

# **Using a Pre-Service Teacher Institute to Improve the Science and Mathematics Skills of Future Teachers**

**Drs. Renee Akbar, John Fulwiler, Rosalind Pijaux Hale, William Jordan, and Ramona Travis**

**Xavier University of Louisiana/Louisiana Tech University/Stennis Space Center**

## **Introduction**

Mathematics and scientific literacy are key requisites for producing students who are problem-solvers and creative thinkers. For the past decade, the American educational landscape has been characterized by sweeping reforms to produce such students. The reform movement has two objectives – set high standards for students and develop curricula to achieve those standards. These objectives have shifted the emphasis of mathematics and science content learning from memorization of facts and formulas to thinking about and understanding concepts and principles. This has become known as standards-based learning.

Consequently, standards-based learning has impacted *how* content is delivered, changing the roles of teachers and students alike. Teachers become the “guide on the side”, facilitating students’ investigations, research and discussions of possible solutions. Standards-based pedagogy, based on the theory of constructivism, helps students to construct knowledge by involving students in the learning process and not just providing them with information that is disconnected from their everyday lives. It’s the doing of mathematics and science that has become so important in helping students process the content to make learning meaningful and applicable to everyday life.

Despite providing children with more rigorous curricula, holding teachers to higher standards, and making schools accountable for achievement, the pace of improvement has been slow, especially for minority students. The impetus of the reform movement centered on decreasing, if not eliminating, the results of the disparities in curriculum, instruction, and expectations found in schools and classrooms that especially serve minority students (Oakes and Wells, 1998)<sup>1</sup>. Teacher quality in particular, has been found to be the biggest discrepancy. High poverty/high minority schools employ a disproportionate number of teachers who teach classes that are not in their field of certification or in which they did not minor (Ingersol, 1996)<sup>2</sup>

According to Linda Darling-Hammond:

“Quantitative analyses indicate that measures of teacher preparation and certification are by far the strongest correlates of student achievement in

reading and mathematics, both before and after controlling for student poverty and language status”.<sup>3</sup>

These findings have generated a number of initiatives designed to improve teacher quality at the preparation level. The purpose of this paper is to describe the use of a Pre-Service Teacher Institute to improve the science and mathematics skills of future teachers. Both content knowledge and pedagogy served as the conceptual framework of the Institute. Not only did participants gain a better understanding of various mathematics, science and technology concepts, but they also learned how to effectively teach those concepts to elementary and middle school students. The remainder of this paper will discuss the history and purpose of NASA’s Pre-Service Institute, provide a detailed description of the curriculum, and examine the results of the experience.

#### NASA’s Pre-Service Teacher Institute

NASA recognized a need to increase the number of well-qualified teachers and engage more K-12 pre-service teachers in the improvement of mathematics and science teaching. The Pre-Service Teacher Institute (PSTI) was initiated through NASA Langley Research Center (LaRC) several years ago in collaboration with Norfolk State University (Virginia). The basic purpose of the program is to provide minority education majors from minority institutions (and sometimes minority students from non-minority institutions) with a two-week intense experience designed to increase content knowledge and improve pedagogical skills to teach science, mathematics and technology through problem based learning (PBL) while focusing on the NASA mission.

After a number of years of success with the program, LaRC and NASA suggested expanding PSTI to other NASA centers. Marshall Space Flight Center (MSFC) and Stennis Space Center (SSC) were added in FY2002. Presently, PSTI also involves the Johnson Space Center (JSC), the Kennedy Space Center (KSC), and Ames Research Center (ARC). In collaboration with NASA, a minority institution in close proximity to a NASA space center implements PSTI. These institutions include Bethune-Cookman College, Fresno State College, Oakwood College, Sitting Bull College, Sinte Gleska University, and Xavier University of Louisiana,

Xavier University of Louisiana was selected to work with Stennis Space Center of Mississippi. During Summer 2004, they collaboratively sponsored their third Pre-Service Teacher Institute. With extra funding from headquarters, two institutes were offered: one in May and the other in July. Led by faculty experts in their respective fields (mathematics, science, technology and pedagogy), forty-three pre-service teachers from around the nation were engaged in an intensive, two-week summer course that increased their mathematics and science content knowledge, taught them new pedagogical skills involving problem-based learning, and developed their competency to integrate technology into the mathematics and science curricula.

NASA personnel and university faculty offered courses that included lesson planning, classroom application of problem-based learning, application of mathematics and science content as related to real-world problems, and the effective use of technology as a teaching tool. In addition, pre-

service teachers toured Stennis' facilities, interacted with NASA scientists, and utilized the Space Center's Educational Resource Center in the development of the problem-based lessons.

### The Curriculum

Each PSTI offers a curriculum that is reflective of their Center's mission. Stennis Space Center is responsible for NASA's rocket propulsion testing and for applied sciences related to geospatial technologies, which served as the framework for the Institute's curriculum. The curriculum was designed to provide pre-service teachers with a deeper understanding of the teaching/learning process so that informed decisions can be made about the appropriate implementation of various instructional strategies. PSTI courses included problem-based learning, mathematics and science content, and technology tools such as \*Hyper Studio, \*Inspiration, \*Marco Polo and \*WebQuest. In addition to completing class assignments and participating in discussion boards, participants were also required to maintain an electronic portfolio on Xavier's Passport system.

The key feature of the Institute was the introduction of an alternative pedagogy called problem-based learning (PBL). Participants analyzed, discussed and evaluated the various components of PBL and its value as a pedagogic strategy. Faculty designed lessons and activities centered on the problem described below:

### The PROBLEM

Blast off!!! The spacecraft lifts off with a trail of smoke following it. Whoa! The rocket has accelerated so fast, you feel like someone is pushing you into the chair. Up. Up. Up. It goes, into the horizon, at speeds beyond our comprehension. After flying for a while, the spacecraft's nose tilts forward until the vehicle is horizontal, flying high above Earth's surface. The ninth planet from the sun looks like a ping-pong ball, but soon it will disappear. The spacecraft carries the Roadrunners to their destination, the International Space Station.

While on the Space Station, the Roadrunner team will carry out various experiments that will investigate the effects of global warming on agriculture. There, they learn that a \$14 billion satellite is falling towards the Earth's surface. The MAC Corporation, the owners of the satellite, wants to save as much of the satellite as possible.

Usually when a satellite falls to the Earth, NASA either directs it to crash into the ocean or the satellite burns up as it descends into earth's atmosphere. This one is different. The directional mechanism is broken and NASA is unable to control where the satellite will crash. It is way too big to disintegrate as it free falls to Earth.

The Team finds a way to rescue the satellite before it crashes to Earth. But, now they have another problem. As they begin their journey back to earth with extra weight, two tons to be exact, they learn that a ferocious hurricane is moving fast

towards where they plan to land. Your task is to prepare a plan that explains how you and other members of the team can solve the problems of:

- Transporting the satellite back to earth safely;
- Adjusting the propulsion system to carry the extra weight back to earth;
- Determining the safest place to land on earth with the extra payload.

Remember, you only have a few days to solve these problems, or Earth, as we know it, may no longer exist.

The courses provided participants various avenues to solutions by integrating hands-on learning with scientific principles. Students learned about the impact of space debris on space exploration, the correlation of weight, thrust and propulsion, the value of remote sensing as technology, and the principles of heat transfer as samples of topics explored.

As a part of the field experience, participants, in groups of four, developed a PBL lesson that integrated the theory and practice of mathematics, science and technology teaching. The problem above was given to each group to solve in their own way. The problem is the basis for the lessons that are built around activities learned at the Institute. Successful implementation addressed student motivation and engagement. Participants were given a budget of \$25.00 to buy supplies above the basic they were already given. Faculty only served as advisors to the groups, who developed lessons autonomously and at their discretion.

Space related aspects of mathematics, science and technology were integrated into all of the courses. Students studied algebraic and geometric principles, concepts and structures with an engineering emphasis. Multiple representations of student thinking with manipulatives included hands-on application of physical and environmental concepts, providing participants with close connections to resources and technologies related to remote sensing, rocket and propulsion, Physics and Earth Science. Students were encouraged to think “outside the book” and create new and innovative strategies to solve problems. The next section of this article will provide a more detailed description of the problem-based learning, mathematics and instructional technologies courses by the faculty members who taught them and the strategies used to teach the courses.

#### Problem-Based Learning Lesson Design

Making connections to real life situations is a key result of problem-based learning (PBL). Dr. Rosalind Pijoux Hale of Xavier University of Louisiana, and Quashee Collier, graduate assistant, taught this component of the PSTI initiative. PBL promotes problem solving by providing active and collaborative learning settings. Learners become subjects, not objects, in the process of learning and teaching. During the PBL sessions the participants were exposed to a variety of techniques to promote active and collaborative learning with real life situations that emphasized the importance of an understanding of mathematics, science and technology. These activities were designed so that the participants could model the techniques in their own

classrooms by developing lesson plans to increase participation and the level of understanding needed to solve real-life problems.

The initial step in learning about PBL was to provide PSTI participants the definition of PBL and the steps in the PBL process. The participants had to work collaboratively to solve problems. This was a challenging concept not only because PBL was new to them but also because the participants were randomly placed in groups the first day of the institute. Since they were from different campuses throughout the United States, they had to learn to work with each other as well as learn the concept of PBL. Team building activities were included each day to strengthen the collaborative learning aspect of the Institute.

The definition of PBL that was used was taken from Dr. Howard Barrows and Ann Kelson of Southern Illinois University School of Medicine ([www.mcli.dist.maricopa.edu/pbl/info.html](http://www.mcli.dist.maricopa.edu/pbl/info.html)).

“PBL is both a curriculum and a process. The curriculum consists of carefully selected and designed problems that demand from the learner acquisition of critical knowledge, problem solving proficiency, self-directed learning strategies, and team participation skills. The process replicates the commonly used systematic approach to resolving problems or meeting challenges that are encountered in life and career.”

Each group had to design a lesson from the problem that was provided. The problem included skills required in mathematics, science and technology. Once the problem was presented, a variety of resources were provided to assist the participants with the development of their lessons. One resource was a set of sample problem boards. These problem boards were described as used to generate information necessary to solve a specific problem. Sample problem boards included

#### Sample Problem Board I.

Know - Need to Know - Our Ideas

#### Sample Problem Board II

Ideas - Facts - Learning Issues - Action Plan

#### Sample Problem Board III

Ideas - What We Know - What We Need to Know - What We Will Do To Gather Information

The participants were provided a basic outline for the development of their lesson plans based on the PBL approach to teaching and learning. The lesson design included:

1. Identification of the Problem
2. Lesson Objectives/Outcome
3. References/Sources of Information
4. Prep the Learners
5. Set Up Structure

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6. Connect with the Problem
7. Visit the Problem
8. Make Assignments

Participants were provided a sample problem to practice using the PBL steps. This session allowed them to work together while learning the process. It also allowed them develop their own PBL techniques. Resources used to provide an understanding of PBL and sample PBL lessons were: *How to use Problem-Based Learning in the Classroom* by Robert Delisle<sup>4</sup> and *Problem-Based Learning for Math and Science: Integrating Inquiry and the Internet* by Diane Ronis<sup>5</sup>.

Since the PSTI problem included the need for knowledge in the areas of mathematics, science and technology, two additional resources in these areas were provided in the PBL sessions. One resource was the website, \*Marco Polo: Internet Content for Your Classroom ([www.mped.org](http://www.mped.org)). The participants used Illuminations (mathematics lessons) and Science NetLinks (science lessons) sections on this site. These lessons are aligned with the national standards and focus on the problem-based approach. The second resource provided was the GLOBE (Global Observation to Benefit the Environment) web site ([www.globe.gov](http://www.globe.gov)). Participants were introduced to the section on Atmosphere Investigation, specifically Cloud protocol activities. These lessons are geared to real-life situations and allow the participants to use the data collected for predicting future occurrences.

The culminating activity of PSTI is the group presentation of the lesson to fourth grade students. Even though each group was given the same problem to use to design the lesson, the other steps in the lesson design were unique. The groups were allowed time to decorate their classrooms prior to the presentation of the lesson. Each session was video taped, observed by outside participants and rated. All groups did extremely well.

The pretest and post-test information for the PBL session indicated a remarkable increase in candidate knowledge about PBL and about its potential for use in their classrooms in the future.

#### Mathematics

Dr. William Jordan from Louisiana Tech University (Ruston, LA) led the mathematics component of the course. He led four different math sections. He tried to give a NASA engineering emphasis to the four math sessions offered during this course. The topics were:

- Problem Solving
- Geometry
- Statistics and data interpretation
- Numbers

#### Problem Solving Session

Students worked in groups to solve these problems. Not all of them had numbers. This was related this to two of NASA's needs: the need to work in teams to solve complex problems and

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the need to look for untraditional solutions to problems. Some of these problems are from the excellent book by Sgroi.<sup>6</sup> Several example problems will be described.

### Sample problem 1

This is a measurement problem.

Using just a 5 gallon bucket and a 3 gallon bucket, how can you put four gallons of water in the five gallon bucket? Assume that you have an unlimited supply of water and that there are no measurement markings of any kind on the buckets.

### Sample Problem 2

This is a spatial problem.

Take twelve sticks and put them in the pattern shown in figure 1 below. Now rearrange four sticks so that you have six equal triangles.

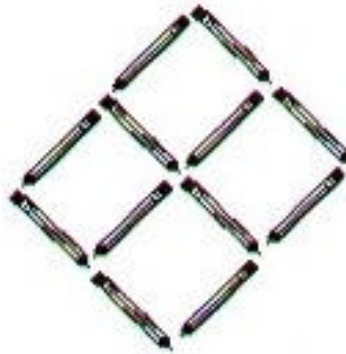


Figure 1 Arrangement of sticks for sample problem 2

### Geometry Session

Students were introduced to concepts of area and perimeter through the use of \*Geoboards. One example is shown below.

#### \*Geoboard Sample Problem

Assume you have fence material that is 10 units long. What is the largest area you can enclose? Use a rubber band on the \*Geoboard and construct several different rectangles with the same perimeter but different areas. Try to determine what would be the optimal shape.

Part of the solution to this is shown in Figure 2 below



Figure 2 Part of solution to \*Geoboard Sample Problem

### Height measurement

Students were shown two different ways in which the height of something could be calculated:

- Students would view the top of an object and measure the angle that has with the ground. They then measured the distance that object. They were introduced to the concept of the tangent of the angle. From this they could calculate the height of an object.
- Students were introduced to the concept of similar triangle. They measured the length of the shadow of an object of known height. They then measured the length of the shadow of the object of unknown height, and from that could calculate the height of the object.
- Students then were given three problems to solve in small groups
  - Measure the height of the flagpole at the class site.
  - Measure the height of the headquarters building at the Stennis Space Center
  - Measure the height of the hotel where the students were staying.

### Statistics and Data Interpretation Session

Engineering experimentation is important to the design of Space Vehicles. When engineers perform tests, they rarely get the same results every time. These issues were used to introduce the students to statistics and data interpretation.

Statistics were examined in two ways. The first aspect was to examine statistics of things you ought to be able to predict, such as flipping coins and throwing dice. The second aspect was to

examine statistics of things you could not predict, such as the results of a set of fatigue experiments.

### Predicting and Measuring Sample Problem 1

Each group flips one coin three times, and counts how many heads and tails they have obtained.

Repeat this experiment for a total of 16 sets of tests.

- How many of each combination was obtained:
  - Three heads
  - Two heads and one tails
  - One head and two tails
  - Three tails

This experiment was used to introduce several statistics concepts. Among them were mean and median. They were to plot the data to get a feel for the amount of scatter. Each group's results were slightly different. The students used Excel to create plots similar to Figure 3 below.

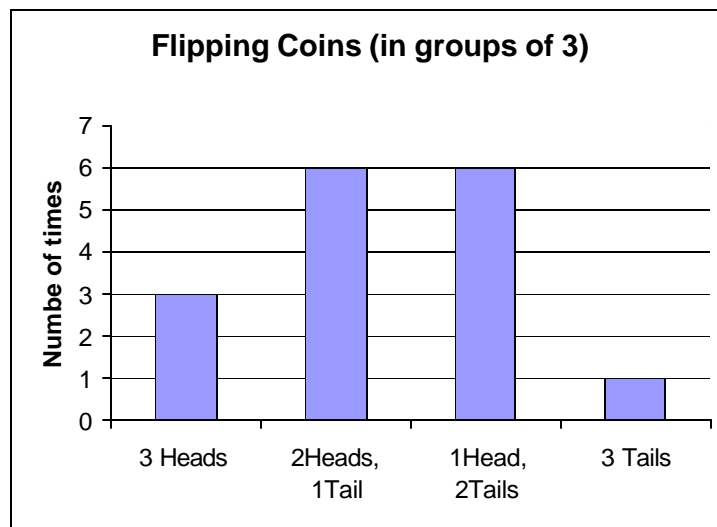


Figure 3 Typical plot of data for Predicting and Measuring Problem 1

The next step was to do an experiment where the results could not be predicted. Fatigue is an important issue for many aspects of space vehicle design. The axles on the wheels of the Space Shuttle orbiters are just one example. Engineers need to know the fatigue behavior of the materials they use in their designs. Unfortunately there is a lot of scatter in the results of fatigue tests.

Students did fatigue tests on paper clips to get an understanding of some of the data issues.

### Predicting and Measuring Sample Problem 2

Each student was given several paper clips. They were to repeatedly bend the clips until they broke. The students then shared all of their data so that they could plot the results. This data could be analyzed in a number of different ways.

Elementary level students could sort the list and rewrite it from the smallest number to the largest number. Note whether or not many of the numbers are very similar. Try to determine which number you think is the best number to use for fatigue life.

Middle school students could do a more complex analysis. Students should use a graph to represent the data. To create a useful plot, the student will first need to sort the data to determine how many samples failed at each number of cycles. Sometimes this data can be plotted directly in a bar chart as shown in Figure 4 below from another fatigue experiment. This shows that most of the paper clips failed in the range of 6 to 10 cycles.

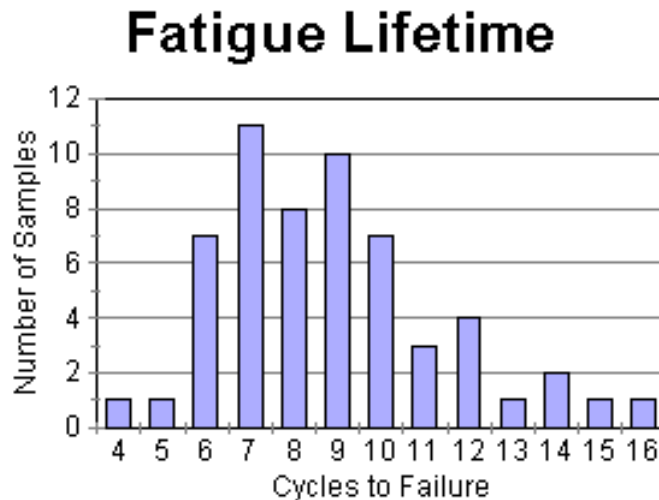


Figure 4 Typical fatigue data plot showing all measured cycles to failure

Sometimes there are too many data points to put on one bar chart. One way to deal with this is to group the data before it is plotted. This is shown in Figure 5 below which is based on the same data as shown above. In this example, the data was broken into five groups and the number of samples in each group was counted.

Group 1	from 2 - 4 cycles to failure	Group 4	from 11-13 cycles to failure
Group 2	from 5 - 7 cycles to failure	Group 5	from 14-16 cycles to failure

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Group 3 from 8 - 10 cycles to failure

If a student has twenty to thirty samples it would probably be useful to break the data into five groups.

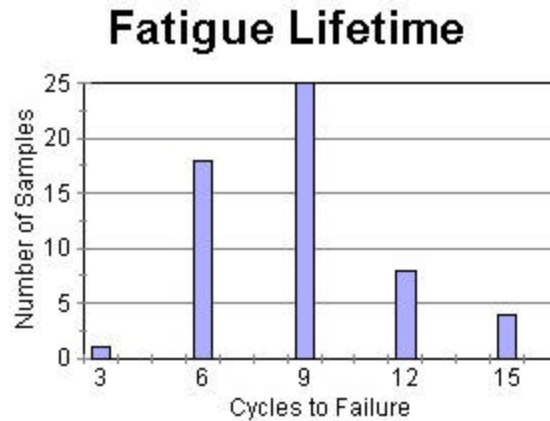


Figure 5 Typical fatigue data plot where the data has been grouped

### Numbers Session

Engineers and scientists use numbers in all of their experimentation and modeling. It is important for students to learn how to make basic calculations quickly and accurately. Students were introduced to various ways to teach arithmetic facts to their students. One approach is to make the learning a game.

### Example Game Provided to the Students

The following is a game that the students played during this session. This game is from the book by Sgroi<sup>1</sup>.

Using each of the numbers 1 through 9 only once, where should each one be placed so that each row and column adds up to 15?


This is a game that will help with addition ability as well as problem solving ability. There is a hard way to solve the problem (trying out many different patterns) and an easier way to solve it.

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Students then had to create a game that helped to teach arithmetic facts to their students. Below is one of the games that were created.

#### Example of Student Created Numbers Game

- Randomly arrange the number cards of a card deck in a large circle.
- Each student rolls the dice, and moves the marker that number of cards. When the card is reached, the student must multiply the number on the dice by the number on the card. If correct, the student removes the card
- Continue game until all cards are removed
- Student removing most cards is the winner

Student feedback from the mathematics component of the Pre-Service Teachers Institute was very positive.

#### Instructional Technology

A critical component of the PSTI initiative was instructional technology taught by Dr. John Fulwiler of Xavier University of LA (New Orleans, LA). During the 2004 program at the Stennis NASA Facility on the Gulf Coast of Mississippi, the participants were expected to infuse multiple technologies into all of the other components of their summer program. Therefore, the primary goal of this component was to enhance PSTI participants' understanding of the skill and practical aspects of the implementation of instructional technologies and classroom management strategies into classroom teaching. Participants were expected to demonstrate an understanding of technologically-related requirements as well as be able to perform specific tasks that demonstrate skill and knowledge of various K-12 software. Additionally, it was expected that participants would demonstrate an expanded facility of the utilization of the Internet/WWW resources that would enhance their instruction in the classroom. The focus on the instructional needs of K-12 classroom teachers and the students they teach as well as other education professionals was purposeful because PSTI participants are expected to become model professionals in the teaching profession. Strategies and techniques of classroom management, when using technology in the educational setting, were also integrated into the IT module.

The planners of the entire experience for the PSTI program viewed the technology module as one that would enhance the participants' functioning in all of the other modules. Since participants were coming to the program from different institutions with varying levels of technological knowledge and skills, a pre-test was administered on the first day and it was discovered that the range of skill and knowledge was dramatic. A couple of participants had little or no exposure to computers prior to the PSTI summer program. By comparison, about one third of the others had taken a comprehensive instructional technology course as a part of their teacher education program requirements. The remaining participants had varying degrees of knowledge and skills either learned from courses taught by their institutions or technology embedded in teacher education courses.

Regardless of their background, skill, and competence in instructional technology, the participants did demonstrate a major interest in utilizing the sophisticated and comprehensive computer lab provided by NASA. Participants also had laptops provided that could be utilized beyond the lab for other PSTI components. Additionally, the PSTI staff as well as NASA-based instructors provided various free copies of teacher education-related software addressing content in math, science, space/remote sensing, and geography. The content-related software, along with copies of \*Inspiration (<http://www.inspiration.com>), provided expanded resources that followed each participant home to their respective institutions. This facilitated the examination of the growth and development of instructional technology, particularly the utilization of specific education-focused software programs that assist the teaching/learning process in educational settings particularly PK-12 schools.

The central focus of the technology component was to provide hands-on learning opportunities for participants. Additionally, they were to develop expertise in the basic factors that need to be considered when selecting and utilizing software and websites to enhance/expand learning opportunities of children with particular emphasis on those children from culturally and racially diverse communities.

In order to accomplish this, the participants engaged in workshop-type activities in an instructional lab environment that enhanced their understanding of their own personal and professional interests in technology. To pull all of this together, a group project, called \*WebQuest, was used. It became a concentrated, hands-on task that developed their skills of researching and utilizing resources of the Internet and the World Wide Web around a theme specifically connected to the PSTI objectives of space, math and science. It was here that the participants were able to take what was being learned in the other PSTI components and make the assigned tasks there come alive in a multimedia format.

The technology component started from the assessment of participants to a general review of the operation of the computer-creation of folders, file saving, functions of windows, as well as a primer on \*MS Office applications. The second major activity was a comprehensive coverage of the tremendous resources available on the WWW for teacher education professionals as well as content-related sites in math, science and space. To supplement this resource exploration, participants were taken through exercises to identify various sets of state standards, benchmarks and the National Educational Technology Standards at ISTE <http://cnets.iste.org/>. To finalize this component, participants were provided with the Louisiana State Department of Education technology-infused lesson plan template that was used in the group \*WebQuest. More on \*WebQuest can be checked out at the official website: <http://WebQuest.sdsu.edu/>.

The participants were broken into groups and were instructed to select \*WebQuest topics based on their teacher education program major. Through collaborative planning and research, the teams built \*WebQuests where they combined various graphics from their math and/or science classes, lesson plan(s) that included state and technology standards and teacher pages that detailed useful resources for the successful utilization in PK-12 classrooms. The instructional technology component culminated with a team presentation in a multimedia theater environment

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in front of a delegation of representatives of the NASA facility including the PSTI program staff from the Education Department of Stennis Space Center.

In summary, the instructional technology component was designed to complement the other content-based components. The participants utilized materials and problem-based tasks created in the math and science part of the two-week comprehensive institute and made them alive through multi-media presentations at the end of the session. The primary medium used to complete this component was team-built \*WebQuests. For more information on these \*WebQuest and other project-related materials contact [jfulwile@xula.edu](mailto:jfulwile@xula.edu).

## Results

Each course differed in content emphasis, but focused on modeling effective teaching techniques to enhance each participant's understanding of the skills needed to implement effective instructional strategies. The hands-on/minds-on strategies used in each course established standards-based learning as the norm and standards-based pedagogy as the rule. These methodologies led to greater participant success. Entries in students' journals indicated that the experience greatly enhanced their understandings of mathematics and science concepts and effective ways to teach children these concepts. Many of the entries conveyed similar messages as the ones below:

- For the \*Geoboard based-problems we had to examine the relationship between the area and perimeter of a rectangle. This was a fun activity
- Math was understandable today. Yeah. \*Geoboards were great! I got it and could do that again.
- The lesson today was on rocket-propulsion. Oh how I enjoyed this hands-on activity that we did. I got a whole lot of ideas from this lesson that I will use for my students. I am so excited. I am eager to learn new and interesting things still to come.
- The more I broaden my teaching style & allow myself to learn new techniques, the more my students, as well as myself will grow.
- I am enjoying the hands-on, actually minds-on activities.
- I learned when you are able to use a hands-on approach the students get more involved and they understand the concept better.

The instructional strategies used by faculty also helped to increase participants' content knowledge. For example, the PBL course helped students to strengthen their skills as planners, managers and facilitators. A pre- and post-test was administered to each student. The results from the May survey indicated that 56 percent of the participants knew how to plan a lesson. However, after the course, that figure increased to 86 percent. Classroom management and is an important skill for effective classroom teachers. Cooperative grouping is an important element of standards-based learning.

Before the course, 70 percent of the participants agreed that they could not create or manage cooperative groups. By the end, 75 percent of the participants agreed that they could create and manage cooperative groups. Facilitating discourse, investigations and research projects is also

an important skill. The pre-test found that 96 percent of the participants did not feel comfortable as a facilitator. The course helped 75 percent become comfortable with that role.

The mathematics course was found to be successful because participants were asked if they had a good conceptual understanding of mathematics at the beginning and the end of the course. Over one-third (35 percent) of the students said they had a “good” understanding of mathematics, while 47 percent said they had a “very good” understanding of mathematics. Yet at the end of the session, 72 percent of the students found the math course was highly effective and helped to increase 95 percent of the students’ enjoyment of mathematics, resulting in 50 percent of them taking more mathematics courses when they returned to school. Examples of student comments about the mathematics course are as follows:

- “At the beginning I was afraid of Math, but you helped me to gain the confidence I needed!”
- “I loved the math problems-some were frustrating but it was fun to try to figure them out.”
- “I have never been so interested in math. Thanks for making it fun. I loved your class.”

Similar results were found with the instructional technology course. At the beginning of the institute, only 16 percent of the students considered themselves “technology wizards.” By the end of the course 92 percent of the students considered themselves “technology wizards,” and generally, feeling comfortable with using technology as a teaching tool.

The field experience was cited by faculty, participants and students alike as one of the best experiences they ever had. All left the experience feeling that personal and professional goals and objectives were met. The 4<sup>th</sup> and 5<sup>th</sup> grade students, who participated as the class, repeatedly remarked how happy they were “learning real hard science stuff”. The participants were equally happy that they were able to “teach” students effectively and in a fun ways. One participant wrote in her journal:

“To see the look on the faces of those students was priceless. They were so excited and interested in what we all had to say, it didn’t bother me one second that I missed out on so much sleep. When the kids got there it felt so natural. I wasn’t nervous at all. It felt right, that’s why I know this (teaching) is what I am supposed to do”.

In conclusion, The Pre-Service Teacher institute was a very positive experience for faculty, participants, and the students, on whom the participants practiced their newly learned skills. The dynamic, intense, two-week institutes accomplished the objective of enhancing participants’ knowledge and skill in teaching mathematics and science using technology as a teaching tool at the elementary and middle school levels

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<sup>5</sup> Ronis, D. (2001). *Problem-based learning for math and science: Integrating inquiry and the Internet*. Arlington Heights, IL: Skylight Training and Publishing, Inc.

<sup>6</sup> Sgroi, L., *Teaching Elementary and Middle School Mathematics: Raising the Standards*, Wadsworth/Thomson Learning, Stamford, CT, 2001, 391 pages.

## Biographical Information

**Dr. Renee Akbar** is an assistant professor at Xavier University of Louisiana. She has a B.S. in Elementary Education, a M.S. in Intercultural/International Development Education, a M.Ed. in Educational Leadership, and a Ph. D. in Educational Leadership and Policy Studies. Dr. Akbar has over twenty years of K-16 experience in teaching and administration. She is a faculty member of the Division of Education in Curriculum and Instruction and Educational Leadership. In addition to teaching, she supervises student teachers, practitioners and interns. Dr. Akbar is the faculty advisor to the Louisiana Association of Educator Students Program and the Coordinator of the Pre-Service Teacher Institute.

**Dr. Rosalind Hale** is an associate professor in the division of education at Xavier University of Louisiana. She served as chair of the division from 1997 until 2004. She received a B.S. in mathematics from Xavier, an M. A. in Sec. Ed. from the University of South Alabama, and an Ed. D. in educational leadership from Auburn University. She is currently the principal investigator for a 1.2 million dollar grant from the U.S. Department of Education to promote alternate teacher certification.

Dr. Hale teaches graduate courses in research, educational leadership, curriculum and instruction and instructional technology. She has had articles published in *Schools in the Middle*, *the High School Magazine*, *the NASSP Bulletin* and *the Kappa Delta Pi Journal*. She is a member of a number of professional organizations and has served on various local, regional and national boards related to education. She is a past chair of RWE and was the 2003 recipient of the Gender Equity Architect Award from the American Association of Colleges of Teacher Education for her work in promoting gender equity in teacher education.

**Dr. John Fulwiler** has had over 35 years of college teaching. Dr. Fulwiler has had a variety of administrative and teaching responsibilities during that time. Currently, he is a full Professor of Education at Xavier University of Louisiana. Dr. Fulwiler works with numerous groups and academic bodies to promote the infusing of technology into the instruction of teacher education candidates. He serves as a member of his state's technology council to set

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policy for the use of e-learning. Dr. Fulwiler serves as a board examiner for teacher certification for the State of Louisiana. He has worked with various governing bodies to facilitate the training of pre-service and in-service teachers. Dr. Fulwiler is currently the director of a nearly one million-dollar PT3 grant from the U.S. Department of Education at the Division of Education at Xavier University. His doctoral studies started at University of Southern California in Gerontology/Adult Studies and ended up completed his doctorate in higher education administration, specializing in non-traditional/adult learners from the University of Southern Mississippi.

**Dr. William Jordan** is Professor and Program Chair of Mechanical Engineering at Louisiana Tech University. He has B.S. and M.S. degrees in Metallurgical Engineering from the Colorado School of Mines. He has an M.A. degree in Theology from Denver Seminary. His Ph.D. was in mechanics and materials engineering from Texas A & M University. He teaches materials oriented courses and his main research area deals with the mechanical behavior of composite materials. He also writes and does research in the areas of engineering ethics and engineering education. He is a registered metallurgical engineer in the state of Louisiana.

**Dr. Ramona Travis** is the University Affairs Officer at NASA Stennis Space Center. She received her Ph. D. from Louisiana State University in Agronomy. She administers a number of university and colleges initiatives and educational and scientific engineering research programs for various agencies that are administered through Stennis space Center. In addition to the many undergraduate, graduate and postsecondary faculty programs she administers, she also directs the Pre-Service Teacher Institute for Stennis Space Center.

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