

NASA Explorer Schools

Evaluation Brief 1

Evaluation Framework: Evaluating the Quality and Impact of the NASA Explorer Schools Program

Steven McGee
Victor Hernandez
Jennifer Kirby

NASA-sponsored Classroom of the Future

Center for Educational Technologies®
Wheeling Jesuit University

NES/EB1/7-2003

The NASA-sponsored Classroom of the Future (COTF) program is helping 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. The COTF program is administered by the Erma Ora Byrd Center for Educational Technologies[®] at Wheeling Jesuit University in Wheeling, WV.

The COTF serves as the National Aeronautics and Space Administration's (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 five strategic enterprises of NASA: Aerospace Technology, Human Exploration and Development of Space, Earth Science, Space Science, and Biological and Physical Research.

The authors of this report are all members of the COTF's research and evaluation team. Steven McGee and Victor Hernandez are senior educational researchers and Jennifer Kirby is assistant educational researcher.

Table of Contents

INTRODUCTION	1
NES Program Objectives	1
Program Benefits	2
School Action Plan	3
Eligibility	3
Three-Year Partnership Activities	4
NES EVALUATION PLAN	4
Design Experiment Data Collection	5
Scientifically-Based Research Data Collection	6
Overall Management and Reporting	7

NES Evaluation Brief 1: Evaluation Framework

Evaluating the Quality and Impact of the NASA Explorer Schools Program

Introduction

Through the NASA Explorer Schools program, schools enter into a unique three-year partnership with NASA to bring exciting opportunities to educators, students, and families through:

- Sustained professional development
- Exciting student learning opportunities
- Integration of technology
- Involvement of parents

NASA Explorer School educator and administrator teams, working along with NASA personnel and other educational partners, will develop and implement team action plans for staff and students. The action plan will promote and support the use of NASA content and programs that address the teams' local needs in mathematics, science, and technology through authentic experiences. Educators and students in a NASA Explorer School will become involved in the excitement of NASA research, discoveries, and missions through participation in engaging NASA learning adventures and scientific challenges.

Materials will be grade-specific in appropriate concepts from national education standards. Through technology applications, opportunities for comparison of local data with other students and the NASA research community will be available.

NASA Explorer School educator/administrator teams will kick off the program by attending a one-week, all expenses paid, professional development residence program at one of the ten NASA Field Centers during July 2003. Throughout the three-year commitment, teams will refine their action plan, continue professional development, and involve students and families in the program.

NES Program Objectives

Through the NASA Explorer Schools activities, participating schools will

- increase student ability to apply science, mathematics, technology concepts;
- increase student knowledge about careers in science, mathematics, technology;

- increase student interest in and participation in science, mathematics, technology;
- increase the active participation and professional growth of educators in science, mathematics, technology;
- increase family involvement in student learning; and
- increase the academic assistance for and technology use by educators in schools with high populations of underserved students.

While it is the case that a variety of programs across the nation share similar program objectives, the NES program addresses these objectives in a unique way that only NASA can. The unique contribution of NASA at the Explorer Schools will provide a measurable impact on these program objectives that goes beyond the impact of other programs available to typical schools located in the same region as the Explorer Schools.

Program Benefits

The following summary provides a description of what the NES program will provide to each of the participating schools.

Each team member from a participating school will attend an all expenses paid one-week professional development residence workshop at one of the ten NASA Field Centers in Summer 2003. They will receive a \$500 stipend for their attendance and the opportunity to earn graduate or professional development credit.

- The summer workshops will focus on the following activities:
- Engage in grade appropriate, NASA Enterprise related hands-on/minds-on activities.
- Learn how to use technology tools to support classroom investigations.
- Work cooperatively with other team members to prepare an action plan to address local needs in science, mathematics, or technology education.
- Design a customized professional development plan to support the implementation of the local action plan using distance learning and identified state content experts.
- Discover new avenues for collaborative learning through advanced educational technologies and strategies.
- Strengthen and increase knowledge about problem-based learning and the inquiry process.
- Explore NASA educational materials and develop an action plan to support their incorporation in local/state curricular needs.
- Learn real world and practical applications of science, technology, engineering, and mathematics, (STEM) and geography from NASA scientists, researchers, and engineers in NASA applied research facilities.

During the school year, schools will have access to all of NASA's educational resources. In addition, schools will be supported by customized resources and events geared specifically for the Explorer Schools. These resources and events will engage students and parents in authentic activities related to NASA's unique mission.

School Action Plan

Each school team is responsible for preparing and implementing an action plan. The plan will outline the specific local needs relative to the six NES program objectives. The plan will also describe how the whole school (not just the NES team) will reorganize to address these local needs. The schools will receive grants of up to \$10,000 (subject to availability of funds) to assist with the implementation of the action plan. Each NES team member will receive a \$500 stipend for implementing the team's action plan during the 2004/2005 school year. The schools will submit progress reports on their action plan as well as participate in videoconference focus groups with the evaluation team.

Eligibility

The 2003 NASA Explorer Schools program is focused on NASA content at the 5-8 grade levels. Educators and administrators in participating schools must be familiar with and have year-round access to the Internet on a regular basis. Optimally, students will also need access to the Internet on an as-needed basis.

A school-based team of 4-5 people will lead the effort beginning with the NASA summer residence workshop. All team members must be U.S. citizens.

Team composition:

- An administrator/decision maker who will serve as a change agent within the school and who will work with and empower the team.
- 3-4 full-time classroom educators who provide regular or special education instruction in science, mathematics, or technology at the 5-8 grade level
- and/or resource, content specialist, or other educators, as determined by overall team needs.
- Teams may also include someone from a local Informal Education venue, a higher education institution, a parent association, or a local business leader who would partner with the Explorer School team.
- All classroom educators on the team must be certified/licensed by their State Department of Education and have a minimum of three years of teaching experience.

The focus during 2003 is on content at the 5-8 grade level. This is a 3-year partnership with NASA: therefore, the team plan could encompass several different grade levels. The team may include educators of grades other than 5-8 based on overall team needs. Teams may consider having a partnership between an elementary, middle, or high school or any combination thereof based on their particular school composition and local needs. We recommend that the team include at least 2 classroom educators who teach at the 5-8 grade levels.

Three-Year Partnership Activities

Designation as a "NASA Explorer School" indicates an ongoing relationship with NASA through a mutual agreement for sustained involvement by educator/administrator teams in professional development, student participation in challenges and investigations, and the design of the action plan to meet the school's local needs.

The team action plan will be instrumental in outlining what programs and services will be provided to the school by NASA during the three-year partnership. During the one-week summer workshop the team will learn about NASA content, resources and programs. The team will begin to develop an action plan to meet their specific needs. The action plan will be further refined by the team during Fall 2003. The team action plan and application for grant funds will be submitted to NASA in October 2003. NASA and other educational partners will work with the school to implement the action plan for the remainder of the three-year partnership.

NES Evaluation Plan

The evaluation of the NES program provides unique challenges. While the NASA education programs have enjoyed wide-scale success for decades, the NES program represents a significant reorganization of NASA's education offerings. NASA's organizational focus for the NES program is to create a structure within which previously independent programs will be integrated around a common set of objectives. This integration will benefit from NASA's decentralized management structure. Each NASA field center will uniquely organize its local resources to meet the needs of the five schools it is supporting. Each of the 50 schools will uniquely organize its local resources and take advantage of NASA resources to address the NES program objectives.

The core evaluation question is focused on whether participation in the NES program leads to accomplishment of the program objectives. However, the fact that the NES program is decentralized and emergent complicates this question. A fundamental objective of the evaluation is to document the design decisions that NASA and participating schools make throughout the program as well as the impact of those design decisions on the program objectives. This information will be fed back to the program participants to inform their design decisions throughout the program.

The evaluation team will adopt a hybrid evaluation design. The process of documenting design decisions and using evaluation information to inform design decisions is the hallmark of a recent advancement of educational research called a design experiment. From one year to the next NASA will use the results of the implementation to make principled adjustments for the subsequent year. It is through this design process that the operational definition of the program emerges. The design experiment approach is internally focused. Using that approach alone does not provide information about the relative benefits of the program.

The design experiment methodology will be combined with a scientific-based research (SBR) methodology to compare a given implementation year to a comparison group to measure the effect of the program for a given year. The What Works Clearinghouse Study Design and Implementation Assessment Device will guide the design of comparative studies of program effectiveness. The design experiment

will provide a means to define the construct validity of the intervention. The use of valid and reliable measures for student learning and career aspirations will help to establish the construct validity of the testing. Internal validity for the study will be established by identifying appropriate comparison schools for each of the participating Explorer Schools. Internal validity will be further strengthened by using the construct definition to establish a strength of implementation variable that characterizes how well each school organized to take advantage of NASA resources. It is hypothesized that the strength of implementation variable will be a statistically significant predictor of student learning and career aspirations. External validity will be established by analyzing the characteristics of the participating schools to determine how representative they are of schools across the nation. Statistical conclusion validity will be established by calculating and reporting the effect sizes between the Explorer Schools and the comparison schools on student learning and career aspirations.

Design Experiment Data Collection

The primary means of documenting the design of the program at each field center and at each school is through the formal design documents produced by each organization. The evaluation team will have access to the action plans from each school through NEEIS . It is important that the action plans specifically address how the schools will achieve each of the six program objectives and how they will measure success at meeting the objectives. Each school will develop a progress report at least once each school year that documents how they implemented the action plan. The evaluation team will follow-up the first-year progress reports with a videoconference focus group. During the focus group, the evaluation team will discuss how NASA resources are being used and clarify outstanding issues within the progress reports. The evaluation team will also analyze participation in the NES community Web site at the level of posted activities.

Each field center will develop an action plan for how they will organize center resources and personnel to meet each of the six objectives. The field centers will submit quarterly reports documenting their progress on their action plan. The evaluation team should be provided with all workshop materials from each field center's workshops as well as any internal planning documents. The evaluation team will conduct site visits at selected NASA workshops. The evaluation team will also conduct videoconference focus groups with the field center personnel at some point during the year to follow-up on the quarterly progress reports. The focus groups will involve interviews with field center personnel and AESP personnel.

Each enterprise will develop an action plan and provide quarterly progress reports. The enterprise content teams will provide a description of the online resources and events for participating schools. It is their responsibility to provide reports on the success of these events. In addition, the evaluation teams will interview enterprise personnel through videoconference focus groups. A fundamental data collection issue emerges around how to document the use of NASA's extensive online resources by the Explorer Schools. We suggest using a top-down and bottom-up approach. The feasibility of these two approaches needs further discussion before committing to implement them. For the top-down approach, we can ask schools with their own Internet domain to provide that domain address to the evaluation team. A list of Internet domains for participating schools will be provided to each of the enterprises. The enterprises will be able to conduct searches of their own Web logs to find Web hits from these participating schools Web domains. For schools that share a proxy

server with other schools, it will not be possible to identify Web hits from their school. For the bottom-up approach, many schools have Web filters that log the Web usage of the school. With the permission of the school board, it may be possible to secure access to these Web logs from each school. The use of the Web logs would be limited to mining and analyzing NASA Web site usage as a percentage of total Web hits. Any non-NASA related Web sites will be deleted from the Web log prior to analysis. For those schools that do not have filtering software, COTF will work with them to set up filtering software.

NEEIS will be used as a primary means to document participant perceptions of the NES program activities. The evaluation team will work with the NES team to develop NEEIS forms for the field center workshops and for AESP support activities. However, it will be up to the enterprises to develop NEEIS forms for their NES resources and events and provide summaries as part of their quarterly reports.

The budget for the design experiment data collection reflects conducting focus groups with each school at the end of their first year participation. The budget increases slightly for the action plan analysis to accommodate the continued analysis of the action plans in subsequent years.

Scientifically-Based Research Data Collection

First and foremost will be the identification of existing measures or the development of new measures of each of the six program objectives. For objective one related to student learning, we will use a combination of state assessment data as well as the collection of new assessment data from existing test banks of high quality items. For objectives two and three related to knowledge of careers and student interest, we will customize existing career awareness and interest surveys. For objective four and six related to teacher professional growth and increased technology use by schools with underserved students, we will adapt the Teaching, Learning, and Computing survey. For objective five related to family involvement, we will customize existing metrics of family involvement. All measures will be collected in NES schools at each of the targeted grade levels. We will also work with each state to identify other relevant data available through the state information systems. These measures will be tracked from one year to the next in a time series design to measure how design changes at each school are impacting the growth of these metrics.

Objectives one through three have been identified for comparative analysis through scientifically based research (SBR). The comparative measure for student learning will be tracking student performance on statewide assessments of math and science in the context of No Child Left Behind requirements for annual reporting and Adequate Yearly Progress. The unit of analysis will be the school level. Performance of Explorer Schools will be compared to performance at comparison schools. Since each state assessment framework and tests are unique, it will not be possible to analyze school performance on the scale of each state's test. Instead, the pair wise comparison between each NES school and its comparison school will be converted to a standardized effect size scale. Once the school performance data has been standardized in the effect size scale, it will be possible to test whether the average effect size across the 50 schools is statistically greater than zero, meaning that the NES school had higher performance on their state test than did the comparison schools.

The comparative measure for objectives two and three will be customized from existing measures. Each spring, they will be administered at each grade level within NES schools. In addition, the measures will be administered each spring at each grade level within the public high school that the NES schools feed into. It is assumed that more than one junior high/middle school feeds into the same high school. The high school students will be asked to provide demographic characteristics as well as which junior high/middle school they attended. These data will be used to create comparison students to compare career awareness and interest.

One underlying objective for NES in particular and NASA education enterprise in general is to increase the number of students pursuing careers in science, math, and technology. In the context of the NES participating students it will be possible to collect data that we know from the literature is predictive of students' career choices. This approach provides only an indirect measure of the program impact. Ideally, the evaluation of the NES participating students will continue after the NES schools graduate from the program. It would be valuable to track students as they complete their high school and even their college careers to see what choices they actually make. At this point the budget horizon is for three years, so we have not yet included a budget for tracking students beyond the three-year horizon.

Every attempt will be made to administer all assessments and questionnaires in an online format. The NEEIS system will be the first resource considered for the development of questionnaires. In situations where the complexity of a questionnaire would be unwieldy to implement in NEEIS, COTF will use Perception software to create and administer online assessments and questionnaires. The AESP personnel will assist with data collection during on site visits to the NES schools.

The COTF will form an advisory group for the scientifically based research component. We will invite representatives from the US Department of Education's Institute for Education Sciences, NSF's Research Evaluation Communication division, What Works Clearinghouse project, and other prominent methodologists.

Overall Management and Reporting

COTF will use the services of a variety of subcontractors to supplement COTF personnel. The evaluation effort will be coordinated by COTF, which will manage all of the design, data collection, and analysis efforts across all components of the evaluation. COTF will communicate regularly with the NES Headquarters Management team about issues, as they are uncovered within the evaluation. COTF will also synthesize all of the evaluation pieces into an annual report of progress. The annual report of progress will provide documentation of ongoing success stories that can be reported to key stakeholders as well as documentation of design decisions and their impact. The annual progress report will provide program design recommendations for the subsequent year. The annual reports will build towards a cumulative report at the end of the third year that will draw conclusions about the impact of the program on the objectives.