and high valued ground targets. The research also develops and demonstrates high confidence target identification and recognition cueing techniques. Additionally, the research includes adaptive ATR algorithms, *network* centric urban vigilance, detection, and identification of inhabited underground dwellings, image processing, and others. TSU is also engaged in conducting research in Radio Frequency (RF) sensors in collaboration with Michigan State University and Louisiana State University in Cognitive Radios. TSU is investigating cross-layer design of MIMO (Multiple Input/Multiple Output) cognitive networks in order to enhance system flexibility and to optimize system performance for a highly dynamic fusion-oriented sensor network in the battlefield.

Image Registration

With increased interest of the Air Force in utilization of multiple unmanned aerial vehicles (UAVs) in surveillance operations, there is a need for developing fast image registration algorithms. The goal of this research is focused towards development of improved methods for image registration of multiple views using fast image processing techniques and test on data generated locally and also provided by AFRL. Figure 1 shows two images taken by a camera mounted on UAV at two adjacent locations and the resulting registered image using registration software developed by the research team. Figure 2 shows an image registration result for multiple images.

Each airborne camera has a certain number of trajectories at any given instant. The trajectory matching can be used for concurrent mosaicing of the wide area or global registration. The system performance will be evaluated by utilizing a moving camera mounted on a mini helicopter (shown at left).

The two images above form the registration image below.

Figure 1.

ATR Test-bed

In our current research, we are establishing a test-bed that consists of a UAV and a collaborative camera network. The UAV is mounted with a wireless camera and a Global Positioning System (GPS) receiver. It sends all visual data and GPS data to the ground station. The ground station processes all the visual data and GPS data, and handles the UAV control and navigation. The collaborative camera network contains three day/lowlight color cameras, three daytime cameras that will cooperate with IR illuminators at night, and one thermal camera. They are all remotely accessible and pan-tilt-zoom (PTZ) controllable via internet. These PTZ cameras are mounted on the fixed platform (the wall and the roof of College of Engineering building). This test-bed is used to generate the aerial image sequence from the UAV the image sequence that covers the public road, campus parking lot, and student living area. These image sequences are used to develop automatic target detection, tracking (ATR) algorithms and image registration algorithms.

The goal of this project is to make this test-bed fully functional for use by AFRL and the participating universities to detect, identify and track both slow moving (people) and fast moving (cars, tanks, etc) targets from fixed and moving platforms. We will develop an interface program that makes this test-bed remotely accessible and controllable, so that this technology will provide researchers from AFRL and other universities/institutes in this ATR group access to remotely login to this test-bed and test their ATR algorithms.

The sensor research that Tennessee State is conducting as the lead in this multi-institution collaboration will assist the Air Force Research Laboratory in its mission to maintain America's advantage by providing leading-edge warfighting capabilities to our air, space and cyberspace forces. ■

Figure 2. Image registration result for 6 input images.

Division of Research and Sponsored Programs

Annual Report Fiscal Year 2007

SUBMISSIONS by Center/College/School

Academic Affairs	$ 1,624,869
Agriculture and Consumer Sciences	89,761
Arts and Sciences	10,051,215
Business	268,533
Center for Health Research	289,695
Center of Excellence- ISEM	3,317,222
Center of Excellence- LS	1,665,895
Cooperative Extension Program	5,200
Education	399,241
Engineering, Technology, and Computer Science	3,751,651
Extended Education	14,850
Health Sciences	1,402,074
Institute of Agricultural and Environmental Research	7,298,049
Institute of Government	284,408
Massie Chair of Excellence in Environmental Engineering	115,000
Nursing	896,377
Research and Sponsored Programs	19,448,898
Student Affairs	250,000
Total	**$ 51,172,938**

SUBMISSIONS by Agency/Corporations/Foundations

Corporations	$ 297,991
Foundations	1,072,717
Tennessee State Agencies	1,103,816
National Aeronautics and Space Administration	1,340,000
National Science Foundation	8,250,029
Office of Naval Research	547,500
U.S. Agency for International Development	45,000
U.S. Air Force Research Lab/OSR	715,855
U.S. Department of the Army	1,260,000
U.S. Department of Agriculture	6,950,093
U.S. Department of Defense/MDA	1,379,364
U.S. Department of Education	19,330,912
U.S. Department of Energy	546,829
U.S. Department of Health and Human Services/NIH	7,612,251
U.S. Department of Housing and Urban Development	600,000
U.S. Department of State	12,689
U.S. Department of Transportation	107,892
Total	**$ 51,172,938**

AWARDS by Center/College/School

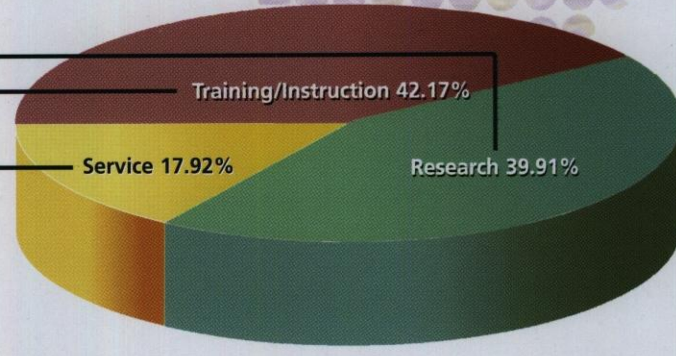
Academic Affairs	$ 105,200
Arts and Sciences	1,995,145
Business	217,965
Center for Excellence - ISEM	2,349,544
Center for Excellence - LS	6,523,244
Center for Health Research	224,999
Cooperative Extension Program	3,548,902
Education	418,999
Engineering, Technology, and Computer Science	1,003,760
Health Sciences	1,859,850
Institute of Agricultural and Environmental Research	4,571,424
Massie Chair of Excellence in Environmental Engineering	1,053,663
Nursing	94,355
RIMI Center for Neuroscience	830,306
Student Affairs	568,891
Research and Sponsored Programs	1,500,000
Technology and Administration Services	656,214
Title III	5,389,543
Total	**$ 32,912,003**

AWARDS by Agency/Corporations/Foundations

Corporations	$ 766,214
Foundations	118,308
Tennessee State Agencies	847,106
National Aeronautics and Space Administration	657,517
National Science Foundation	2,257,009
National Geospatial-Intelligence Agency	750,000
U.S. Air Force	500,000
U.S. Department of Agriculture	8,094,826
U.S. Department of Defense	1,564,642
U.S. Department of Education	7,458,034
U.S. Department of Energy	336,073
U.S. Department of Health and Human Services	9,019,936
U.S. Department of Housing and Urban Development	49,000
U.S. Small Business Administration	168,964
U.S. Department of Transportation	324,374
Total	**$ 32,912,003**

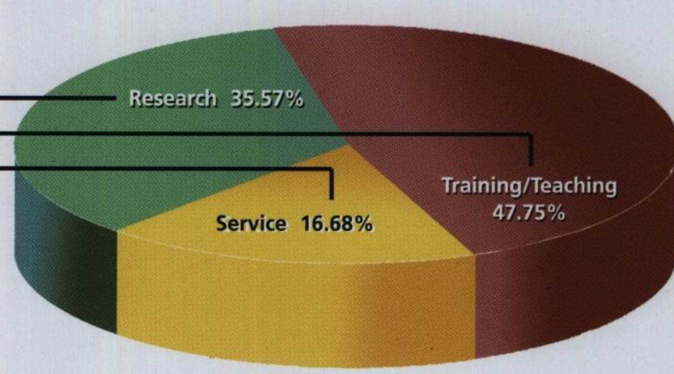
SUBMISSIONS BY PROJECT TYPE

Research $20,423,239 (88)
Training/Instruction $21,579,216 (35)
Service $9,170,483 (17)
TOTAL $51,172,938 (140)



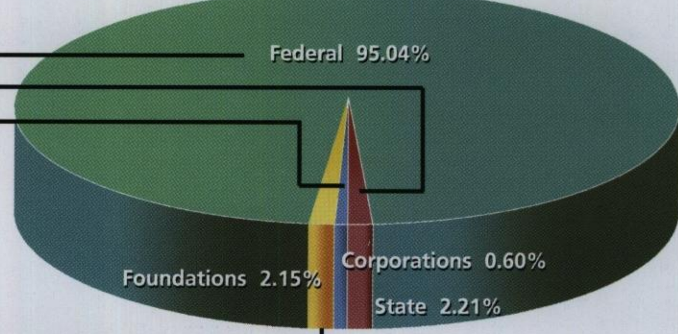
Awards By Project Type

Research $11,705,303 (40)
Training/Teaching $15,715,458 (63)
Service $5,491,242 (13)
TOTAL $32,912,003 (116)



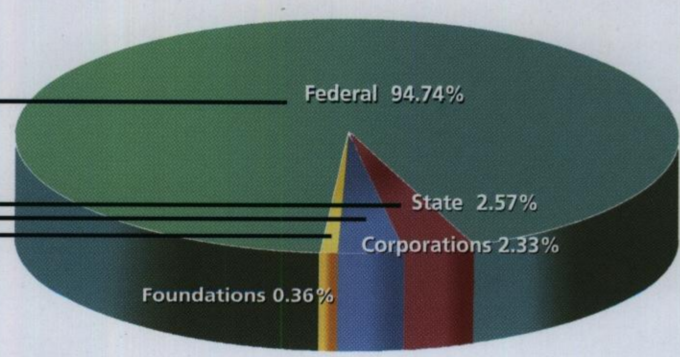
SUBMISSIONS BY SOURCE

Federal $48,673,414 (110)
State $1,103,816 (6)
Industry/Corporate $297,991 (9)
Private Foundations $1,097,717 (15)
TOTAL $51,172,938 (140)



Awards By Source

Federal $31,180,375 (103)
State $847,106 (5)
Corporations $776,214 (4)
Private Foundations $118,308 (4)
TOTAL $32,912,003 (116)



Research at Tennessee State University utilizes the diverse skills and expertise of our researchers, faculty, staff, and students to make significant and sustained contributions to the knowledge of humankind through new discoveries that have positive impact on our community, our nation, and the world in which we live. At Tennessee State, we believe research is essential to excellence in education and enhances the educational experience of our students.

Marcus W. Shute, P.E, Ph.D.
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TSU Publication Number: TSU-08-0008(B)-361010

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