

Center for Educational Technologies®
Wheeling Jesuit University

2002 Annual Report

Oct. 1, 2001, to Sept. 30, 2002

Changing the way people learn

Home of  Classroom of the Future™

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■ Executive Summary

The mission of the Erma Ora Byrd Center for Educational Technologies® (CET™) is to enhance lifelong learning and teaching through the effective use of technology. The CET is located on the campus of Wheeling Jesuit University in Wheeling, WV. Given the nature, scope, and outcomes of the activities conducted from October 2001 to September 2002, the CET was successful in working toward accomplishing its mission through four core activities:

- Development of curriculum supplements
- Professional development for teachers administrators, college faculty, and corporate personnel
- Educational research and evaluation
- Educational outreach

To date the CET has published seven curriculum supplement products: Astronomy Village:

Investigating the Universe®, Astronomy Village®: Investigating the Solar System™, BioBLAST®, ExoQuest®, Exploring the Environment® (ETE), Global Perspectives, and The Underground Railroad: Connections to Freedom and Science.

These products were developed to support NASA's initiatives in space science, human exploration and development of space, and Earth system science. This year the CET had six additional products under development: Cuyahoga Valley Environmental Education Center (CVEEC), Foundations of Freedom™, International Space Station (ISS) Challenge™, Journey to El Yunque, Lewis and Clark Rediscovery Project, and STORM-E.

During this reporting period the CET also provided general leadership training in educational technology through its Integrating Strategies and Technologies in Education Practice (InSTEP™), BUCKEYE, and Cuyahoga Valley Environmental Education Center (CVEEC) programs; product-specific training through its product workshops; and content-specific training through its online Earth system science courses and probability and statistics workshops. The CET also collaborated with regional curriculum supervisors to offer science, math, engineering, and technology enrichment activities for middle and high school programs. These activities focused on engineering and technology associated with NASA innovations and NASA partners.

The learning sciences provide a foundation for the research and evaluation conducted at the CET. The main focus of the research team is to understand the conditions under which learning takes place by considering theories of cognition, applications of theory to practice, and technology-rich learning environments. This year the research and evaluation team was involved in three projects: Global Science and Technology Week (GSTW), JesuitNET, and Virtual Design Center (VDC).

To support educational outreach activities, the CET received funding from the NASA Office of Space Science (OSS) to establish a broker/facilitator program. The CET formed the Mid-Atlantic Region Space Science Broker (MARSSB) this year and became a member of the Office of Space Science education/public outreach support network. MARSSB serves as a resource to bring scientists and educators together to communicate the discoveries of NASA space science missions to students and public audiences. The MARSSB program serves the following nine states plus the District of Columbia: West Virginia, Pennsylvania, New York, Delaware, New Jersey, Maryland, Virginia, Kentucky, and Ohio.

This collective work contributed to NASA's Classroom of the Future™ (COTF™) program, which is also housed at the CET. Because of the work completed in the four core activities, the CET continued to assist schools, school districts, state departments of education, federal agencies, foundations, businesses, and industry in planning, developing, and implementing advanced educational technologies in support of science learning.



■ ABOUT THE ORGANIZATION AND REPORT

Background

The Erma Ora Byrd Center for Educational Technologies® was dedicated in 1994 with funding from NASA. The center is located on the campus of Wheeling Jesuit University in Wheeling, WV. Wheeling Jesuit University was founded in 1954 as one of America's 28 Jesuit institutions of higher learning.

Administered by the Erma Ora Byrd Center for Educational Technologies, the Classroom of the Future™ began in 1990 and remains the central program within the CET™. Now in its third cooperative agreement with the NASA, the COTF™ serves as NASA's premier research and development program for educational technologies. In this role the COTF develops and conducts research on technology-based learning materials. These materials challenge students to solve problems by using datasets and other information resources. These resources are provided by the five strategic enterprises of NASA: aerospace technology, biological and physical research, Earth science, human exploration and development of space, and space science.

Core Activities

The Classroom of the Future program aims to bridge the gap between America's classrooms and the expertise of NASA scientists, who have advanced the frontiers of knowledge in virtually every field of science over the last 40 years. This year 45 CET staff contributed to core activities of CET/COTF work. Staff with collective expertise in software and content development, research, publications and support, computer support, and video support contribute to product development, professional development, research and evaluation, and educational outreach. Although projects under core activities are conducted by working groups, the center draws upon interdisciplinary expertise to accomplish the goals of its multiple activities.

Leadership

Center leadership is provided by:



Nitin Naik, Ph.D.
President



Jeanne Finstein, Ed.D.
Assistant Director



Stanley Jones, Ed.D.
Assistant Director
Washington office

Report Structure

This report covers Oct. 1, 2001, to Sept. 30, 2002. It is divided into four areas: product development, professional development, research and evaluation, and educational outreach. Each area is then divided into product sections. These describe the product and/or service, annual accomplishments (including project milestones and web statistics for the year), and if research is available, the impact of the projects.

To document product use and project participation, the center began using the NASA EDCATS system in 1996 to collect information about its products and services. EDCATS allows CET staff to track the number of participants and their opinions on the quality of CET products and services. Related information refers to "unique users" as an IP address that connects to the server (this number is counted only once per recording session) and "web hits" as raw web hits including any image or page accessed from the server.

■ PRODUCT DEVELOPMENT

In 2002 CET™ staff continued to work in two major activities: publishing curriculum products and developing/refining existing curriculum materials.

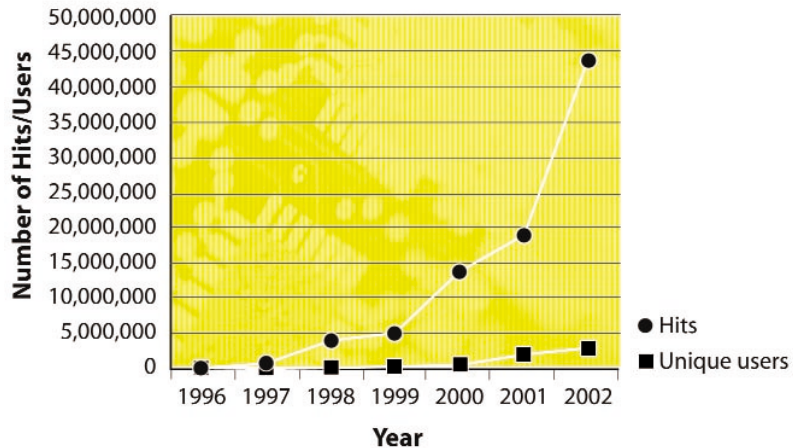
PUBLISHED PRODUCTS

To date the center has published seven curriculum supplement products: Astronomy Village: Investigating the Universe®, Astronomy Village®: Investigating the Solar System™, BioBLAST®, ExoQuest®, Exploring the Environment®, Global Perspectives, and The Underground Railroad: Connections to Freedom and Science. These products were developed to support NASA's initiatives in aerospace technology, biological and physical research, Earth science, human exploration and development of space, and space science.

The hallmarks of CET software are the use of cutting-edge NASA science questions, the use of real NASA data, and the innovative combination of instructional strategies and technology tools. The programs engage students in hands-on experimentation, cooperative learning and collaboration with experts, and important scientific inquiry activities (e.g., collecting and analyzing data, weighing evidence, and presenting findings). Students participate as real scientists doing real science. As they work in teams to conduct investigations, they develop positive attitudes toward science and the important problem-solving skills required for scientific inquiry. The CET also houses a NASA regional Educator Resource Center (ERC), which serves as a distribution outlet for NASA's curriculum products.

In 2002 the CET distributed 1,434 products. At the same time, the number of users accessing CET products and/or related information electronically increased dramatically compared to previous years (see *web hits* and *access by unique users* in Figure 1).

Figure 1: Trend in Web Access



Astronomy Village: Investigating the Universe®

In 2002 a total of 245 complimentary and purchased copies of Astronomy Village: Investigating the Universe® were distributed. There were 9,713 unique users with 31,740 hits to the web site in 2002. In addition, more than 12,000 free copies of Astronomy Village have been distributed to educational communities across the country since March 1996 when COTF™ first published it as a CD-ROM multimedia program for the Macintosh® computer. This innovative software has received acclaim from professional science educators. In 1996 it won *Technology & Learning* magazine's award for best microcomputer software of the year. The program was developed by NASA-COTF and funded through NASA cooperative agreements NCCW-0021 and NCC5-451.



Following national science standards, the activities promote learning of both astronomical concepts (stars and stellar evolution) and processes related to scientific inquiry. Astronomy Village provides 9th- and 10th-grade science classrooms with 10 complete investigations of important questions in stellar astronomy. It simulates living and working at a mountaintop observatory (the village) as the main way in which students investigate contemporary problems in astronomy. Numerous curricular resources allow students to experience the same computer-based tools that NASA scientists use to acquire, explore, and analyze information. Students have access to an image-processing program, a document reader, an image browser, the Internet, simulation programs, digitized video clips, Hubble Space Telescope images, interviews with astronomers, computer animations, and graphics. For more information visit www.cotf.edu/av1.

Astronomy Village®: Investigating the Solar System™

Since its January 2000 release, 956 complimentary and purchased copies of the CD-ROM Astronomy Village®: Investigating the Solar System™ have been distributed. In 2002 there were 10,604 unique users and 55,605 hits to its web site. In April research staff presented two papers at the annual meeting of the American Educational Research Association in New Orleans. The researchers reported that students achieved significantly greater learning outcomes with each implementation year. Also, researchers concluded that the use of activity summaries as a classroom tool showed great promise for improving the performance of low-achieving students.



Astronomy Village: Investigating the Solar System was funded by the National Science Foundation (grant ESI-96178) with additional support from NASA-COTF. It is an exciting multimedia program intended to supplement existing science curricula. Although designed for middle school students, components of the software can be adapted for use at other grade levels. Two core research areas, encompassing seven focused investigations, form the basis for student explorations. Each investigation encourages students to participate in scientific inquiry individually or as members of a cooperative learning group. Additional software components include an image browser, a variety of simulators, and a solar system explorer.

The program consists of tools and multimedia material housed in a virtual community (the village). Individuals or teams of student researchers pursue one of Astronomy Village's two core research areas.

Astronomy Village can also be used as a teacher resource and classroom astronomy reference. It contains numerous articles on astronomy as well as many Earth- and space-based telescope images. Teachers and students alike can access these articles and images by using the online retrieval system in the Astronomy Village library. The solar system explorer, an optional component of the program, lets students and teachers explore the wonders of the solar system. The solar system explorer contains hundreds of planetary images and a wealth of information about solar system astronomy. Computer simulations and a variety of other activities let students explore and construct their own knowledge. For more information visit www.cet.edu/av2.

BioBLAST®

The CD-ROM program BioBLAST® (Better Learning through Adventure, Simulation, and Telecommunications) was officially released in September 1999. Since then 890 complimentary and purchased copies have been distributed. In 2002 there were 38,152 unique users and 156,944 hits to the BioBLAST web site.



This year the CET also continued supporting the product with professional development workshops (see p. 11). Project leaders were invited to write a chapter about the simulations in BioBLAST for a book that examines the impact of digital technologies on the teaching and learning environment.

BioBLAST was developed by NASA-COTF and funded through NASA cooperative agreement NCC5-203. This product uses an innovative multimedia approach and has received positive teacher testimonials indicating that students find it exciting. Because of this positive feedback one of the BioBLAST simulations has been published on the International Space Station Challenge web site and can be downloaded at no cost. Teachers can use this simulator in conjunction with the Farming in Space lab activity also published on the web at www2.cet.edu/iss/activities/farinspace.asp.

BioBLAST is a curriculum supplement for high school biology classes and is based on NASA's advanced life support research. The curriculum offers students both traditional and computer-based research tools to study the interdependent components of a bioregenerative life support system for long-term space habitation.

BioBLAST uses a multimedia learning environment, resources from the Controlled Ecological Life Support System (CELSS) project, and other NASA sources. The program features a virtual reality interface, laboratory investigations, computer simulations, computer-based resources, and a link to interviews with NASA scientists and engineers. Students are required to work cooperatively as research scientists to investigate the interdependence of plant and human life. Starting with instruction about photosynthesis, plant cultures, and recycling, students participate in authentic NASA-CELSS research, with the goal of balancing life-supporting dynamics. For more information visit www.cotf.edu/BioBLAST.

ExoQuest®

This curriculum supplement was released in September 2001 on a CD-ROM, and 627 complimentary and purchased copies have been distributed since then. In 2002 there were 5,779 unique users and 20,163 hits to the ExoQuest® web site. ExoQuest was developed by NASA-COTF and funded through cooperative agreement NCC5-451.



Whether or not extraterrestrial life exists is a question of immense popular interest and a scientific issue of profound importance. ExoQuest uses this question as a framework for integrating current research in astrobiology into the grades 7-9 curriculum. Within the context of astrobiology, students explore astronomy, evolution, paleontology, biology, Earth science, physics, chemistry, geology, and remote sensing.

ExoQuest creates links between students, NASA scientists, and other research organizations, thus integrating NASA's experience and expertise into middle and high school curricula. Students travel on virtual journeys to destinations in the solar system and beyond. Their trips are based on past, present, and future NASA missions. At each destination students conduct investigations that include hands-on and simulated experiments. Each investigation poses problems that focus on different areas of research, providing an interdisciplinary approach to science and scientific inquiry. For more information visit www.cotf.edu/ExoQuest.

Exploring the Environment®

In 2001-2002 CET staff added four modules—Biomes; Earth Systems; Remote Sensing; and Weather, Seasons, and Climate—to the K-4 section of the online Exploring the Environment® curriculum supplement. In 2002 there were 1,935,389 unique users and 37,400,105 hits to the web site. This level of access suggests a growing interest in this product.



With funding from NASA’s Learning Technology Program (NASA CAN NCC5-107), the Exploring the Environment project features a series of 17 problem-based, Earth science modules for middle and high school students. ETE provides real-time and near real-time data visualization tools to help students understand and record fast-changing natural phenomena and human influences on Earth. Students decide how to best respond to real-world problems related to weather, population growth, biodiversity, land-use patterns, volcanoes, water pollution, and global warming.

ETE has made some major contributions to science education. First, ETE is Internet-based and free of charge, which makes it usable around the world and accessible to schools that might not have the financial resources to invest in software. By using this broad, low-level technology, the curriculum is usable on older model computers and across both Windows® and Macintosh® platforms. Second, the ETE curriculum addresses current and authentic worldwide environmental issues. Examples include hurricane tracking, the global impact of volcanic eruptions, endangered species, the Amazon rainforest, deforestation, ozone depletion, and atmospheric carbon buildup. Third, the designers anticipate that ETE learning activities encourage students to work cooperatively. Through such self-directed research, students develop important scientific inquiry skills and improved attitudes toward science. Fourth, ETE provides students with unique access to powerful and authentic science tools, techniques, and data, such as imaging software and remote-sensing data from NASA. Students are trained online to use imaging software so they can view extensive biological, chemical, geological, and physical changes on Earth. Finally, ETE actively supports teacher implementation through training workshops and other activities. For more information visit www.cotf.edu/ete.

Global Perspectives

The Global Perspectives web site has been extremely well received since its release in 1999. Teachers reported that they appreciate finding "everything we need" in one place. The site continues to set the standard for engaging K-12 humanities resources for teachers across the country. In 2002 there were 5,412 unique users and 961,935 hits to the web site.



Global Perspectives was funded by the National Imagery and Mapping Agency. The project’s objectives included producing an interdisciplinary web site for middle and high school students in geography, social studies, and history; providing tools and resources for data gathering and analysis on topics of worldwide concern; involving teachers in the design, development, and assessment of learning materials; and developing sample lesson plans with supporting problem-based learning modules.

In 2002 CET staff updated the modules with problem-based scenarios designed to engage students in standards-based investigations. For more information visit www.cet.edu/earthinfo.

The Underground Railroad: Connections to Freedom and Science

This product is a video supplement distributed at no cost through NASA's Educator Resource Center network. Teachers can purchase copies through NASA Central Operation of Resources for Educators, which has distributed 89 copies of this product since its release in 1999.



In July 1998 President Clinton signed a bill into law to recognize and preserve the Underground Railroad, the South-North escape routes used by freedom-seeking slaves during the 19th century. Specifically, the law authorized the National Park Service to physically link the railroad's "safe houses," to produce educational materials about the railroad, and to otherwise commemorate this important part of our nation's history. The development of this project is funded through NASA cooperative agreement NCC5-451. This fascinating video is the result of a collaborative effort between the COTF, the National Park Service, and NASA educational resources.

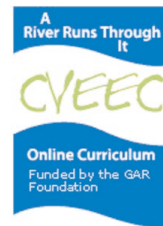
Slaves traveling the Underground Railroad, usually on foot, depended on celestial navigation to find their way northward. They continually looked to the Big Dipper and the North Star for direction. This video increases student awareness of the Underground Railroad and the role celestial navigation played in the railroad's success. The video also highlights the importance of modern global information system technology in reconstructing historical topographies and finding the exact route of the railroad. The video combines amazing historical facts, such as the use of handmade quilts for communication, with mathematics, remote-sensing technology, Earth system science, and astronomy. The educational experience is dynamic and moving and has many potential cross-curricular uses.

PRODUCTS UNDER DEVELOPMENT

Concurrent with efforts to support and refine existing products, CET staff have continued to work on the development of new products. This year staff worked on the development of the following projects: Cuyahoga Valley Environmental Education Center, Foundations of Freedom™, International Space Station Challenge™, Journey to El Yunque, Lewis and Clark Rediscovery Project, and STORM-E. The scope and nature of this development reflect CET efforts to reach a wider audience.

Cuyahoga Valley Environmental Education Center

In 2002 cadre members of this project used nine CET modules and contributed to the development of 20 modules. Additionally, two new modules were completed: Water Quality and Terrible Toxic Spill on I-271. There were 1,508 unique users and 43,339 hits to the web site during this period.



The CVEEC project is a partnership among the Cuyahoga Valley Environmental Education Center, Summit Education Initiative, and the CET and is privately funded by the GAR Foundation. The purpose of the partnership is twofold: to develop nine online curriculum supplements (three during each of three years starting in 2001) that bring together Summit county students, their parents, and the community; and to provide professional development for Summit County teachers (see Professional Development section, p. 11).

The How Big? How Far? module of this product introduces students to remote sensing and map skills. Students must use ArcView™ and/or Scion Image to digitally measure the distance between their school and the CVEEC. The Panther Relocation module introduces students to the concept of endangered species. Students must determine whether or not it is feasible to transplant some of the endangered Florida panthers from the Everglades to Cuyahoga Valley National Park. The Predicting the Weather module introduces students to remote-sensing products and other tools meteorologists use to predict weather. Students must determine the weather for the next 24, 48, and 72 hours to prepare for a trip to the CVEEC.

Foundations of Freedom™

In 2002 staff completed two alpha-version curriculum modules: Court Packing and War Powers. Also during this period there were 1,106 unique users and 2,905 hits to the web site. The final release for the Foundations of Freedom™ project is planned for fall 2003.

The development of Foundations of Freedom is funded by the U.S. Department of Education and is part of an initiative of U.S. Sen. Robert C. Byrd's to restore history to its rightful place in America's schools. The primary objective of the Foundations of Freedom project is for high school students to learn about the historical and philosophical foundations of the U.S. Constitution. A number of "challenges" are posed within the context of constitutional themes. These challenges address the following constitutional themes: popular sovereignty, representative government, structure of government, federalism, separation of powers, Congress/the president, judicial review, and amendment process. Each challenge poses a question focusing on a historical event and illustrating one of the themes.

Legal scholars and constitutional historians introduce challenges with documentary-style video segments and video commentary. All necessary research materials are contained within an electronic archive. The archive includes historical documents, landmark court cases, and significant speeches, debates, essays, and letters. All materials in the archive are fully cross-referenced and searchable. Support tools include an online notebook and glossary.

Learning objectives are consistent with the National Standards for History published by the National Center for History in the Schools. Specifically, the main focus of the curriculum is on historical analysis and interpretation. To complete each challenge, students must compare and contrast differing sets of ideas, values, personalities, and institutions. They also are expected to marshal evidence of antecedent circumstances and contemporary factors contributing to problems and alternative courses of action. For more information visit www.cet.edu/constitution.

International Space Station Challenge™

Two new simulators (Material Science and Oxygen Sensor Activity) were produced in 2001-2002. The web site for this curriculum supplement recorded 27,352 unique users and 680,320 hits.



The International Space Station Challenge™ project contributes to the overall NASA effort to attract students from all backgrounds to pursue further studies and possible careers in science and engineering. ISS Challenge draws upon International Space Station design, construction, human exploration, and research as a vehicle to capture student curiosity. By glean science, technology, and human factors challenges from the space station, ISS Challenge brings NASA research and development and technology innovations into its curriculum modules. The development of this project is funded through NASA cooperative agreement NCC5-451.

ISS Challenge highlighted the unique opportunity of linking curriculum modules to a live, progressively changing, multiyear NASA mission that is visible to the naked eye in the night sky. The ISS Challenge has tried to highlight the unique timeliness of the ISS with weekly updates on its front page, feature stories in the ISS Tech Check newsletter, frequent updates to the Reading Room, and live links to space station resources in all curriculum activities. The curriculum modules feature unique design, construction, human exploration of space, and scientific research uncertainties and challenges that have emerged with the development of the space station. Each module attempts to capture student interest by presenting a real problem in which students must practice their science, math, technology, geography, and communication skills to solve it. In May 2002 the Materials Science Challenge was featured on the NASA Connect web site (connect.larc.nasa.gov/dressed/dressed.html). For more information visit www.cotf.edu/iss.

Journey to El Yunque

Journey to El Yunque is a three-year project funded by the National Science Foundation (grant ESI-0099213). The project began in August 2002 with the goal of developing a web site designed to improve student understanding of ecology and changing ecosystems. In particular, the web site improves students' dynamic understanding of ecosystem environments and abilities of scientific inquiry. A primary goal of the web site is to develop a bilingual middle school, web-based learning environment that allows students to investigate the effects of Hurricane Georges on the Caribbean National Forest, commonly known as El Yunque. The modules align selected National Science Education Standards and unifying concepts. In addition, the web site includes embedded assessments. The second goal of the web site is to develop teacher support materials and a standard workshop structure for professional development related to the use of the web site. The web site also intends to provide parent-support pages. Since the program is disseminated over the Internet, students can access it from home to show their parents the progress they have made. The site contains specific pages designed to facilitate interaction between students and their parents.



Lewis and Clark Rediscovery Project: Lifelong Learning Online

In recognition of the 200th anniversary of the Lewis and Clark exploration, the University of Idaho (the lead institution for the project) teamed with the CET and the University of Montana-Missoula to continue building a learning environment that offers an introspective look at our country. Maps, images, GIS data, and NASA visualizations are housed in a database that interacts with the University of Idaho's learning environment interface. Using multimedia from historians, American Indians, scientists, and citizens connected to the Lewis and Clark saga, the project piques students' curiosity and looks at the growth of the United States, from the Louisiana Purchase through the 200 years of change that followed. Four new modules were completed in 2001-2002: Monticello, St. Louis, Pierre, and Lemhi Pass. Funding for this project is provided by the University of Idaho through an earmark from NASA.

So far, development has centered on content, design, the use of interactive learning environments, and NASA's role in future exploration. The program uses a learner-centered environment usable by a variety of learners and teachers. It emphasizes K-12 standards, allows interaction among learners at different stages, and will become a model for online education for K-12 and college courses. The learning environment includes mathematics and science as well as aspects of geographic, historic, and cultural change. The themes include various changes over the past 200 years in the context of the Lewis and Clark expedition and where we, as a nation, are headed. For more information visit www.l3-lewisandclark.com.

STORM-E

In April and May 2002 center staff conducted the alpha testing of this meteorology curriculum product in five area schools. By November 2002 CET staff had turned the curriculum into a web site for electronic access by students and teachers.

STORM-E is a weather simulation that immerses and engages grades 4-6 students in standards-based content materials. The development of this project is funded by NASA cooperative agreement NCC5-451. The student-centered simulation encourages teamwork and the application of knowledge. Students study general and specialized information so they can serve as experts in the areas of air pressure, humidity, temperature, and wind during a live event. This event is a videoconference connecting the students to the CET. The students provide weather predictions based on data. During the event CET staff members present students with new data, which allow students to update their predictions. For more information visit www2.cet.edu/weather.

PROFESSIONAL DEVELOPMENT

The CET™ group involved in professional development activities provides general leadership training in educational technology. The group aims to integrate content, pedagogy, and technology as a means to help teachers implement new activities and reflect on their experiences. An important dimension of professional development activities is the focus on helping teachers build a learning community by providing them with opportunities to serve as facilitators and mentors to other teachers.

With the increased availability of curriculum products and related instructional information on the Internet, teacher participation in organized professional development has decreased over the years as shown in Figure 2. In 2002, however, there was a substantial increase in teacher participation representing all grade levels (4,081 combined total: grades K-4 = 1,503; grades 5-8 = 1,743; grades 9-12 = 835) compared to the prior year. Overall, the majority of participants were female (82 percent), Caucasian (97 percent), had 10+ years of teaching experience (69 percent), were teaching in public schools (91 percent), and held a master's degree (60 percent). A significant number of teachers reported teaching K-4 (40 percent) and 5-8 (37 percent) grade levels, while only 23 percent indicated they taught high school. The data represents mostly InSTEP™ workshop participants and is consistent with West Virginia's 3 percent minority demographic.

In turn, teacher participation had a direct impact on student involvement in CET's curricular activities for a total of 19,153 students when adding participation across all grade levels. At both K-4 and 9-12 grade levels the number of students increased greatly compared to the prior year (1,282 and 2,935, respectively). Only at the 5-8 level was there a slight decline in the reported number of students (14,936) who received instruction in 2002 directly and/or indirectly as a result of teacher participation in CET's professional development activities (see Figure 3).

The level of student participation increased dramatically, above and beyond numbers reported in Figure 3, when considering the outreach efforts conducted by teachers who participated in CET professional development activities. As these teachers trained other teachers in their home school districts, the reported number of students impacted by CET professional development activities increased substantially to 151,954.

All in all, based on the nature and scope of professional activities and related survey data, professional development activities were highly regarded by participants. Brief descriptions of professional development efforts follow.

Figure 2: Trends in Teacher Participation

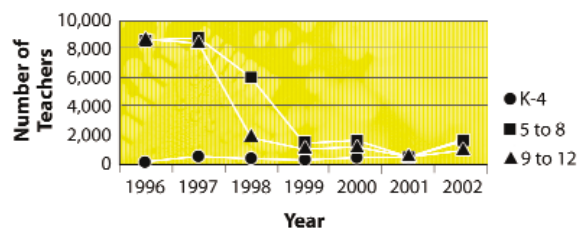
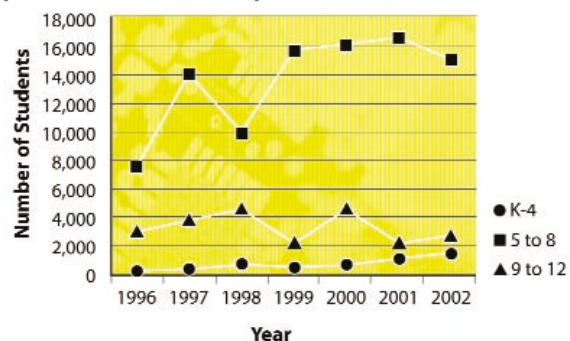


Figure 3: Impact on Student Participation



BioBLAST®

Teachers and teacher training organizations continued to use BioBLAST® as a resource to enhance life science curriculum, as a vehicle to link science and math, and as a supplement to help students understand the process of conducting scientific research. In 2002 the CET supported a workshop on BioBLAST implementation. Nine teachers participated (six male, three female). All teachers were white, and the majority reported having 16+ years of experience. Six had either a master's or doctoral degree, and all nine taught in public schools. The majority worked in high schools, and the combined number of students taught by all teachers was 764.

The feedback on the quality of the workshop was very positive. All teachers either agreed or strongly agreed that the program was a valuable experience, they expected to apply what they learned in the workshop, they felt the workshop was well organized, and they rated the staff as excellent. All teachers were satisfied with the overall quality of the presentations and would highly recommend the workshop to others. Overall, participating teachers felt the workshop adequately prepared them to implement instructional activities immediately and thought that what they learned was important to the educational process.

BUCKEYE

The CET is a member of the BUCKEYE (Bolstering the Uses of Computer Knowledge to Enhance Youth Education) program consortium along with Barnesville, Bellaire, Belmont-Harrison Joint Vocational School, Bridgeport, Martins Ferry, Shadyside, St. Clairsville, and Union Local school districts, all located in Eastern Ohio. The BUCKEYE program addresses substandard Ohio proficiency test scores through teacher professional development, technology infusion, and engaging curriculum. In 2002 the BUCKEYE program received a \$200,000 grant from the U.S. Department of Agriculture to support activities. The program began in 2000. Two graduate courses have been offered each year. Each strand consisted of teachers from grades K-4, 5-8, and 9-12. The fall course covered math methods; the spring course, science methods. In addition, four Martins Ferry teachers organized a four-day problem-based learning workshop. BUCKEYE demonstrated that teacher professional development can take place over a sustained period of time and that technology such as asynchronous discussion spaces and videoconferencing equipment can contribute significantly to teacher professional development. Informal analysis suggested that positive changes in teaching and learning occur as a result of emphasis on teachers as reflective practitioners.

Cuyahoga Valley Environmental Education Center

Two CVEEC workshops were conducted in Summit County (OH) in June and August 2002. A total of 24 public school teachers attended the workshops. The teachers were primarily female (96 percent), white (91 percent), and half of them reported 16+ years of teaching experience, while 30 percent were in their first five years of teaching. Overall, 67 percent reported that they hold master's degrees and that they were teaching either at the K-4 level (54 percent) or grades 5-8 (43 percent). The combined number of students receiving direct and/or indirect instruction as a result of teacher participation was 2,044. The data reflects Summit County teachers' characteristics.

The workshops were extremely well received, as suggested by teacher feedback. All teachers thought the workshops were a valuable experience and well organized, and the teachers would highly recommend the program to others. Overall, teachers thought the program and staff were excellent and felt that what they learned in the workshops prepared them to implement related instructional activities immediately.

A goal of the professional development workshops was to introduce teachers to problem-based learning, Earth system science, and the integration of technology into their classrooms. The target audience of this initiative was an expanding group of Summit County teachers who had an interest in sharing and improving their instructional practices using various technology tools to support them.

Earth System Science Education Alliance

In 2002 there were 47,473 unique users and 524,455 hits to the The Earth System Science Education Alliance (ESSEA) web site. In addition, a workshop was held in Woods Hole, MA, for the seven universities new to the program. Another was held at the CET™ for the 20 returning universities.

ESSEA, funded by NASA's Earth Science Enterprise, provides teacher professional development in Earth system science. It shows the effectiveness of the Internet in delivering high-quality courseware, and it responds to the need for more science teachers. ESSEA efforts are conducted through a systematic, five-year program in which institutions of higher learning from around the country integrate the ESSEA online courses into their curricula. These online graduate courses, developed over a three-year period, address the needs of K-4, 5-8, and 9-12 teachers in the areas of content, technology, educational resources, and new teaching methods.

The ESSEA program has disseminated these cutting-edge graduate courses to 27 colleges and universities engaged in in-service teacher professional development. Participating institutions learn how to incorporate the courses into their curricula. The ESSEA team at the CET and the Institute for Global Environmental Strategies support participant institutions' execution of ESSEA courses. For more information visit www.cet.edu/essea.

Integrating Strategies and Technologies in Education Practice

Five InSTEP™ workshops were conducted at the CET in 2002. Additionally, two were held in southern West Virginia and one in the Eastern Panhandle. Three groups of teachers participated. A total of 116 InSTEP I teachers participated in on-the-road workshops, while 131 InSTEP I, 55 InSTEP II, and 16 InSTEP II+ teachers participated in the in-house workshops. The combined number of students taught by participants was 24,635.

Overall, participants were primarily white (96 percent), female (85 percent), public school teachers (91 percent) with 16+ years of experience (47 percent). Teachers in their first five years of teaching represented 24 percent of the group. The rest reported 6-15 years of experience and made up 29 percent of the participating group. Overall, 58 percent held a master's degree, and all grade levels were represented proportionately (K-4 = 38 percent, 5-8 = 38 percent, 9-12 = 24 percent). The data reflects West Virginia's actual 3 percent minority population.

All teachers had very positive feedback on the workshops. The ratings on both the overall quality of the program and staff were excellent, and teachers reported that participation was a valuable experience and that they expected to apply what they learned. Teachers felt the workshops were well organized, and the teachers would highly recommend participation to others. All in all, everyone felt participation in the workshops adequately prepared them to implement related instructional activities immediately.

InSTEP participation requires teachers to train other teachers in their home regions upon completion of workshops. In 2002 participating InSTEP teachers trained at least four teachers each for a combined total of 1,292 teachers. These additional teachers were mostly white (98 percent), female (81 percent), and were also teaching in public schools (91 percent). Further, the majority of the teachers had 16+ years of experience (56 percent) and were teaching in grades K-8 (77 percent). An estimated 109,095 students were reached directly and/or indirectly through InSTEP-related instructional activities.

The teachers trained by InSTEP participants were also highly satisfied with the related professional development provided to them. Teachers rated their experience as valuable and thought this additional effort was excellent. They too felt that the program prepared them adequately to implement appropriate instructional activities immediately.

Also, staff worked on four new projects: National Board Certification, InSTEP online, PBL Academy for trainers and eventual participants, and Lewis and Clark-related project activities. Finally, in April 2002 research staff disseminated evaluation findings via a paper presentation at the annual meeting of the American Educational Research Association. The research team reported that project participation had a positive impact on teachers' technical skills, attitudes toward technology, constructivist teaching strategies and philosophy, and constructivist uses of technology.

InSTEP™ formed a unique partnership to meet the needs of the underserved community in southern West Virginia. Forward Southern West Virginia is a private organization charged with quickening the pace of economic development in southern West Virginia. InSTEP subcontracted with the organization and its Phase 9+ program to train math and science teachers in that part of the state in using computers as teaching tools. Executive Director Thomas S. Acker, S.J., headed the program. The program emphasized health issues in response to a report Forward Southern West Virginia completed on the poor health of people in the region.

InSTEP workshops are designed to enhance teachers' understanding of constructivist learning principles and ability to integrate technology in the classroom. InSTEP is funded by the U.S. Department of Education and focuses on West Virginia teachers. Participants receive five days of intensive training in problem-based learning, inquiry, and the effective integration of technology into the teaching and learning process. Workshop sessions address pedagogy, methodology, and application by providing participants with authentic interdisciplinary tasks and problems. For more information visit www.cet.edu/instep.

Instituto Tecnológico de Estudios Superiores de Monterrey Problem-Based Learning Institute

Since the summer of 2000, the CET has conducted problem-based learning (PBL) workshops followed by on-site training and support for the Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM), which is a university system comprised of 30 campuses around Mexico. A group of 30 professors attended a two-week workshop and received certification at the CET in 2002. A team experienced and knowledgeable in educational reform, teacher professional development, and alternative instructional teaching methodologies conducted the workshop. Faculty members and administrators have reported anecdotally that they are pleased with the PBL Institute and its impact on the manner in which students are educated in Mexico.

The workshops acquaint professors with the theory behind problem-based learning, model it to the professors, coach them during practice, and provide feedback. Professors work in groups of 3-5 in designing and refining PBL scenarios. They also practice implementation of PBL by working with groups of college students brought in to support the workshop. Professors end the two-week workshop by presenting their credentials to a certification panel. The credentials consist of written documentation supported by an interview. The CET believes the PBL Institute has proven to be a significant contributor to the systemic reform on the ITESM campuses.

Probability and Statistics for High School Teachers

Probability and Statistics for High School Teachers was a professional development program for math and science teachers in the Northern Panhandle of West Virginia conducted in summer and fall 2002. Funded through Eisenhower Professional Development funds, this \$30,000 program focused on math content and the application of probability and statistics concepts in both math and science courses. Thirteen area teachers participated. One area high school math teacher and one Wheeling Jesuit University math faculty member served as the instructors.

All the participants were white, public school teachers with more than 10 years of teaching experience. The majority of the participants were female (69 percent), held master's degrees (92 percent), and were teaching at the high school level (93 percent). Collectively, the estimated number of students taught by participating teachers was 1,210. All participants agreed or strongly agreed that participation in the workshop was a valuable experience and that they expected to apply what they learned in it. Participants also thought that the workshop was well organized. They gave excellent ratings to both the overall program and the staff. Further, participants indicated they would recommend the workshop to others because it adequately prepared them to implement related instructional activities.

The program consisted of five full days of instruction and hands-on activities during the summer plus two Saturdays in the fall. Participants developed lesson plans that incorporated probability and statistics. Participants received a collection of those lesson plans.

■ RESEARCH AND EVALUATION

The research team worked primarily on three projects in 2002: Global Science and Technology Week, JesuitNET, and Virtual Design Center. In addition, the research and evaluation team continued to contribute to the evaluation of CET™ curriculum products and professional development activities. See www.cet.edu/research/main.html for a complete list of the research studies conducted by CET researchers. This section highlights the main accomplishments for the past year.

Global Science and Technology Week

GSTW is an annual event sponsored by the president's Office of Science and Technology Policy. To support this event, NASA wanted to create an interactive electronic linkage campaign that would allow citizens to experience and discover ways that NASA technology touches their lives. A virtual team planned, developed, and implemented a web site to meet this goal. CET staff were called upon to conduct the evaluation of how people used the site and what their perceptions were.

The 2002 theme was "Science and Technology: Serving Our Global Community." The event took place April 28–May 4. Its primary audience was K-12 students, but the week also targeted parents, teachers, university students, professional societies, museums, and technology groups. More than 70 partners participated in the campaign. The general theme was spinoffs. Five NASA technology areas were explored: communication, food-nutrition, health-medicine, remote sensing, and transportation.

Research staff collected access data and found that 25 percent of all hits to the NASA Education site were directed to GSTW. Overall, in 2002 there were 48,214 unique users and 368,010 hits to the GSTW web site. The popularity of each section of the web site was determined by recording the number of sessions where a user requested the main page for each of the target audiences. The total number of these user sessions was 3,362, and this number was used as a proxy for the popularity of each section of the web site. Overall, the distribution of user sessions seemed fairly even. Educator/Parent activities registered the most requests with 1,228 (37 percent), followed by youth activities with 1,148 (34 percent). Interested citizen activities had 986 requests (29 percent).

JesuitNET Evaluation

JesuitNET is a collaboration of 25 U.S. Jesuit colleges and universities. The main goals of JesuitNET are to develop, share, and deliver a broad range of online academic programs and services for a national and eventual international audience; and to produce courses that embody the Jesuit attributes of higher education (academic rigor, personalized instruction, faculty advisement and support, service to others, and ethical concerns).

The CET evaluated the implementation of the courses that faculty members designed as part of the JesuitNET program. In spring 2002 three online courses were offered: database systems and research ethics at Loyola and data warehousing at Fordham. Overall, students were satisfied with the courses. They found them to be comparable to traditional courses in a number of ways, yet much more convenient. The faculty was also generally pleased with the courses. Although the courses required a great deal of effort to develop and deliver, the benefits outweighed the costs in most cases.

The CET also evaluated the delivery of a Competency Assessment Distance Education online faculty workshop provided to four faculty members who were designing a course to be delivered in fall 2002. In general, the faculty's reactions to the workshop were positive. Faculty members were very pleased with the amount of support they received from the workshop staff and found the workshop templates to be useful in the development of their thinking. The only significant complaint was that the education terms were used too casually at the beginning of the workshop when they had not yet been well explained. The faculty felt that these terms/ideas should be introduced more gradually and that perhaps the terminology could be less formal.

These evaluation activities are part of an ongoing formative evaluation of A Model for Competency-Based Distance Assessment. This is a JesuitNET project funded by the Department of Education's Learning Anytime Anywhere Partnership (LAAP). The underlying goal of the project is to build a new model for distance education that will help institutions break free of classroom-based models of course credit and instead define credits in terms of student competencies. A first step in achieving this goal was to develop a technological infrastructure to support faculty members in developing competency-based online courses, that is, the LAAP online faculty development course. The CET™ is focusing its evaluation on this development course and the resulting distance education courses produced by the participating faculty members.

Virtual Design Center

An important goal of the CET research team is to guide the development of future products through consideration of theories of cognition, applications of theory to practice, and technology-rich learning environments. To this end, the CET research team has developed the Testing Educational Theory through Educational Practice (TETEP) framework to communicate the conditions in which effective learning takes place. The TETEP framework links the phases of scientific inquiry as described by the Third International Mathematics and Science Study framework with theoretical constructs that inform the design of instruction to support scientific inquiry.

The Virtual Design Center is funded by NASA cooperative agreement NCC5-451. The Virtual Design Center is a web-based resource that will provide detailed instructional design guidelines based upon the TETEP framework. The NASA community involved in or interested in designing online learning experiences will use the VDC. To achieve this goal, the VDC will provide a large, searchable collection of existing best practices linking research and education. The CET's existing collection of research articles will be supplemented with links to existing, searchable databases. The selected topics will be of particular importance to the nation's educational agenda and will be presented with in-depth content to assist in the design of meaningful, effective electronic resources. The VDC will also serve as a showcase for NASA products as examples of best practices and effective designs. It is also intended that the VDC will be used in the future as a professional development tool.

The four phases of scientific inquiry serving as the organizing foundations for the VDC are identifying questions to investigate, designing investigations, conducting investigations, and formulating and communicating conclusions. In 2002 entries were reviewed and revised for the conducting investigations phase. These entries address self-regulated learning, team research, the fostering of multiple abilities, and the offering of choices to students. Additional entries were developed for the following phases:

- Identifying questions to investigate: prior knowledge and motivation.
- Designing investigations: knowledge organization with collection of existing technology tools.
- Formulating and communicating conclusions: argumentation skills with collection of existing technology tools.

The CET research team also formed the Editorial Board during this period. It includes Dr. Barbara Grabowski, associate professor at Penn State University, and Dr. David Jonassen, distinguished professor at the University of Missouri. The Editorial Board reviewed and revised the framework and the completed entries of the Virtual Design Center. Further, the VDC concept was presented at the NASA Education conference.

Evaluation of CET's Products and Professional Development Activities

In 2002 staff evaluated the effectiveness of professional development activities conducted as part of the InSTEP™ project. Further, the research team studied teachers' use of Astronomy Village®: Investigating the Solar System™ and the usefulness of related classroom assessment techniques, called activity summaries, in the context of a summative evaluation. See the Product Development section for findings. The team presented three papers at the annual American Educational Research Association meeting as a result of this work.

List of Publications/Paper Presentations

In 2002 CET™ staff and collaborators conducted four paper presentations at national forums, published a journal article and a book chapter, and released two technical reports.

Lindeman, C. (2002). Integrative teaching and learning. *NCSSMST*, 8(1), 14-15. Lynchburg, VA: National Consortium for Specialized Secondary Schools of Mathematics, Science, & Technology.

McGee, S., Dimitrov, D. M., Kirby, J., & Croft, S. K. (2002, April). Using design experiments to investigate long-term program success. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

McGee, S., Kirby, J., & Croft, S. K. (2002, April). Activity summaries as a classroom tool. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

McGee, S., & Kirby, J. (2002). Results of the ExoQuest beta test. In-house report. Wheeling, WV: Center for Educational Technologies®.

McGee, S., & Kirby, J. (2002). Results of the CVEEC year-end report. In-house report. Wheeling, WV: Center for Educational Technologies.

Myers, R. J., Davis, H. B., & Botti, J. (2002). Modeling cooperative learning in online staff development. Paper presented at the National Educational Computing Conference, San Antonio, TX.

Ruberg, L. F., & Baro, J. A. (in press). Designing graphical, interactive simulations to model scientific problem solving. In S. Naidu (Ed.), *E-learning: Technology and the development of teaching and learning*. London: Kogan Page.

Schmidt, R., McGee, S., Scott, L. A., Kirby, J., Norris, K., & Blaney, L. S. (2002, April). Promoting constructivist uses of technology through professional development. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

■ EDUCATIONAL OUTREACH

To leverage educational outreach, the CET™ houses a NASA regional Educator Resource Center (ERC), which serves as a distribution outlet for NASA's curriculum products. In 2002 the ERC distributed 1,946 products. Further, the CET continues to search for ways to bridge the science and education communities to build synergy and support regional collaboration in formal and informal projects of mutual interest.

Mid-Atlantic Region Space Science Broker

In 2002 the CET received funding through a five-year cooperative agreement to serve as one of seven broker/facilitator programs from the NASA Office of Space Science. The CET leads the Mid-Atlantic Region Space Science Broker, which serves the following nine states plus the District of Columbia: West Virginia, Pennsylvania, New York, Delaware, New Jersey, Maryland, Virginia, Kentucky, and Ohio. MARSSB functions as a regional point of contact by using its web site, mailings, and personal communications to reach scientists and educators seeking information or involvement in the OSS education/public outreach program.

In 2002 project staff developed a database of scientists, educators, informal science centers, NASA affiliates, and commercial partners within the MARSSB region. The team also established a web site at www.cet.edu/ossbroker, which was accessed by 1,297 unique users and received 6,997 hits since its release in June 2002. The MARSSB team also coordinated a meeting that included two scientists and other parties from rural colleges to discuss potential collaboration. In addition, the team also assisted the Belmont Career Center Vocational High School, Belmont County, OH, in arranging a tour of Iron Bay, a local model-building manufacturer. Forty students and four teachers attended the tour and participated in problem-based learning activities afterward.

Project information was disseminated at the annual Science Education, Communication, and Math Experience Teacher Institute as part of a NASA showcase held at Howard University in Washington, DC. Further, important individuals at minority universities were identified at the OSS Minority University Initiatives meeting, held in Washington, DC, for future collaborations and consultations on outreach activities. Other dissemination efforts included sending project information to 1,300 scientists, educators, informal science centers, and NASA partners in the broker region and reviewing education/public outreach proposals submitted by scientists and education outreach specialists.

WV Space Grant Consortium/NASA EPSCoR

The CET represented Wheeling Jesuit University as part of the West Virginia Space Grant Consortium (WVSGC) and the West Virginia NASA EPSCoR boards. WVSGC activities included the funding of student interns at the CET, faculty minigrants, and faculty research enhancement awards. WVSGC and EPSCoR also provided opportunities for faculty and K-12 educators to apply for more competitive statewide grant funds.

Additional Outreach Activities

The CET partnered with Ohio County (WV) and Southeast Ohio curriculum supervisors to offer science, math, engineering, and technology enrichment activities for middle and high schools. Through CET efforts four Wheeling-area middle schools participated for the first time in the National Engineering Week Future City Competition, a NASA-supported program. This outreach activity received partial funding support from Hopeful City, a citizen-based community improvement coalition in Wheeling. On the secondary level the CET and the Southeast Ohio Tech Prep program collaborated to facilitate work among three high schools to offer space station design challenges to their pre-engineering and manufacturing programs. Both of these enrichment programs were designed to encourage students to apply mathematical and science concepts to real-world problems. These projects also involved students working with practicing engineers and technical experts who agreed to serve as mentors.

■ THE YEAR IN REVIEW

Overall, the nature of core activities conducted by the Erma Ora Byrd Center for Educational Technologies® staff in 2002 was aligned with the mission of the center: to enhance lifelong learning and teaching through the effective use of technology. Based on the scope of the work accomplished under the CET™'s four core activities, the year was a productive one.

To date the CET has published seven curriculum supplements to support NASA initiatives. Further, in 2002 the CET had five additional products under development. Curriculum supplements have been well received by teachers and other interested audiences as demonstrated by awards, available research in some cases, and anecdotal information. Additional evidence of impact in the field is the increasing web access to curriculum products. The increase in access during this year was dramatic (see Figure 1, p. 3).

During this reporting period the CET also provided general leadership training in educational technology through a program of workshops targeting product-specific and content-specific training in house, on the road, and online. The number of teachers participating in organized professional development increased compared to the year before (see Figure 2, p. 10). Based on demographic data, it is important to note that although a majority of participants are experienced and hold a master's degree, they are still interested in improving their teaching if high-quality professional development is available. To this end, quality ratings of CET's professional development activities were consistently high during this period.

The nature of research and evaluation activities was also aligned with the mission of the center and continued to focus on understanding the conditions under which learning takes place by considering theories of cognition, applications of theory to practice, and technology-rich learning environments. This year in addition to supporting the evaluation of CET products and professional development activities, the research and evaluation team was involved in three research/evaluation projects. Dissemination of project findings was successfully conducted through paper presentations at regional and national forums.


Finally, the educational outreach activities received a boost this year with funding from the NASA Office of Space Science to establish a broker/facilitator program. The Mid-Atlantic Region Space Science Broker team established itself as a regional point of contact using its web site, mailings, and personal communications. MARSSB facilitated collaborations between scientists and educators in Washington, DC, West Virginia, Pennsylvania, New York, and Maryland to make OSS research and discoveries available to students, teachers, and the general public.

Collectively, the work accomplished this year under CET's four core activities demonstrated its continued commitment to develop high-quality curriculum supplements, provide related professional development, study the theoretical foundations of products and professional development activities, document the impact of center work, and provide outreach support. Concurrently, the work accomplished this year reinforced NASA's Classroom of the Future™ program. The nature and scope of activities also reflect center efforts to serve different audiences, which include schools, school districts, state departments of education, federal agencies, foundations, businesses, and industry. The activities reflect the CET's efforts to assist these organizations in planning, developing, and implementing advanced educational technologies in support of science learning.



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