NASA Explorer Schools Project Evaluation: Summer 2003 to Spring 2006

Final Report

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Prepared by:
Laurie Ruberg, Ph.D.
Karen Chen, Ph.D.
Judy Huang Martin

Center for Educational Technologies®
Wheeling Jesuit University
316 Washington Ave.
Wheeling, WV 26003

Submitted to:
Rob LaSalvia
NASA Explorer Schools Project Manager (Acting)
Educational Programs Office
NASA Glenn Research Center
21000 Brookpark Rd MS 7-4
Cleveland, OH 44135

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The COTF serves as NASA's premier research and development program for educational technologies. In this capacity the COTF develops and conducts research on technology-based learning materials that challenge students to solve problems by using datasets and other information resources provided by the NASA mission directorates.

The authors of this report are all members of the COTF's research and evaluation team. Laurie Ruberg is associate director of the Center for Educational Technologies. Karen Chen is an educational researcher there, and Judy Huang Martin is the center's implementation research coordinator.

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Executive Summary

Background: The NASA Explorer Schools (NES) project provides curriculum materials, professional development, and technology support for low performing, socioeconomically challenged, ethnically diverse schools serving grades 4-9. The focus of NASA's support is on improving teacher abilities and student achievement in science, technology, engineering, and mathematics.

Purpose: This report integrates the results of five previous interim reports and provides an impact analysis of the first three years of the NASA Explorer Schools intervention. This study reports the results of data collected from the start of the project in 2003 through the spring 2006.

Setting: This study includes NASA Explorer Schools participating in the program between 2003 and 2006. Schools from all 50 states plus Puerto Rico are represented in this sample group, and the intervention is carried out on a regional level through 10 participating NASA field centers located in Alabama (1), California (3), Florida (1), Maryland (1), Virginia (1), Mississippi (1), Ohio (1), and Texas (1).

Study Sample: 149 schools, 596 teachers, 149 administrators, and potentially 135,396 students were involved in this program in the 2003-2006 period that is the focus of this study.

Intervention: The NES project provides a three-year partnership between NASA and the participating schools to offer professional development, funding for technology resources, STEM-related curriculum activities, materials, and expertise, and individual consultation to help teacher and administrator teams achieve the academic goals outlined in their NES sustainability and implementation plans.

Research Method: This study examines the first three years of the NASA Explorer Schools project using a blended method approach that combines qualitative and quantitative methods. Applying a theory-based research design, a cluster-based, randomly selected sample of case study school implementations was rated and compared to the theoretical guidelines of anticipated outcomes and practices. Student achievement scores were collected to compare participating schools' standing in their district and state the year before beginning the Explorer Schools project with their standing after one, two, three, and four (one-year post completion) years of participation. The research design included pre-/posttest comparisons to examine the impact of the STEM education intervention on school curriculum, teacher professional development, technology integration, family involvement, and student interest and achievement.

Data Analysis: The analysis uses a blended methods research design. The quantitative analysis primarily conducted on survey data included descriptive and inferential statistics, including mixed design analysis of variance and regression modeling analysis. The

qualitative data analysis followed procedures to verify interrater reliability and triangulation of data by comparing similar data questions across several instruments.

Findings: The data analysis shows that all of the 29 case study schools had achieved some level of successful outcomes associated with participation in the NES project. The cross-case qualitative analysis and regression modeling reinforced the same findings, showing that student achievement gains were most strongly associated with evidence of applying teaching instructional strategies to support inquiry, teacher reports of knowledge gains in STEM content and pedagogy, teachers collaborating to integrate NES intervention into district and/or school curriculum, and use of educational technologies to support classroom instruction. These areas should be emphasized and reinforced in future professional development for NES teachers and administrators.

Discussion: The field center implementation of the NES project was improved and made more coherent over the course of the three-year evaluation. Teachers indicated that they highly value how the NES workshops helped them grow personally and professionally. Teachers reported that they found it difficult to schedule field center staff visits to their schools, while field center staff reported facing tight timelines for providing schools with information and assistance.

Schools that met NES expectations for implementation showed positive impact on teacher growth, integration of educational technology, family involvement, and student interest and achievement in STEM-related topics and careers. While challenges faced by underachieving schools participating in NES were not erased, these schools achieved significant areas of success. The number of schools meeting their annual yearly progress goals doubled from 2003 to 2006 for all cohort groups.

The case study analysis provides detailed school-based factors that either contribute to or impede successful implementation of NES as a comprehensive STEM-related intervention. The quantitative analysis from survey data supported and in some cases further defined the trends identified in the cross-case analysis. Generally, the grounded theory model was found to be an effective tool for identifying successful school implementation. The following six areas emerged as the most critical to be further refined and expanded in future NES implementation:

- Involve students in the process of generating and evaluating scientific evidence.
- Help teachers be able to model scientific reasoning for students.
- Help teachers know how to recognize and change common student misconceptions.
- Help teachers improve their pedagogical understanding of content so that they can document the impact of specific teaching strategies on student learning.
- Help teachers work as a team to plan, review, and connect NES implementation to specific standards for student achievement.
- Prepare teachers so that they can integrate student use of technology within STEM content instruction.
- Support student participation in the scientific inquiry process.

Recommendations for Next Steps

The following recommendations were made as suggestions for next steps for the NASA Explorer School project to continue to improve and expand its comprehensive STEM-related school reform intervention program.

- Identify content and pedagogical areas for NES by narrowing the focus of what it offers schools, and offering NES services to grades K-16 partners.
- Increase the rigor of how school-based implementation is documented by implementing some restructuring to the e-Folio website and conducting an in-depth investigation on how teachers implement inquiry-based strategy and technology tools.
- Expand and improve professional development and training opportunities but target those areas that showed the strongest student achievement gains.
  - First, quality of workshops in each field center should be conducted, analyzed, and evaluated.
  - Second, technical skills and teaching strategies have the greatest impact on constructivist uses of technology; workshops should focus on increasing teachers' technical skills and knowledge about constructivist teaching strategies.
- Research designs for future evaluation should include a randomized controlled trial study design as well as continued and expanded case study research that was begun in the three-year period reported here.