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Brief Overview of the NASA/NOVA Faculty Professional Development Program: 1995-2006

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Abstract

NASA Opportunities for Visionary Academics (NASA/NOVA) was a university STEM faculty professional development program initiated by NASA in 1995. The multifaceted NASA/NOVA program was designed to foster reform in higher education through development and modification of entry-level, undergraduate STEM discipline courses. NOVAs goal was to facilitate course change to enhance STEM literacy of pre-service teachers. Faculty at a total of 103 US colleges and universities were deeply involved in the program over an 12 year period

Overview of the NASA/NOVA Faculty Professional Development Program: 1995-2006

NASA Opportunities for Visionary Academics (NOVA) was created with NASA Headquarters funding to develop and disseminate a national framework for enhancing science, mathematics, engineering and technology literacy for teachers in the 21st century. This framework uses interactive learning and integrates science, mathematics, engineering and technology as a means of developing a new paradigm for educating future teachers.

The NOVA consortium, consisting of the University of Alabama, University of Texas at Tyler, Miami University of Ohio, Fayetteville State University, and Cal Poly Pomona University is working to produce enhanced scientific literacy for new teachers. NOVA invites the participation of science, engineering, technology, mathematics, and education faculty who are concerned with how universities prepare new teachers. Using the NASA mission, facilities, and resources, NOVA provides these faculty members with enhanced knowledge and skills to implement change in university mathematics, science, engineering, and technology courses.

Each year of the project, the NOVA team conducted a series of three-day workshops for interdisciplinary teams of college or university faculty. Each team consists of 2-3 members where one member must be from the college of education and the other members are from science, mathematics or engineering. Approximately ten teams attend each NOVA workshop.

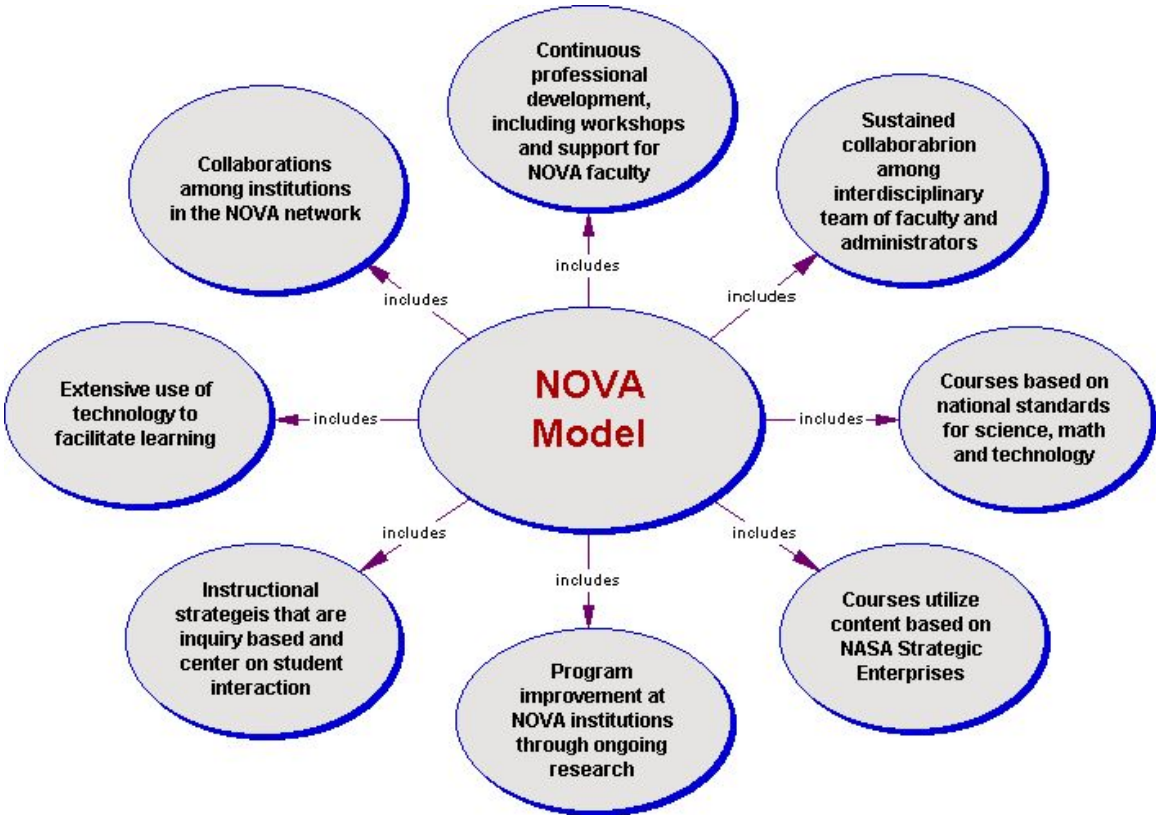
Each workshop focuses on the implementation of national science and mathematics standards and benchmarks, the use of innovative pedagogy and authentic assessment, the impact of educational technology, and utilization of research on development activities from NASA's strategic enterprises, as well as an emphasis on collaboration and diversity. Upon successful completion of a workshop, a participating team is eligible to submit a proposal for an Implementation Planning Grant up to 34_k, with at least a 1-to-1 cost-share match.

The NOVA website, located at http://education.nasa.gov/nova, features a description of some of the course materials that have been developed to date. Additional information and workshop applications can also be obtained by accessing the NOVA website.

NOVA Program Features

- Dissemination of a national pre-service model that is based on national standards and benchmarks for mathematics, science and technology,
- Utilization of the research and development activities from NASA's strategic enterprises (Earth Science, Aero-Space Technology, Human Exploration and Development of Space, and Space Science),

• Collaboration between faculties in education and science, mathematics or engineering to develop innovative approaches to teacher preparation for enhanced student learning.



Background

The NOVA consortium originally consisting of the University of Alabama, Fayetteville State University, and Eastern Michigan University was created to develop and disseminate a national framework for enhancing science, mathematics and technology literacy for preservice teachers in the 21st century. Over the duration of the project the consortium lead universities changed to include the University of Idaho, University of Texas at Tyler, Miami University of Ohio, and Cal Poly Pomona University.

This effort was accomplished through the demonstration of an undergraduate science and mathematics course framework, examples of successful course models, and a mentoring support system for faculty wishing to implement new courses or modify existing courses at their universities. The framework used interactive learning and integrated science, mathematics and technology as a means of developing a new paradigm for educating future teachers.

NOVA invited the participation of science, mathematics, engineering, technology, and education faculty who are concerned with how universities prepare new teachers. Using

the NASA mission, facilities, and resources, NOVA provides faculty with enhanced knowledge and skills to implement change in university courses.

The number of affiliated NOVA institutions has grown from three in 1996 to 105 in 2006. The NOVA program benefits from the enthusiastic support of hundreds of dedicated university and college faculty from among the 88 institutions. The grassroots design has fostered the formation of diverse partnerships and networks that provide for collaboration on a wide range of research and educational endeavors.

NOVA Objectives:

- disseminate a national preservice model that is based on national standards and benchmarks for mathematics, science, and technology and involves the research and development areas of NASA (Earth Science, Aerospace Technology, Human Exploration and Development of Space, and Space Science).
- encourage collaboration between the education and science, mathematics, or engineering faculties to develop innovative approaches to teacher preparation for student learning.
- through the NOVA web site, link all sites together and provide a means for faculty and students to exchange and have access to the model, materials, activities, and updated information.
- utilize interactive technologies in learning.
- make use of instructional strategies that are not common in traditional content courses.
- be compatible with new teacher certification.

How does NOVA accomplish these objectives?

The NOVA team conducts a series of three-day workshops for interdisciplinary university teams. These universities were then eligible to submit proposals for small Implementation Planning Grants to initiate change in science or mathematics courses for preparing K-12 teachers.

Workshops:

The workshops are based on successful university faculty development models that emphasize enhancing faculty in the areas of instruction, content, educational technology, and using the Internet and other technologies in teaching; developing an action plan for implementing the framework; and providing examples of interdisciplinary collaboration, partnerships and resources.

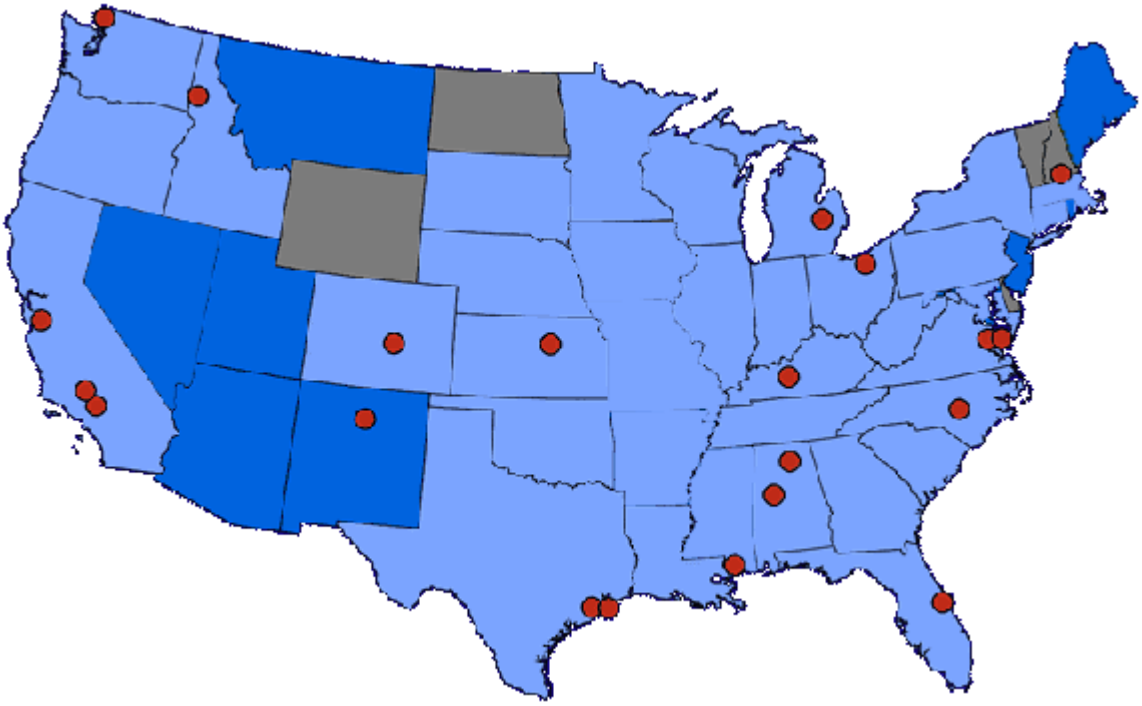
The workshops were conducted by the NOVA team at NASA centers and selected universities. Each 3-day workshop involves approximately 10 universities and colleges. The delivery approach for each workshop replicates the methods of instruction and the interdisciplinary nature of the example courses. The NOVA workshop team itself is interdisciplinary and exemplifies instructional techniques that are desirable in university

teams developing interdisciplinary science, mathematics, or engineering courses for teachers.

Faculty wishing to participate in a workshop must complete an application and be selected. The workshop applicants must describe their commitment to developing interdisciplinary science courses for teachers. Each interdisciplinary team consists of 2-3 members where faculty demonstrate a willingness and ability to work together. Examples are team members from science (e.g., physics), mathematics, or engineering collaborating with faculty from the college of education. A memorandum of understanding signed by the appropriate administrators of each college or division participating in the project must be submitted to demonstrate a university-wide commitment.

Beginning in 1999, NOVA reduced the number of regular workshops to three and then in 2000 to two per year, but added two MU-SPIN workshops to the calendar. The MU-SPIN workshops were held at Hampton University, VA, in March 2000 and Prairie View A & M University, TX, in April 2000. In 2003, there was a hiatus in NOVA funding so no new workshops were held until funding resumed in 2004.

NOVA Workshop Locations 1996-2006



Networking, Dissemination, and Research Grants (Phase II):

A second funding opportunity for NOVA institutions, Phase II Grants, were competitively available for NOVA Network teams to propose further development and dissemination of their NOVA projects. Funded institutions developed methods and techniques for replicating the NOVA change model among additional institutions not directly reached by the NOVA workshops. Emphasis was placed on fostering partnerships with community colleges and other educational communities.

The research aspect of the Phase II Grants was designed to assess the impact of the NOVA model. Successful research projects had metrics to include student retention, student achievement and attitudes, innovation sustainability, the extent to which support and collaboration have been maintained, and the overall impact the project has had on students, faculty and administrators.

Projects must have also produced publishable reports, CD-ROMs, videos, or web sites for dissemination. Universities funded through the Phase II Grants were Brescia University, California State Polytechnic University-Pomona, California State Polytechnic University-Northridge, Columbus State University, Florida International University, Fort Hays State University, George Fox University, Indiana University, Louisiana Tech University, Michigan State University, Susquehanna University, the University of Arkansas, the University of the Virgin Islands, and Western Kentucky University.

Connecting to NASA's Strategic Plan and Field Centers (Phase III):

NOVA further connected local Network activities with NASA's strategic plan and the field centers via a new funding program. The overall goal of this program was to create and maintain a NOVA presence at all NASA centers and to infuse cutting edge NASA data into innovative higher education courses. To ensure the widest possible participation by NOVA Network institutions in this program, participants created interactive web sites for NOVA courses. The five universities selected to participate in the first pilot held at Goddard Space Flight Center in May 1999 were Austin Peay State University, California State Polytechnic University-Pomona, Hampton University, University of Dayton, and University of the Incarnate Word. Participants in the second pilot workshop at Marshall Space Flight Center in June 2000 were: Alaska Pacific University, Louisiana Tech University, Texarkana College and Texas A & M University- Texarkana, Western Kentucky University and Wheeling Jesuit University. The 2001 Phase III workshops were held at the Jet Propulsion Laboratory and at Johnson Space Center. Participants in the 2001 Phase III workshops included: Baker University, Columbus State University, George Fox University, Lewis and Clark State College, and Morehead State University. The 2002 Phase III workshops were held at Langley Research Center and AMES Research Center. Participants included: Hampton University, Elizabeth City State University, Bennett College, University of Idaho, Gonzaga University, San Francisco State University, UT Chattanooga, Whitworth College, Allen University, and Mercer University. The 2005 Phase III Workshops were held at Goddard Space Flight Center and Jet Propulsion Lab and included Northern Michigan University, Southern Connecticut State University, University of Texas at Tyler, Miami University (Ohio),

Wheelock College, Tuskegee University, Alabama State University, Jackson State University, and University of New Mexico-Gallup.

Mentoring:

All workshop participants were mentored during and after the workshop. In particular, faculty teams received mentoring about implementation planning grant proposal preparation, proposal revision(s), implementation, and institutional barriers. For those institutions that become part of the NOVA Network, additional mentoring takes place through site visits by the NOVA management team.

Publications and Conference Presentations:

Information and progress regarding a framework for effective teaching is made available by NOVA in key educational and scientific journals and disseminated through papers delivered at educational and scientific conferences. All faculty and research groups concerned with teacher education or scientific and technological literacy are targeted. Cooperative activities will take place involving major national education organizations.

Leadership Development Conference:

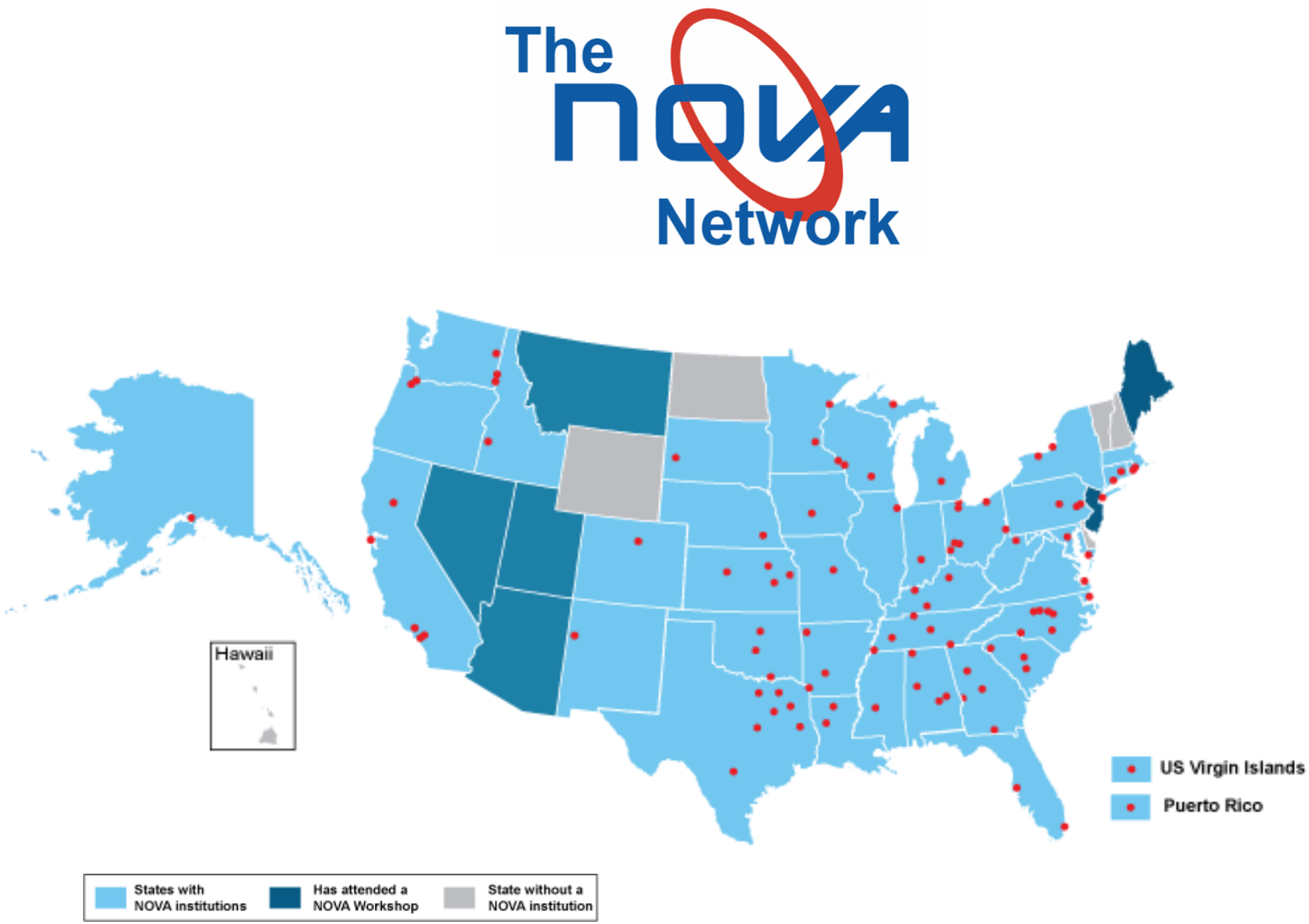
An important element of NOVA is the annual Leadership Development Conference (LDC) to which all the NOVA Network institutions are brought together to present their projects and research results. Both the 1997 and 1998 LDCs were conducted at the University of Maryland Inn and Conference Center. The 1999 LDC was January 11-14, 2000, in Orlando, FL. The 2000 LDC was held in Washington, DC, on January 9-11, 2001. The 2001 LDC was held at Goddard Space Flight Center, in Greenbelt, MD, on March 17-19, 2002. The 2002 LDC was held at Johnson Space Center, in Houston, TX, on February 23-25, 2003. After funding resumed the final LDC was held at the Towson University Conference Center in February of 2005.

Electronic Dissemination:

A web site (http://education.nasa.gov/nova) has been developed to ensure broad dissemination of demonstrated examples beyond the workshops and to provide a means for all universities to learn about the work of NOVA. The website provides an efficient means for accessing information and data that facilitates the implementation of strategies and materials of the project. Included in the website are a variety of datasets, graphics, text, and images to support the mission of NOVA. For the future, the website has been revised to create an archive and a meeting place for continued collaboration within the established NOVA Network. This site can be accessed at http://www.novaprogram.org.

The NOVA Network

The NOVA Consortium membership has grown from three members in 1996 to 105 members in 2006. Members include some of the most prestigious colleges and universities in the nation, including private and community colleges. Membership comes with a price. Members contribute time, funds, and facilities. In return, members gain advantages depending on their needs and interests. Academic members gain access to fellowship and scholarship funds for their students; new curricular development, especially interdisciplinary curricula; interactions with faculty from diverse institutions and departments; NASA field centers and industry laboratory facilities.


The NOVA Network
Hawaii
US Virgin Islands
Puerto Rico
States with NOVA institutions
Has attended a NOVA Workshop
State without a NOVA institution

Instructional Technology: NOVA Web-based Course Enhancements

NOVA technology focuses on the use of web technology and the use of NASA web products in education. The NOVA technology initiative encourages the introduction of technologies into college courses and seeks to greater affect change in the manner that content courses are taught to pre-service teachers. Meaningful integration of technology is an integral part of NOVA and of web-based learning. The electronic design of an environment for learning is quite different from a design for giving out information. Incorporating technology in a "meaningful way" into all courses reflects the manner in which technology enhances the four areas and integrates them with each other. Technology offers a number of ways to do this. The use of electronic asynchronous interactions in the form of "whole class idea containers", where the student's view is presented to the class, small "study group" discussion spaces, private journal spaces, (and even "live chat" sessions), allow students the opportunity to examine their ideas, comments and reflections, in varying degrees of "safe" environments. The structure and delivery of content knowledge is what most university faculty members accomplish very well. However the effective integration for all students of this with the other three areas is not common in many courses. The use of technology so as to provide integration of content knowledge with reflective assignments, while at the same time maintaining a reasonable faculty time involvement, offers a significant enhancement to the learning structure. Sample NOVA Internet course modules can be found at the NOVA website in the resource library.

Evaluation of NOVA

The NOVA evaluation instrument was designed to measure and evaluate workshop effectiveness. This evaluation tool includes statements and/or questions that relate to participants' exposure, learning, content, awareness, skills development, and application. This tool is incorporated into the NASA EDCATS evaluation system.
Evaluations administered at the completion of each 3 day workshop from 1996 to 2001 are outlined in the summary report via graphs and tables. The findings identify patterns and possible trends to build upon in the future. Analyses in this report are limited to descriptive measures. Higher order analyses are possible for future consideration.
The evaluation instruments are comprised of two components:

> 1) background questions that record respondents' race, gender, occupation, tenure status, years in current position, and average number of preservice courses taught per year; and
> 2) a 37 item evaluation including measures of participant involvement in the professional development training, quality of program topics/features, overall agenda, sample lesson preview, and presentation.

Evaluation of the NOVA Professional Development Model

In response to the needs identified in undergraduate science teaching, guidelines were developed a national professional development model for higher education faculty in

1995 (Peterman, 1993; Weimer & Lenze, 1994; Loucks-Horsley et al., 1998; Sunal et al, 2001; Sunal, 2004a, Zollman, 1997, 2004). The model's implemention was sponsored by the National Aeronautics and Space Administration's pre-college preparation program, NOVA (NASA Opportunities for Visionary Academics). Since 1995, NOVA has invited the participation of undergraduate faculty concerned with how universities prepare pre-service teachers. Through NOVA, entry-level reform science courses are developed by collaborative teams of faculty in the sciences and education. Currently, 101 institutions have implemented 167 reformed undergraduate science courses in a national network of institutions.

Participation in NOVA includes opportunities for, and commitment to, enhanced knowledge and skills through workshops, exemplary models, grants, mentoring, evaluation site visits, and collaboration within and between higher education institutions. The NOVA Faculty Professional Development Model for enhancing undergraduate science courses for preservice teachers is delivered in 3 *phases*: (1) *planning and preparation,* involving training, collaboration, and action planning for addressing baseline needs in faculty skills and knowledge enhancement; (2) *development and implementation*, involving initial course change, action research, mentoring, and sharing of expertise; and (3) *continuing development and long-term sustaining activity*, involving action research, networking, monitoring including site visits, and dissemination (Sunal et al., 2004). The NOVA Professional Development Model includes:

1. a team approach with faculty and administrators in a systemic initiative (collaboration) *Phases 1, 2, 3*
2. Intensive professional development addressing
    a. higher education concerns reflected in the national science standards (learning environment, course structure, pedagogical content knowledge [PCK]) (Siebert & McIntosh, 2001; NRC, 1996; AAAS, 1993)
    b. best practices and exemplary demonstration models from research in science curriculum, pedagogy, assessment, collaborative learning, and working with student diversity in higher education, (learning environment, PCK) (Backer, 2002; Christopher & Atwood, 2004; Francis, Adams & Noonan, 1998; Krinsky, Anderson & Kidane, 1998; Project Kaleidoscope, 2005; Scharmann, Stalheim-Smith & James, 2004; Slater & Sireci et al, 2003; Sunal, 2004b; Swanson & Bilderback, 1998; Wycoff, 2000)
    c. action research planning and methodology (PCK, collaboration) (Raubenheimer, 2004)
    d. best practices in research and methods in the use of technology to facilitate science learning (learning environment, PCK) (Odell et. al. 2004)
    e. course change through grant writing skills (collaboration) *Phase 1*
3. development of a proposal for course change that is reviewed with feedback provided (collaboration) *Phase 1*
4. development of standards-based reform undergraduate science courses in a range of institutions from Bachelor's degree granting through research universities (learning environment, course structure, PCK, collaboration) (Goldston, Clement, & Spears, 2004; Gardner, 2004) *Phases 1, 2*

5. financial support to implement reform science courses on a long term basis (collaboration) *Phases 1, 2, 3*
6. continuous mentoring and monitoring of progress including evaluation site visits during development and implementation (collaboration) *Phases 1, 2, 3*
7. action research conducted by faculty teams that examines student and faculty development (PCK, collaboration) *Phases 2, 3*
8. continuous long-term professional development activities based on best practices research over multiple years (PCK, collaboration) Phase *1, 2, 3*
9. collaboration and sharing of expertise and practices between faculty within an institution and among different institutions (PCK, collaboration). (Sunal, 2002). *Phase 3*

Comparisons of courses in several evaluation research studies found significantly positive results for the use of this Model that indicated it met the specific conditions identified above for successful course reform (Bland-Day, 1999; Staples, 2002*;* Sunal et al., 2003b, 2003c). In addition, these studies found increased undergraduate student achievement, long-term change in efficacy in science teaching, positive attitudes toward science, more effective use of research based science teaching practice among the pre-service elementary teachers after they graduate (Gabel, 2004; McCormick, & MacKinnon, 2004; Jordan, Elmore & Sundberg, 2004; Sunal et al., 2001; Sunal et al., 2003; Waggoner et al., 2004). These evaluation research studies found long-term impacts *increased* as students gained additional experiences in coursework and in classroom teaching rather than declining over time.

The following NOVA *reform course characteristics* have been identified in the evaluation studies:

- emphasis on facilitating all students' learning of science
- use of pedagogy engaging students' prior knowledge
- use of structured inquiry pedagogy with active and extended student participation as a regular part of the instruction
- refocusing of the role of the instructor who works to become a reflective practitioner using action research
- use of integrated multiple learning formats not only separated lecture and lab
- refocusing of science content on a few key ideas covered in depth
- use of interdisciplinary approaches in course content
- use of student group reflection and learning activities focused on interactive and collaborative learning through shared responsibility
- emphasis on evidence-based learning, using relevant and real data reflecting the way science is done
- use of diverse technology in most course activities to facilitate learning
- focusing on performance assessment forming the greater part of course assessment (DeBoer, 2004; Herppert & French, 2004; Mason & Gilbert, 2004) .

Additional Research and Evaluation

There was also a formal evaluation conducted in 2003 that examined other factors beyond those required by EdCATS/NEIS. This included and examination of collaboration between education and science/engineering/mathematics faculty, use of interactive www technologies, innovative strategies for teacher preparation courses that enhance learning, and courses based on NASA Strategic Missions. In the appendix you will find a complete copy of that report. In 2006, the National Science Foundation funded the University of Alabama to continue the research. The NSF funded research will examine 30 institutions' NOVA courses and their impact on K-6 teacher candidates. This research will be available to NASA as it is completed.

Investment and Leveraging

The number of affiliated NOVA institutions has grown from three in 1996 to 105 in 2006. The NOVA program benefits from the enthusiastic support of hundreds of dedicated university and college faculty from the consortium. The NOVA model has fostered the formation of diverse partnerships and networks that provide for collaboration on a wide range of research and educational endeavors. NASA funds have remained stable, but the consortium has leveraged matching funds, including in-kind contributions, to more than double the NOVA Grant awards. This information is presented in the financial report that will be forthcoming from the University of Alabama.

NOVA Dissemination -1996-2006 Workshops

University of Alabama
Eastern Michigan University
Fayetteville State University
NASA JPL/California State Polytechnical Institute - Pomona
New Mexico Highlands University
NASA Lewis Research Center/Ohio Aerospace Institute
University of Idaho
NASA Kennedy Space Flight Center, FL
NASA Johnson Space Flight Center/University of Houston, TX
University of New Hampshire
Kansas State University
NASA Ames Research Center, CA
Western Kentucky University
Bellingham, Washington
Marshall Space Flight Center, AL
Hampton University, VA
Prairie View A & M University, TX
Colorado Springs, CO
NASA Goddard Space Flight Center, MD
NASA Dryden Research Center, CA
NASA Stennis Space Flight Center, MS

NASA Marshall Space Flight Center, AL

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