NWO

Northwest Ohio Center for Excellence in STEM Education

2011 Evaluation Report

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Executive Summary

The Northwest Ohio Center for Excellence in STEM Education (NWO) coordinated and implemented several activities and projects during the 2011 fiscal year. The purpose of this report is to describe the evaluation findings regarding those activities and projects, and measure the extent to which NWO attained the following goals:

1. Develop the expertise of pre-service and in-service teachers in STEM and STEM education disciplines.

2. Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.

3. Conduct and communicate collaborative research in STEM and STEM education disciplines.

4. Develop and sustain a regional collaborative alliance including university, school, informal education, and business partners through a shared vision and collaborative spirit for tackling current STEM education issues.

5. Support higher education faculty and future faculty in pursuit of the best practices in STEM and STEM education disciplines to enhance undergraduate and graduate education.

Online surveys were the primary data collection method used for the evaluation of the NWO activities and project, but observations and document analyses were also used. For most of the NWO goals, data were collected to answer multiple evaluation questions. The evaluation findings for each goal are summarized below.

NWO Goal 1. Data were collected and analyzed in order to evaluate the NWO Inquiry Series, NWO Symposium, Community Resources Workshop, and USE-IT project. Specifically, the data were used to measure participants' perceptions of the NWO activities and projects, and the impact of the activities and projects on participants. The evaluation findings indicate that teachers had positive perceptions regarding the NWO Inquiry Series, NWO Symposium, Community Resources Workshop, and the USE-IT project. The teachers' written comments on the evaluation surveys suggested that teachers intended to use the knowledge and resources

gained from the NWO activities and projects in their classroom. Furthermore, teachers improved their attitudes about STEM and STEM education as a result of participating in the NWO activities and projects.

NWO Goal 2. Data were collected and analyzed in order to evaluate the Ohio Junior Science and Humanities Symposium (OJSHS) and STEM in the Park. Specifically, the data were used to measure the participants' perceptions of the NWO activities and the extent to which the activities attracted and sustained interest in STEM. The findings indicate that participants perceived the NWO activities to be valuable, engaging, and influential in the improvement and sustainability of students' interest in STEM.

NWO Goal 3. Data were collected and analyzed in order to evaluate the Faculty Research Learning Community. Specifically, the data were used to measure the participants' perceptions of the NWO activity, and the nature of participants' contribution to STEM teaching and learning research. The findings indicate that the participants in the learning community perceived it to be valuable and well organized. Furthermore, as a result of the learning community, many of the participants developed, conducted, and communicated research studies regarding STEM teaching and learning.

NWO Goal 4. The NWO projects and activities were analyzed in order to determine the extent to which they developed and sustained regional partnerships, and the nature of those partnerships. Almost all NWO activities and projects were founded upon long-standing relationships between NWO and its partners. As such, the implementation of these activities and projects successfully sustained and developed existing regional partnerships with multiple colleges and departments at Bowling Green State University, K-12 schools, educational service centers, community organizations, and businesses. In addition, new partnerships were formed across northwest Ohio, due largely to the funding of the NWO STEM Consortium in January of 2011. The NWO partnerships were collaborative in nature, with NWO both providing and receiving assistance in various forms from its partners throughout northwest Ohio.

NWO Goal 5. Data were collected from the participants of the Faculty Research Learning Community in order to determine impact of the research community on participants' STEM research and teaching practices. The evaluation findings indicate that the learning community resulted in the implementation of new pedagogies and learning strategies, and that

the learning community successfully facilitated the development of collaborative research projects.

Overall, the evaluation findings suggest that NWO successfully attained its goals. And in addition to providing evidence for the attainment of goals, the evaluation findings were also used to identify ways in which NWO activities and projects could be improved. The participants' comments and suggestions, in conjunction with other evaluation data, were used to develop several recommendations regarding the future implementation of STEM in the Park, USE-IT, the NWO Symposium, OJSHS, and the Community Resources Workshop.

Introduction

This report will describe the evaluation findings regarding the activities and grant projects implemented by the Northwest Ohio Center for Excellence in STEM Education (NWO) during the 2011 fiscal year (July 2010 – June 2011). The report will begin with an overview of the evaluation design, including a description of the methods used for data collection. The report will continue with a presentation of the evaluation findings and conclusions, and will end with several recommendations regarding the NWO activities and projects.

This report will present evaluation findings for the following activities and projects that were coordinated and implemented by NWO during the 2011 fiscal year:

- STEM in the Park (September 2010) *

- NWO Inquiry Series (September 2010 – April 2011)

- USE-IT (September 2010 – April 2011) *

- Faculty Research Learning Community (September 2010 – April 2011)

- NWO Symposium (November 2010) *

- NWO Consortium Activities (January 2011 – June 2011) *

- Ohio Junior Science and Humanities Symposium (March 2011) *

- Community Resource Workshop (June 2011) *

Independent evaluation reports were written for the NWO activities and projects that are followed by an asterisk. The evaluation reports contain a more detailed account regarding the evaluation of the activities and projects than what is included in this report, including full versions of the evaluation instruments. The evaluation reports can be found at www.nwocenter.org/reports.

The NWO evaluation activities were generally designed to measure the extent to which NWO attained the following goals:

1. Develop the expertise of pre-service and in-service teachers in STEM and STEM education disciplines.

2. Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.

3. Conduct and communicate collaborative research in STEM and STEM education disciplines.

4. Develop and sustain a regional collaborative alliance including university, school, informal education, and business partners through a shared vision and collaborative spirit for tackling current STEM education issues.

5. Support higher education faculty and future faculty in pursuit of the best practices in STEM and STEM education disciplines to enhance undergraduate and graduate education.

More specifically, the purposes of the NWO evaluation were to 1) assess the quality of NWO activities and projects; 2) measure the impact of NWO activities and projects on educators, students, members of the community, and NWO business and community partners; 3) identify the strengths and weaknesses of NWO activities and projects; and 4) provide recommendations regarding the implementation of future NWO activities and projects.

Each of the NWO activities and projects were aligned with one or more of the above NWO goals. In order to measure the extent to which NWO attained its goals, one or more evaluation questions were formulated for each goal, and the evaluation findings from each activity and project were used to answer the evaluation question(s). Online surveys were the primary data collection method used for this evaluation, but observations and document analyses were also used. Table 1 demonstrates the alignment between NWO goals, activities/projects, evaluation questions, and data collection methods.

Table 1. Alignment of NWO goals, activities, evaluation questions, and data sources

NWO Goal	NWO Activities and Projects	Evaluation Questions	Data Collection Methods
1. Develop the expertise of pre-service and in-service teachers in STEM and STEM education disciplines.	• NWO Inquiry Series • NWO Symposium • Community Resource Workshop • USE-IT	• What are the participants' perceptions of NWO activities and projects? • What is the impact of NWO activities and projects on participants?	• Online surveys • Observations
2. Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.	• Ohio Junior Science and Humanities Symposium (OJSHS) • STEM in the Park	• What are the participants' perceptions of NWO activities and projects? • To what extent do NWO activities and projects attract and sustain interest in STEM?	• Online surveys
3. Conduct and communicate collaborative research in STEM and STEM education disciplines.	• Faculty Research Learning Community	• What are the participants' perceptions of the research community? • What is the nature of participants' contribution to STEM teaching and learning research?	• Online survey • Document Analysis
4. Develop and sustain a regional collaborative alliance including university, school, informal education, and business partners through a shared vision and collaborative spirit for tackling current STEM education issues.	• NWO Collaborative Council • STEM in the Park • Community Resource Workshop • NWO STEM Consortium Activities	• To what extent do NWO activities and projects develop and sustain regional partnerships, and what is the nature of those partnerships?	• Document Analysis • Online surveys
5. Support higher education faculty and future faculty in pursuit of the best practices in STEM and STEM education disciplines to enhance undergraduate and graduate education.	• Faculty Research Learning Community	• What is the impact of the research community on participants' STEM research and teaching practices?	• Online survey

Data Collection Methods

This section will describe the methods that were used to collect data from the NWO participants during the 2011 fiscal year.

NWO Inquiry Series Evaluation Survey

The Inquiry Series Evaluation Survey consists of several demographic items (e.g., grade levels taught, number of years teaching) and several items that measure teachers' perceived value of the Inquiry Series session they attended. The items are measured on a four-point scale, with 1 = Disagree, 2 = Somewhat Disagree, 3 = Somewhat Agree, and 4 = Agree. Some examples of the items include, "The session was engaging," and "The content/information presented during the session was valuable to me". The survey was administered online after the completion each monthly Inquiry Series professional development session. The average monthly response rate was 83%.

NWO Symposium Evaluation Surveys

The NWO Symposium was evaluated using three surveys: the session evaluation survey, the attendee evaluation survey, and the presenter and vendor evaluation survey. The session evaluation survey consisted of the following statements, to which to the participants rated their level of agreement on a four-point scale (1=Disagree, 2=Somewhat Disagree, 3=Somewhat Agree, 4=Agree):

1. The session was engaging.
2. The information presented during the session was valuable.
3. I learned something new from the session.
4. The educational community would benefit from knowing the information presented during the session.
5. The session was easy to follow and well organized.

The session evaluation survey also provided participants an opportunity to offer comments about the session and/or presenter. The prompt on the survey read, "Please use the box below to tell us about your perceptions of the session in your own words. You can include comments (good or bad) about the session, as well as your perceptions about the value and applicability of the information presented during the session". The attendees were asked to complete one survey for each session they attended. Eight surveys – one for each session – were

provided to the attendees in an envelope at registration. Attendees were asked to complete the surveys, put them back in the envelope, and return the envelope at the end of the day.

The attendee evaluation survey was an online survey that consisted of 21 items regarding the attendees' demographic information (e.g., professional status, teaching information) and perceptions regarding the NWO Symposium. The perception items were primarily about the sessions, but also asked about the vendors, venue, food, and program book. The section regarding the attendees' perceptions of the Symposium sessions included five items measured on a four-point Likert scale with 1=Disagree, 2=Somewhat Disagree, 3=Somewhat Agree, and 4=Agree. Sample items include, "The sessions I attended were engaging" and "I will incorporate the information/resources from the Symposium into my professional practices (e.g., teaching, administration, etc.)". The items regarding the attendees' perceptions of the vendors, food, program book and venue were measured on a four-point Likert scale with 1=Poor, 2=Average, 3=Good, and 4=Excellent. The survey also included several open-ended items to solicit attendees' comments and suggestions about the NWO Symposium. The link to the attendee evaluation survey was included in an e-mail sent to the attendees following the NWO Symposium. Reminder e-mails were sent to the attendees who did not complete the survey after one and two weeks. The overall response rate for the attendee evaluation survey was 69%.

The presenter and vendor evaluation survey was an online survey that consisted of 14 to 18 items (depending on the whether the respondent was a presenter, vendor, or both) regarding the presenters' and vendors' perceptions about the success of the NWO Symposium, and the overall quality of the NWO Symposium. The items regarding the participants' perceptions were mostly open-ended. The items regarding the overall quality of the NWO Symposium were measured on a four-point Likert scale with 1=Poor, 2=Average, 3=Good, 4=Excellent. The survey also included several open-ended items to solicit the presenters' and vendors' comments and suggestions about the NWO Symposium. The link to the presenter and vendor survey was included in an e-mail that was sent to the presenters and vendors following the NWO Symposium. Reminder e-mails were sent to those who did not complete the survey after one and two weeks. The overall response rate for the presenter and vendor survey was 61%.

OJSHS Evaluation Survey

The OJSHS evaluation survey included several items that asked participants to rate the quality of several aspects of the 2011 OJSHS, including the keynote presentation, the poster and paper judges, the organization of poster presentation space, and the awards ceremony. The survey also asked participating students to rate how effective the OJSHS was at increasing their interest in STEM research and careers. The survey included several closed-ended multiple-choice items (nine for students and four for non-students) and several open-ended items (three for students and four for non-students) that asked participants to write about their perceptions of the 2011 OJSHS and give suggestions regarding how it could be improved. A link to the online survey was included in the participants' registration packet. The link was also e-mailed to the participants one week after the end of the event. The response rate was 68% for the student participants and 34% for the non-student participants.

STEM in the Park Evaluation Surveys

STEM in the Park was evaluated with two online surveys. The Public Perceptions of STEM in the Park survey included several questions regarding the attendees' perceptions of the event. An e-mail containing a link to the online survey was sent to the 344 adult attendees who provided an e-mail address when registering for STEM in the Park. As an incentive for completing the survey, attendees were entered into a raffle to win a one-year membership to the Imagination Station, Sauder Village, or the Toledo Zoo. A total of 171 responses were collected for the attendee survey, resulting in a response rate of 49.7%.

The Exhibitor Perceptions of STEM in the Park survey included several questions regarding the exhibitors' perceptions of the event, including their perceptions of the attendees' (both children and adult) engagement in the event activities. An e-mail containing a link to the online survey was sent to 53 exhibitors the week following the event. A total of 26 responses were collected for the exhibitor survey, resulting in a response rate of 49.1%.

Community Resources Workshop Evaluation Survey

The Community Resources Workshop Evaluation Survey consists of 15 items that measure teachers' perceptions of the quality of the workshop as well as the impact the workshop had on the teachers' awareness of and attitudes toward community resources. The impact questions

asked teachers to rate their opinions twice: once to represent their opinion at the end of the CRW and another to represent their opinion as it was before the CRW, resulting in a measure of self-reported change. In addition, the survey asked teachers to estimate their monthly use of community resources during the last school year (2010-2011), and then to estimate their monthly use of community resources for the following school year (2011-2012). The survey was administered to teachers participating in the CRW at the end of the last day of the workshop.

Faculty Learning Community Survey

The Faculty Learning Community Survey consisted of four demographic items (e.g., number of years at BGSU, gender) and several items that measured participants' perceptions of the quality and impact of the learning community. Most of the items were measured on a five-point scale, with 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree. The survey was administered online at the end of the school year to faculty members participating in the NWO Faculty Research Community.

Teacher Beliefs Instrument

The Teacher Beliefs Instrument consists of two sections. The first section measures teachers' self-efficacy and outcome expectancy beliefs regarding science teaching. Some examples of items from the first section include, "I know the steps necessary to teach science concepts effectively," and "The inadequacy of a student's science background can be overcome by good teaching". The items in this section are measured on a five-point scale, with 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

The second section lists several teaching strategies and asks teachers to rate their perceptions of the importance of the strategies, their preparedness to use the strategies, and the frequency with which they use the strategies. Some examples of the teaching strategies include, "Have students make connections between science and other disciplines," and "Ask students to explain science concepts to one another". The items in this section are measured on three different four-point scales, one for each sub-scale (i.e., importance, preparedness, frequency). For the Frequency scale, 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Frequently. For the Importance scale, 1 = Not Important, 2 = Somewhat Important, 3 = Important, 4 = Very Important. For the Preparedness scale, 1 = Not Prepared, 2 = Somewhat Prepared, 3 = Prepared,

4 = Very Prepared. The survey was administered online at the beginning and end of the school year to the teachers participating in the USE-IT project.

Technology Attitudes and Usage Survey

The Technology Attitudes and Usage Survey consists of three sections. The first section measures teachers' self-efficacy beliefs about using technology in the classroom. Some examples of items from this section include, "I am continually finding better ways to use technology in my classroom," and "I find it difficult to help students who have trouble using technology in my classroom". The items in this section are measured on a five-point scale, with 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

The second section lists several instructional technologies and asks teachers to rate a) how *familiar* they are with the technology, b) how *frequently* they use the technology, and c) how *prepared* they feel using the technology. Some examples of the instructional technologies included in this section are Google sites, Professional Learning Networks, and Skype. The items in this section are measured on three different four-point scales, one for each sub-scale (i.e., familiarity, frequency, and preparedness). For the Familiarity scale, 1 = Not Familiar, 2 = Somewhat Familiar, 3 = Familiar, 4 = Very Familiar. For the Frequency scale, 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Frequently. For the Preparedness scale, 1 = Not Prepared, 2 = Somewhat Prepared, 3 = Prepared, 4 = Very Prepared.

The third section lists several strategies to integrate technology and 21st century learning into the classroom. Teachers are asked to rate how *frequently* they use the strategies, and how *prepared* they feel to use the strategies. Some examples of items from this section include, "Have students use technology to complete collaborative learning tasks," and "Facilitate learning activities that foster 21st century skills". The items in this section are measured on two different four-point scales that correspond to the scales used for the frequency and preparedness sub-scales of the second section. The survey was administered online at the beginning and end of the school year to the teachers participating in the USE-IT project.

Observations

Observations were conducted for the USE-IT project and STEM in the Park. For the USE-IT project, the evaluator observed two professional development sessions to evaluate the quality of

the professional development. The field notes taken during the observations were analyzed to determine the extent to which the session facilitators used best practices to teach participants how to use educational technology in the classroom. For STEM in the Park, two members of the evaluation staff observed children and parents interacting with exhibitors at each activity table. The observational data collected during STEM in the Park was analyzed to determine the extent to which children and parents were engaged at each activity table.

Document Analysis

Document analysis was used for the evaluation of several NWO activities and projects. The following types of documents were analyzed in order to answer evaluation questions regarding the extent and nature of the NWO regional partnerships and the faculty research learning community: attendance records, internal NWO documents (e.g., meeting minutes, e-mail correspondence, grant proposals), and research abstracts.

Evaluation Findings and Conclusions

This section will describe the evaluation findings and conclusions regarding each NWO goal. The findings will be organized by the NWO goal with which they align, and the evaluation question(s) that they answer.

NWO Goal 1: Develop the expertise of pre-service and in-service teachers in STEM and STEM education disciplines.

The NWO activities and projects that are aligned to this goal are the NWO Inquiry Series, the NWO Symposium, the Community Resources Workshop, and USE-IT. The evaluation questions will be answered using data collected from the participants of these activities and projects.

What are the participants' perceptions of NWO activities and projects?

NWO Inquiry Series

The participants' perceptions of the NWO Inquiry Series were determined from the participants' responses to the NWO Inquiry Series Evaluation survey. The survey was completed every month

from September 2010 to April 2011 by an average of 37 participants, who were asked to rate the overall value of the Inquiry Series session they attended. Some sessions were better attended than others, and therefore some sessions have more evaluation data than others. On average, five to seven evaluation surveys were completed every month for each session.

The survey responses indicate that participants generally perceived the Inquiry Series to be engaging, valuable, informative, applicable, and motivating. Table 2 includes the participants' monthly responses for each session. The average survey scores were calculated using all of the responses about a particular session over the course of the Inquiry Series (e.g., 41 total responses for Engineering is Elementary from six different evaluation surveys).

Table 2. Inquiry Series participants' average survey scores by session

Survey Item	Average Survey Score per Session					
	Engineering is Elementary (n = 41)	Soil and Water (n = 29)	Take Math Outdoors (n = 34)	The Blade & Toledo Museum of Art (n = 29)	Uncovering Student Misconceptions (n = 43)	Total
The session was engaging	3.88	3.78	3.88	3.94	3.88	3.87
The information presented during the session was valuable to me	4.00	3.66	3.93	3.75	3.89	3.85
I learned something new from the session	4.00	3.94	4.00	3.93	4.00	3.97
I will incorporate the information from the session into my classroom lessons.	3.52	3.55	3.69	3.55	3.45	3.55
Attending the session made me feel more excited about teaching science, technology, engineering, and/or math	3.71	3.54	3.60	3.88	3.69	3.68
Session Totals	3.86	3.84	3.97	3.52	3.62	---

The Inquiry Series Evaluation survey also provided participants with the opportunity to write comments and suggestions about the session they attended at the Inquiry Series. The comments indicate that participants perceived the Inquiry Series to be a high quality event, with

many participants positively commenting about the hands-on nature of the Inquiry Series sessions, and the expertise of the session facilitators. Some of the participants wrote:

> *The session kept me engaged the entire time! It was hands-on and so much fun!*

> *I was surprised how hands-on the session was. We did a little bit of explanation and discovery through PowerPoint presentations, but then we did several activities which had us learning things that we could teach in our own classroom.*

> *The sessions was packed full of great hands-on activities to do in my classroom. A great session!*

> *[The facilitator] was engaging, fun, and had excellent handouts. [S/he] modeled what to do with kids through good stuff and "problem solving".*

> *[The facilitator] did a great job with the material that [s/he] had with [her/him]. [S/he] was an engaging, knowledgeable speaker.*

Despite the fact that overall, participants agreed the least with the statement, "I will incorporate the information from the session into my classroom lessons," participants frequently commented on their intentions to use the information and resources from the Inquiry Series in their classroom. Some participants wrote:

> *I came away with problem solving ideas to use with my students.*

> *I thought the information was valuable and could easily be used in the classroom.*

> *I think that the resources will be very beneficial in my classroom.*

> *I walked away with actual materials & ideas that can be easily implemented into upcoming themes & lesson plans! It was fun!*

NWO Symposium

The participants' perceptions of the NWO Symposium were determined from the participants' responses to the NWO Symposium evaluation surveys. Overall, the responses from the session evaluation surveys indicated that attendees perceived the Symposium sessions to be engaging and valuable. In addition, the responses to the online evaluation survey indicated that the

attendees perceived the 2010 NWO Symposium to be a high-quality professional development experience. When asked if they would attend again, 64% of the attendees reported they would be very likely to attend next year. Tables 3 and 4 contain the attendees' responses to the session surveys and online attendee survey, respectively.

Table 3. Attendees' average scores for each item on the session evaluation surveys

Survey Item	Average Score
The session was engaging	3.62
The information presented during the session was valuable	3.73
I learned something new from the session	3.79
The educational community would benefit from knowing the information presented during the session	3.73
The session was easy to follow and well organized	3.70
Total	**3.72**

Note: 1=Disagree, 2=Somewhat Disagree, 3=Somewhat Agree, 4=Agree

Table 4. Attendee responses and average scores from the attendee evaluation survey

Survey Item	Responses (n=115)				
	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Average Score
The sessions I attended were engaging	0	1	34	80	3.67
The information presented during the Symposium was important to me	0	2	32	81	3.69
I will incorporate the information/resources from the Symposium into my professional practices (e.g., teaching, administration, etc.)	0	2	28	85	3.72
I learned something new from the sessions I attended	0	0	16	99	3.86
As a result of the NWO Symposium, I feel more excited about the teaching and learning of science, math, and/or technology	0	3	36	76	3.63

The qualitative responses collected from the Attendee Evaluation Survey were analyzed to identify themes among the attendee responses. One major theme was attendees' perceptions of session variety. Several attendees commented on the wide variety of sessions that were available to choose from. Some of the attendees said:

> *I liked the variety of topics covered, and the fact that it felt like there were many different sessions that touched on each sub-STEM group (physical science, math, technology, etc).*

> *I am impressed with the high quality sessions! Lots of choices for a wide range of interests. Well done!*

> *I always enjoy the wide spectrum of topics offered at the [NWO] symposium.*

Another theme among the attendees' qualitative responses was the applicability of the NWO Symposium information. These responses augment the finding that 74% of attendees agreed with the following statement in the online evaluation survey: "I will incorporate the information/resources from the Symposium into my professional practices (e.g., teaching, administration, etc.)". The qualitative responses indicated that many attendees were planning to use (or were already using) the resources/knowledge gained at the NWO Symposium in their classroom. Some attendees said:

> *I attended several that were incredible and very informative. They were wonderful and I will certainly be using those strategies in my classroom!*

> *I have already started using some of the technology I learned that day and am satisfied with how I am using it.*

The presenters and vendors were asked to rank the 2010 NWO Symposium on several factors, including organization of the event, room set-up (for presenters), exhibit space (for vendors), available technology, volunteer assistance, the venue, the food, the Symposium staff, and the Symposium overall. The responses to these items indicate a positive overall experience. Each aspect of the Symposium (except for food) was perceived to be Excellent.

The presenters and vendors were also asked to comment about the success of their sessions and/or exhibit. Most of the presenters and vendors perceived their sessions/exhibits to

be successful based on the attendees' engagement and interest in their activities/exhibit and the verbal feedback they received from the attendees. When asked if their participation in the 2010 NWO Symposium was worthwhile, 52% responded "Definitely", 41% responded "Moderately", and 7% responded "Very slightly" or "Not at all". Many of the presenters and vendors explained that their participation was worthwhile because of the available networking opportunities. However, many presenters and vendors suggested that their participation was not as worthwhile as it could have been due to the low attendance. Some of the presenters/vendors wrote:

> *Attendance was down this year . . . so much so that I'm not sure it was worth our effort to be present as a vendor.*

> *Our session had only 8 participants, so the amount of time spent in preparation for the session was quite a lot for such a small group.*

> *Disappointed that there weren't more people there. Many sessions had just a handful of participants.*

Community Resources Workshop

The participants' perceptions of the 2011 Community Resources Workshop (CRW) were determined using the responses from the Community Resources Workshop Evaluation Survey. The participants were asked to rate their level of agreement/disagreement for four statements regarding the quality/value of the workshop. Overall, the participants' responses indicated that the participants perceived the workshop to be highly valuable. More than 90% of the participants agreed with all four statements. Figure 1 illustrates the participants' responses (n=45) to each of the four statements.

Figure 1. Participants' perceptions of the 2011 Community Resources Workshop
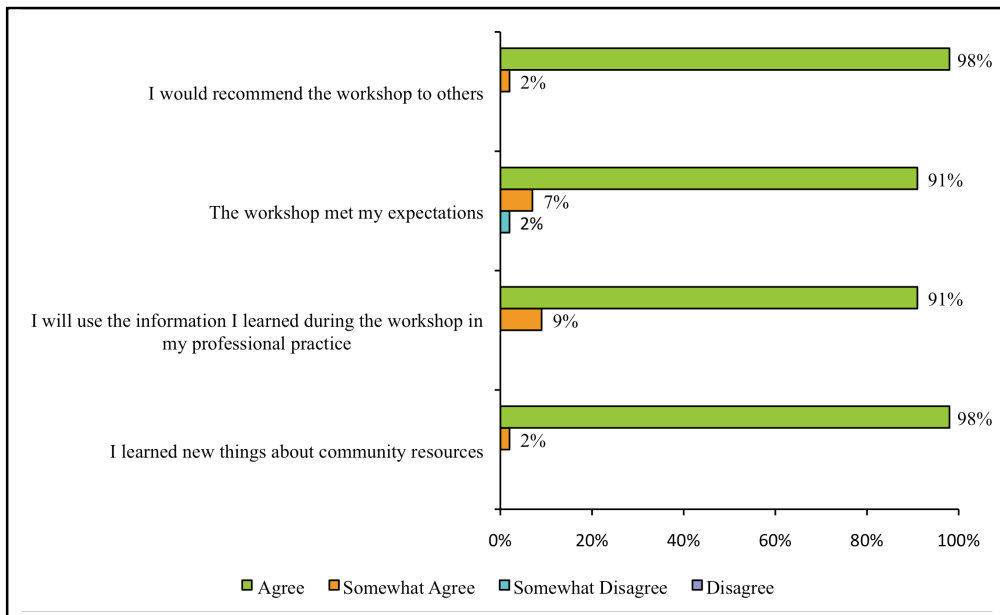
USE-IT (Uniting Science Education, Inquiry, and Technology)

The participants' perceptions of USE-IT were determined using the Inquiry Series Evaluation Survey (since the USE-IT professional development sessions took place in conjunction with the NWO Inquiry Series). The teachers who participated in USE-IT generally perceived it to be valuable and applicable to their classroom teaching. Many teachers wrote about their plans to use the technology addressed during USE-IT in their classroom:

> *I'm pretty excited to use my FlipCam in the classroom.*

> *I loved the information on Skype! I hadn't thought of using it in my classes but will now!*

> *I loved the sharing of documents with Google documents, but was thrilled to learn about the questionnaire feature – I'll be using that right away!*

The teachers' responses also indicated that the teachers liked the format of the sessions, with the facilitators modeling the use of the technology before the teachers were given time to try the technology on their own. Several teachers mentioned the benefits of the guidance provided by the facilitators, given the teachers' lack of experience with the technology being addressed.

Another aspect of the professional development that the teachers perceived to be particularly valuable was the sharing of information and experiences among colleagues. A large portion of the last professional development session was devoted to "sharing out" about the teachers' experiences during the year. Many teachers wrote about the benefits provided by this practice, and suggested that more "share out" time should be incorporated into the project.

> *Seeing what other teachers were thinking and their challenges was helpful. We could problem solve together.*

> *The colleague share was the most helpful. More of this would be appreciated.*

> *I think it would be valuable to have "share out" time each week, and allow different people to share their favorite websites and tech ideas.*

What is the impact of NWO activities and projects on participants?

Community Resources Workshop

The impact of the 2011 Community Resources Workshop was determined by measuring the change in teachers' awareness of and attitudes toward the use of community resources in their classroom. The teachers responded to the following questions on the Community Resources Workshop Evaluation survey:

- I am aware of the educational resources/services that are offered by local organizations
- I can confidently integrate community resources into my lesson plans
- Using community resources in my lesson plans can get my students excited to learn

The participants gave two responses for each of these statements – one to represent their opinion at the end of the CRW and another to represent their opinion as it was before the CRW. Wilcoxon tests were conducted to evaluate whether the participants' responses significantly changed as a result of the CRW. The results indicated that teachers significantly improved their awareness of and attitudes toward the use of community resources in their classroom as a result of the CRW. Teachers' average survey scores are found in Table 5.

Table 5. Changes in teachers' awareness of and attitudes toward using community resources

Survey Item	Average Pre-CRW Score (S.D.)	Average Post-CRW Score (S.D.)	Wilcoxon test p-value
I am aware of the educational resources/services that are offered by local organizations	2.44 (.69)	4.00 (.00)	< .001
I can confidently integrate community resources into my lesson plans	2.52 (.66)	3.87 (.34)	< .001
Using community resources in my lesson plans can get my students excited to learn	3.28 (.77)	4.00 (.00)	< .001

Note: Any p-value less than .05 is considered significant

USE-IT

The impact of USE-IT was determined by measuring the change in teachers' beliefs and behaviors regarding science teaching and technology integration with the Teacher Beliefs Instrument and the Technology Attitudes and Usage Survey, respectively. Figures 2 and 3 illustrate the teachers' average survey scores from before and after the project.
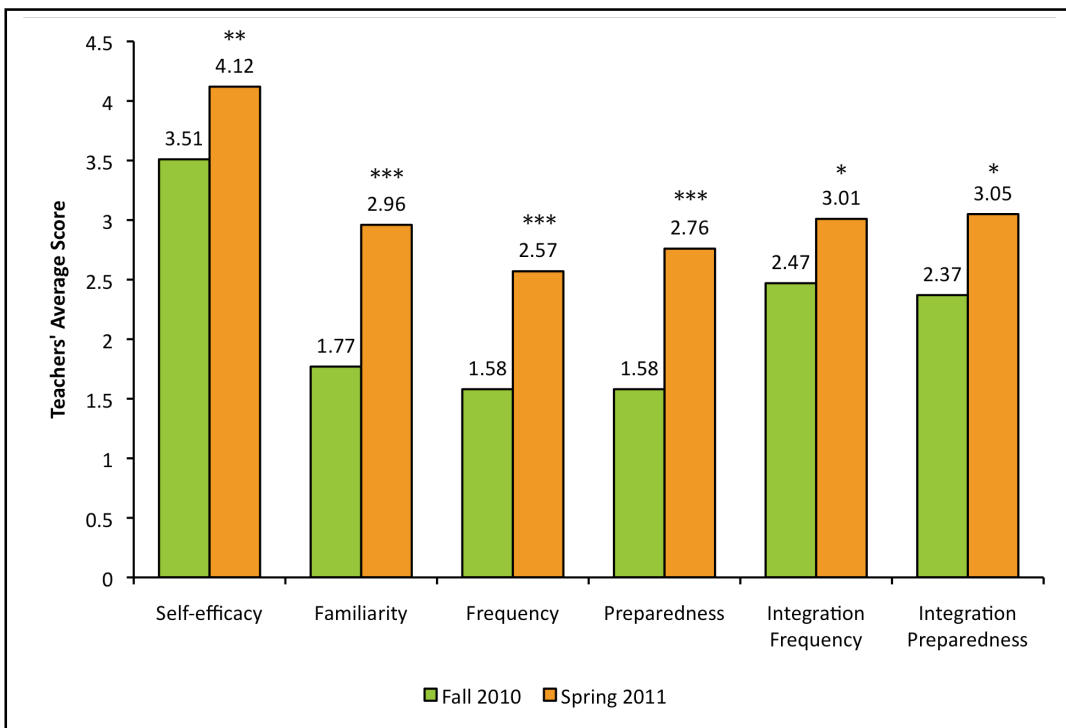
Figure 2. Changes in USE-IT teachers' beliefs and behaviors regarding science teaching
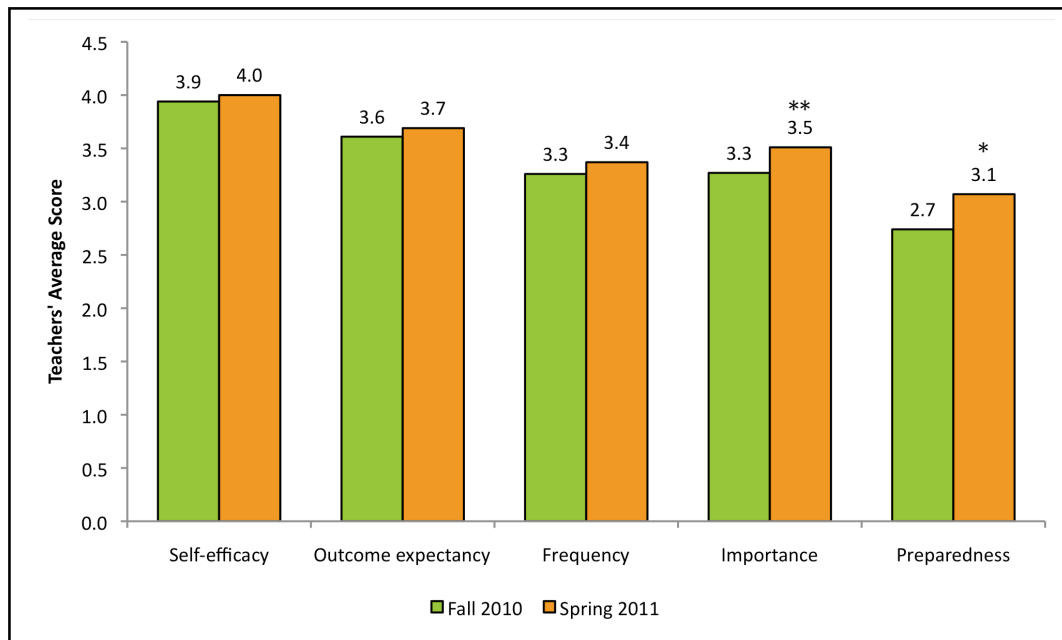
Note: * p < .05, ** p < .01; Self-efficacy and outcome expectancy were measured on a scale of 1-5, and all others were measures on a scale of 1-4.

The results of the Teacher Beliefs Instrument indicate that after USE-IT, teachers believed reform-based science instructional strategies to be more important, and felt more prepared to use the strategies than before the project. Teachers did not improve their self-efficacy or outcome expectancy beliefs regarding science teaching, nor did they more frequently use reform-based strategies after the project than before. These data suggest that USE-IT may have helped teachers to see the importance of reform-based science teaching and to feel more prepared to use reform-based strategies. The lack of a control group makes it difficult to attribute the observed change in beliefs solely to USE-IT – especially since the effect sizes weren't that large – but it's likely that the project did, to some extent, positively influence teachers' beliefs about science teaching.

Figure 3. Changes in USE-IT teachers' beliefs and behaviors regarding technology integration

*Note: * p < .05, ** p < .01, *** p < .001; Self-efficacy and outcome expectancy were measured on a scale of 1-5, and all others were measures on a scale of 1-4.*

The results demonstrate that after participating in USE-IT, teachers 1) felt more self-efficacious about integrating technology in their classroom, 2) were more familiar with the

technology addressed during the project, 3) used the technology addressed during the project with greater frequency, 4) felt more prepared to use the technology addressed during the project, 5) used technology integration and 21st century learning strategies with greater frequency, and 6) felt more prepared to use technology integration and 21st century learning strategies.

Conclusions

The evaluation findings indicate that NWO was successful in achieving its goal of developing the expertise of pre-service and in-service teachers in STEM and STEM education disciplines. Teachers generally had positive perceptions regarding the NWO Inquiry Series, NWO Symposium, Community Resources Workshop, and the USE-IT project. These activities and projects provided opportunities for both pre-service and in-service teachers to develop their expertise in STEM and STEM education. The teachers' written comments on the evaluation surveys suggested that teachers intended to use the knowledge and resources gained from the NWO activities and projects in their classroom. Furthermore, teachers improved their attitudes about STEM and STEM education as a result of participating in the NWO activities and projects.

NWO Goal 2: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.

What are the participants' perceptions of NWO activities and projects?

OJSHS

The participants' perceptions of the Ohio Junior Science and Humanities Symposium (OJSHS) were determined using the OJSHS Evaluation survey. Both students and non-students (e.g., teachers, parents, paper and poster judges, OJSHS staff/volunteers) were asked to rate several components of the 2011 OJSHS, including the evening events, keynote presentation, awards ceremony, and the 2011 OJSHS overall. Overall, the participants' had positive perceptions of the 2011 OJSHS, with more than 80% of participants rating most components as "Good" or "Excellent". The students' and non-students' responses are shown in Tables 6 and 7.

Table 6. Student perceptions of the 2011 OJSHS		
OJSHS Component	n	Mean
Wednesday and Thursday evening activities	67	3.69
Keynote presentation	69	3.81
Paper and poster judges	79	2.96
Organization of the poster presentation space	69	2.97
Organization of the paper presentation space(s)	65	3.68
Awards ceremony	68	3.38
T-shirts	78	3.28
2011 OJSHS Overall	80	3.70

Note: 1=Poor, 2=Average, 3=Good, 4=Excellent

Table 7. Non-student perceptions of the 2011 OJSHS		
OJSHS Component	n	Mean
Online registration process	11	3.00
Wednesday and Thursday evening activities	12	3.83
Keynote presentation	15	4.00
Organization of the poster presentation space	22	3.45
Organization of the paper presentation space(s)	17	3.82
Awards ceremony	12	3.58
2011 OJSHS Overall	22	3.77

Note: 1=Poor, 2=Average, 3=Good, 4=Excellent

Students rated the paper and poster judges and the organization of the poster presentation space lower than any other aspect of the 2011 OJSHS. Accordingly, many of the students' written responses addressed the judges and the poster space. Three students mentioned that a larger variety of judges (in terms of expertise) would have improved the paper and poster judging. Several students noted that the space for poster presentations was too small, and a few students further commented that some students had more space than others.

Non-students rated the online registration and the organization of the poster presentation space lower than any other aspect of the 2011 OJSHS. The comments explained that the "posters were a bit more crowded this year than in the past" and that there "needs to be better defined poster space for each participant". The only comment about the online registration was that "teachers need a little more information to ensure that the students are registered".

In addition to rating the OJSHS, participants were also asked to describe their experience at the 2011 OJSHS in their own words. Two of the main themes that emerged from the students' responses were the opportunity for student-student interaction, and the learning that occurred among students. Some of the students wrote:

> *I liked the opportunity to meet other students and listen to the research that they were conducting*

> *I loved getting to know people who have similar interests in STEM education.*

> *I really enjoyed seeing other people's projects and research. There are many fields that I found very interesting and never would have thought to explore.*

> *I loved that I was being exposed to other people that did research in levels higher than me because it helped me create ideas of projects that I could do.*

The overall tone of the non-student responses was positive – many participants reported that they enjoyed different aspects of the event as well as the event in general. The poster judges specifically stated that they enjoyed talking to the students. Many of the non-student participants echoed the comments of the students, emphasizing the role of OJSHS in fostering positive student-student interactions. One participant wrote:

> *It's more than a competition. It allows the students to interact with one another and share ideas. I love that aspect of it.*

When asked about their intentions to participate in the future, 83% of students who are eligible to return next year (i.e., not 12th graders) reported that is very or moderately likely that they will be involved with the OJSHS next year. Similarly, 87.5% of the non-student participants reported that is very likely that they will be involved with the OJSHS next year. The remaining 12.5% reported that it is not all likely that they will be involved with OJSHS next year.

STEM in the Park

The participants' perceptions of STEM in the Park were determined using the Public Perceptions of STEM in the Park survey and the Exhibitor Perceptions of STEM in the Park survey. Most of the attendees who responded to the survey reported that attending STEM in the

Park moderately improved their awareness of community STEM organizations and resources and their knowledge about STEM. Also, most attendees also reported that their children were substantially engaged in STEM activities during STEM in the Park, and substantially improved their knowledge about STEM as a result of STEM in the Park. Table 8 includes the attendees' responses to several items from the Public Perceptions of STEM in the Park survey.

Table 8. Attendees' perceptions of STEM in the Park

Survey Item	Responses (n = 171)				
	Not at all	Very slightly	Moderately	Substantially	N/A
How much did STEM in the Park increase your knowledge about STEM?	1.8%	12.4%	64.5%	21.3%	-
How much did STEM in the Park increase your awareness of community organization and resources?	2.4%	11.2%	44.4%	42.0%	-
How much do you think STEM in the Park increased your children's knowledge about STEM?	1.2%	6.4%	39.2%	48.5%	4.7%
How engaged were your children with the STEM in the Park activities?	0%	1.2%	12.9%	81.8%	4.1%

Overall, the attendees' comments were very positive. Many respondents wrote how impressive the event was, and expressed their gratitude for being able to attend a free community event. Some examples include:

In this day and age it was SO WONDERFUL to go to such a great, organized, and educational program ... for free. Sorry, but most people with kids don't have a lot of extra money. So, thanks! We also took advantage of the lessons to help with our homeschooling science class.

I would really like to thank all the workers and volunteers for making such a great impression on my husband and I and my boys. We also were so impressed with all the activities and fun simple things that got my kids interested in STEM. I really hope you will continue to have this event every year. Thank you very much for a great Saturday!!!!

The exhibitors' survey responses mirrored those of the attendees, in that they demonstrated that STEM in the Park was an engaging event for children and adults. Almost all of the exhibitors reported that the children seemed excited and enthusiastic about participating in the activities. Three of the exhibitors wrote:

> *The children embraced the activity, asked great questions and worked hard to excel. I was pleasantly surprised at the level of participation, and the level of enthusiasm.*

> *Children dragged their parents to the table. Some children kept coming back – one 12 year old spent the entire time "helping" with the demo. Children enjoyed passing the critters on to the other children and telling them what they knew about the critters.*

To what extent do NWO activities and projects attract and sustain interest in STEM?

OJSHS

Since student participation in the OJSHS is voluntary, it is likely that most student participants already have a fair amount of interest in STEM. However, the OJSHS seeks to provide an environment that nurtures and grows students' interest in STEM. In order to determine the role of the OJSHS in attracting and sustaining interest in STEM, students were asked to rate their level of agreement with three statements. The students' responses to the statements are found in Table 9.

Table 9. The impact of the OJSHS on students' interest in STEM

Survey Item	n	Mean
Participating in the OJSHS increased my interest in STEM research.	79	3.58
The OJSHS provided me with valuable opportunities to network with other students and STEM professionals.	80	3.39
The OJSHS increased my desire to pursue a career in STEM.	80	3.30

Note: 1=Definitely Disagree, 2=Kind of Disagree, 3=Kind of Agree, 4=Definitely Agree

The non-student participants were also asked to describe the impact of the 2011 OJSHS on students' interest in and understanding of STEM. Although it is likely that most of the participating students were already interested in STEM, many non-student participants suggested that the OJSHS provided students with motivation to continue learning and conducting research about STEM. Some of the participants wrote:

> *The experience seems to greatly motivate the students to do more in the field. They want to research more and do higher quality work after watching the paper presentations.*

> *The younger students especially were appreciative of feedback and showed marked interest in returning next year.*

> *This event piques our students' interests and has many interested in continuing research and returning next year!*

STEM in the Park

The main purpose of STEM in the Park is to engage children and adults in hands-on STEM activities in order to improve and sustain their interest in STEM. The impact of STEM in the Park on the attendees' interest in STEM was determined by the attendees' responses to the Public Perceptions of STEM in the Park survey. Table 10 includes the attendees' responses to two survey items regarding interest in STEM.

Table 10. The impact of STEM in the Park on attendees' interest in STEM

Survey Item	Responses					
	Much less	A little less	About the same	A little more	Much more	N/A
Do you think your children are more or less interested in STEM after coming to STEM in the Park?	0%	0%	9.9%	28.1%	58.5%	3.5%
Is your family more or less likely to do activities related to STEM after coming to STEM in the Park?	0%	0%	17.8%	40.8%	41.4%	-

The findings indicate that STEM in the Park was successful at improving children's interest in STEM. The survey responses also indicate that STEM in the Park had a lasting impact

on attendees' interest in STEM. As a result of attending STEM in the Park, most attendees (41%) reported being much more likely to do other STEM-related activities. Moreover, many families reported doing some of the STEM in Park activities at home, and more families anticipated doing the activities in the future. Many of the respondents' wrote about the lasting impact of STEM in the Park on their children.

> *My three girls absolutely loved this event. Everyone that they have seen since then they tell them about what they did and learned and show them some of the activities they had made.*

> *My 4 and 7 year old girls were fully engaged, loved every activity, and we did science activities for the remainder of the day as a result. They are still flying their airplanes, and are making preparations to make baking soda rockets later this week.*

> *First time I say my kids so engaged – they simply could not get over their DNA – they carried it all over with them for days!*

> *We have already planted our garden (thanks WBGU!) and look at the seeds every morning to see if they've germinated.*

Conclusions

The evaluation findings indicate that NWO was successful in achieving its goal of attracting and retaining students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty. Although STEM in the Park and OJSHS were mainly centered around students, there were opportunities for teachers and faculty to be involved. The evaluation findings indicate that students, teachers, and faculty perceived the activities to be valuable, engaging, and influential in the improvement and sustainability of students' interest in STEM.

NWO Goal 3: Conduct and communicate collaborative research in STEM and STEM education disciplines.

What are the participants' perceptions of the research community?

The participants' perceptions of the research community were determined using the Faculty Learning Community Survey. Seven faculty members completed the survey at end of the 2010-2011 school year. There were five items on the survey that measured participants' general perceptions of the learning community. The participants perceived the learning community to be meaningful, well organized, and conducive to collaboration. The participants' survey responses are found in Table 11.

Table 11. Participants' perceptions of the Faculty Research Learning Community

Survey Item	Responses (n = 7)					Mean Score
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
At each meeting I learned something new and practical	0	14% (1)	14% (1)	29% (2)	43% (3)	4.0
This LC was a meaningful/productive professional development experience	0	0	14% (1)	29% (2)	57% (4)	4.4
The LC meetings were well organized	0	0	0	43% (3)	57% (4)	4.6
The lines of communication in this LC were open and strong	0	0	0	43% (3)	57% (4)	4.6
This LC felt like a community	0	0	14% (1)	0	86% (6)	4.7

Note: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

What is the nature of participants' contribution to STEM teaching and learning research?

The participants in the Faculty Research Learning Community worked throughout the year on collaborative research projects regarding STEM teaching and learning. The participants' contribution to STEM teaching and learning research can partly be determined by the number of presentations and manuscripts that resulted from the research community. Four articles were

prepared for peer-review during the 2010-2011 Faculty Research Learning Community: (The abstracts for these articles can be found in Appendix A.)

- "Developing and Validating an Instrument to Measure Motivation, Engagement, & Attitudes in College Biology" by Matthew L. Partin, Eileen Underwood and W. Robert Midden

- "Use of Help Sheets on Exams to Motivate Students in College Algebra" by Beth Burns and Lindsey Haubert

- "Technology Integration in Early Childhood Science Education" by Rick Worch, Lan Li and Terry Herman

- "Effectiveness of In-Class Activities on Student Learning and Motivation in Introductory Astronomy" by Kate Dellenbusch and John Liard

In addition to these four research articles developed during the 2010-2011 Faculty Research Learning Community, the NWO Team wrote eleven other articles during the 2011 fiscal year. The NWO Team meets bi-weekly during the academic year, and consists of faculty and staff from several STEM and STEM education departments in Bowling Green State University.

Conclusions

The evaluation findings demonstrated that NWO was successful in achieving its goal of conducting and communicating collaborative research in STEM and STEM education disciplines. The Faculty Research Learning Community was the main activity that facilitated communication and collaboration regarding research among STEM and STEM education faculty members. The participants in the learning community perceived it to be valuable and well organized. And as a result of the learning community, many of the participants developed, conducted, and communicated research studies regarding STEM teaching and learning. A broader contribution to STEM teaching and learning research is recognized by considering the work of the faculty and staff that are members of the NWO Team.

The evaluation findings in this section will describe *how* NWO developed and sustained regional partnerships, and *what* those regional partnerships looks like. The first part of the evaluation question will be answered by breaking down the actions of NWO into those that sustained and developed existing regional partnerships, and those that created and developed new regional partnerships. The second part of the evaluation question will be answered by analyzing meeting minutes and other internal documents to determine the nature of NWO's regional partnerships.

To what extent do NWO activities and projects develop and sustain regional partnerships, and what is the nature of those partnerships?

During the 2011 fiscal year, the NWO activities and projects fostered and maintained regional partnerships. Almost all NWO activities and projects were founded upon long-standing relationships between NWO and its partners. As such, the implementation of these activities and projects successfully sustained and developed existing regional partnerships with multiple colleges and departments at Bowling Green State University, K-12 schools, educational service centers, community organizations, and businesses.

Existing regional partnerships were sustained in several ways. First, NWO professional development activities (i.e., Inquiry Series, Symposium, USE-IT, Community Resources Workshop) during the 2011 fiscal year were largely facilitated by regional partners. The NWO Symposium included dozens of sessions facilitated by teachers, university faculty, informal educators, and STEM business professionals from northwest Ohio. Likewise, the Community Resources Workshop was coordinated and facilitated by several community organizations and businesses in the area. Second, STEM in the Park provided an opportunity for NWO partners to come together as a group to improve STEM awareness and interest in northwest Ohio. This event was mutually beneficial to all partners involved, in that partners could provide community outreach and perhaps increase their community visibility while contributing to an overall successful NWO event. Third, the NWO Collaborative Council (NWOCC) met six times from

October 2010 to May 2011. Twenty-one individuals from partnering K-12 schools, institutions of higher education, community organizations, and businesses attended the NWOCC meetings. The NWOCC meeting minutes indicate that the content of the meetings mostly included updates and announcements regarding activities and projects implemented by NWO and its partners, and discussions about educational issues in northwest Ohio (e.g., changing Ohio standards in science and math). The meetings were collaborative in nature, in that members of the NWO staff and the NWOCC attendees discussed together the current and future activities of NWO, and determined what role each partner could play in the activities to ensure that the partners are mutually benefited. Fourth, NWO participated in various ways in the development and implementation of regionally collaborative grant proposals. NWO provided assistance to several of its partners in the development and implementation of their grant projects. NWO assisted in the writing of seven grant proposals, the recruitment of participants for 41 activities and grant projects (via e-mail communication and the dissemination of NWO newsletters), and the evaluation of four grant projects. Some of these services were not provided by NWO in the past, and therefore added another collaborative aspect to existing partnerships. The existing partnerships also provided support to NWO in the development and implementation of grant projects. Partnering K-12 schools and community organizations drafted letters of support and assisted in the planning for NWO grant proposals. Fifth, the NWO Team, which consists of NWO staff and BGSU faculty members from the Colleges of Arts of Sciences, Education, and Technology, met biweekly during the school year. The NWO Team meetings provided a venue for collaborative discourse among STEM and STEM education faculty and staff regarding the current and future direction of NWO. According to the NWO Team meeting minutes, topics of discussion included NWO funding opportunities, modifications to NWO goals, and upcoming NWO events and activities. Although these partnerships were contained within BGSU, and therefore were not necessarily regional, the decisions and suggestions made within the meeting had regional impacts. Sixth, the NWO Inquiry Series and Symposium were again hosted at Rossford High School and Penta Career Center, respectively. It was the third and second time, respectively, that those partners hosted the Inquiry Series and Symposium.

In addition to sustaining existing partnerships, many NWO activities and projects also created new partnerships. For example, many local organizations that had never before partnered with NWO participated in STEM in the Park in 2010. However, the most salient examples of

new partnerships are the activities associated with the development of the NWO STEM Consortium, which was created in January 2011 as a result of funding from the Ohio Board of Regents in association with the Ohio STEM Learning Network and the Ohio STEM Committee. The funding allowed NWO to expand its network of partners across the 29 counties of northwest Ohio. The preparation and implementation of this grant proposal resulted in new partnerships with educational organizations in more distant regions of northwest Ohio. Several school districts in the southern and eastern most regions of northwest Ohio, for example, became major partners in the NWO STEM Consortium. Bob Midden, the director of NWO, cultivated new K-12 school partnerships by visiting dozens of schools in northwest Ohio throughout the development and implementation of the NWO STEM Consortium grant.

One component of the NWO STEM Consortium was the formation of a regional Advisory Board, consisting of representatives from all regions in northwest Ohio. The Advisory Board met twice during the 2011 fiscal year – once in March and again in May. The first meeting introduced the main purposes of the STEM Consortium and included discussions about the STEM education resource center that was being developed by NWO, a strategic plan for the NWO Consortium, and identifying and recruiting STEM business and government partners. The second meeting included discussions about the effective assessment of STEM learning, identifying best practices for promoting STEM learning, and inspiring administrators and communities to adopt best practices in STEM teaching and learning.

The NWO Consortium activities also allowed for the expansion of NWO's communication network by funding a print newsletter and a STEM resources website. Two print newsletters were sent during the 2011 fiscal year – one in February and the other in May – to more than 5,000 educators, STEM professionals, business people, and government employees in Ohio. The comments from a few members of the Consortium Advisory Board suggest the newsletters were visually appealing, and included valuable information for NWO partners. The STEM resources website (www.nwostemresources.org) was developed from January to June of 2011. Members of the NWO STEM Consortium Advisory Board previewed the site, and were asked to provide feedback regarding its formatting, navigation, and usefulness. The feedback from the Advisory Board was positive, suggesting that the resource center was nicely formatted, easy to navigate, and useful to stakeholders like teachers, administrators, informal educators, businesses, and parents.

The expansion of NWO's communication network also resulted in more individuals receiving the NWO e-newsletter. About 2,000 teachers, administrators, university faculty, undergraduate and graduate students, community partners, and business partners received the NWO e-newsletter every month during the 2011 fiscal year. Starting in June of 2011, the number of e-newsletters sent by NWO substantially increased from about 2,000 to over 6,000. Two evaluation surveys were administered online regarding the NWO e-newsletters. One survey was administered in February, and another survey was administered in May. Survey respondents were asked to rate several aspects of the e-newsletters (e.g., length, layout), and provide comments and suggestions for improvement. The survey results indicate that readers of the NWO e-newsletter typically read at least 75% of the newsletter, and perceive it to be "good" in terms of its length, layout, readability, and value. Furthermore, the results demonstrate that the e-newsletter increases awareness of STEM resources and opportunities, and is a source of motivation for improving STEM education. Table 12 includes the results of the two NWO e-newsletter evaluation surveys.

Table 12. Survey respondents' perceptions of the NWO e-newsletter

Survey Item	Average Score	
	February	May
Length	3.0	3.0
Layout	2.9	3.1
Readability	3.1	3.3
Value	3.3	3.2
Overall Satisfaction	3.2	3.3
The e-newsletter was useful to me*	3.6	3.7
The e-newsletter increased my motivation to improve STEM education in my school/organization*	3.4	2.4
The e-newsletter increased my awareness of STEM professional development opportunities, grants, and resources*	3.8	3.9

Note: Rating scale was 1=Poor, 2=Average, 3=Good, 4=Excellent for the items without an asterisk, and 1=Disagree, 2=Somewhat Disagree, 3=Somewhat Agree, 4=Agree for the items with an asterisk

The comments and suggestions provided by survey respondents on the February evaluation survey led to several changes in the format and layout of the NWO e-newsletters (e.g., change in background color, layout of articles). The survey data from the May evaluation survey suggest that the changes were successful in improving the layout and readability of the e-newsletter.

Conclusions

The evaluation findings demonstrate the NWO was successful in achieving its goal of developing and sustaining a regional collaborative alliance including university, school, informal education, and business partners through a shared vision and collaborative spirit for tackling current STEM education issues. NWO maintained it current partnerships with almost every activity and project implemented during the 2011 fiscal year. In addition, new partnerships were formed across northwest Ohio, due largely to the funding of the NWO STEM Consortium in January of 2011. The NWO partnerships were collaborative in nature, with NWO both providing and receiving assistance in various forms from its partners throughout northwest Ohio.

NWO Goal 5: Support higher education faculty and future faculty in pursuit of the best practices in STEM and STEM education disciplines to enhance undergraduate and graduate education.

What is the impact of the research community on participants' STEM research and teaching practices?

The impact of the research community on participants' STEM research and teaching practices was determined by the participants' responses on the Faculty Learning Community Survey. There were five items on the survey that measured the participants' perceptions regarding the impact of the learning community on their STEM research and teaching practices. Most of the participants agreed that the learning community resulted in the implementation of new pedagogies and learning strategies, which resulted in an increase in student learning. Furthermore, the participants' responses suggest that the learning community successfully

facilitated the development of collaborative research projects. The participants' survey responses are found in Table 13.

Table 13. The impact of the Faculty Research Learning Community on participants' STEM research and teaching practices

Survey Item	Responses (n = 7)					Mean Score
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
As a result of this LC, I have initiated new pedagogies and learning strategies in my classroom or program	0	0	29% (2)	14% (1)	57% (4)	4.3
This LC was useful for increasing student learning	0	0	14% (1)	29% (2)	57% (4)	4.4
This LC was useful for establishing collaborations, finding collaborators, broadening my professional network	0	14% (1)	0	0	86% (6)	4.6
As a result of this LC, I have increased the number of learner-centered activities in my classroom or program	0	0	33% (2)	33% (2)	33% (2)	4.0
As a result of this LC, I have incorporated activities/assessments that allow students to reflect on their learning	14% (1)	0	43% (3)	0	43% (3)	3.6

Note: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

Recommendations

The evaluation findings suggest that the NWO participants generally have positive perceptions of NWO activities and projects. The participants perceived the activities and projects to be meaningful and valuable for their professional practice, and successful in providing engaging and interesting STEM-related learning opportunities. However, the evaluation findings also suggest ways that the NWO activities and projects can be improved. Most NWO evaluation instruments encouraged participants to comment about the strengths and weaknesses of the NWO activities and projects, and suggest methods for improvements. The participants'

comments and suggestions, in conjunction with other evaluation data, were used to develop several recommendations regarding the future implementation of the NWO activities and projects. This section of the report will outline and describe recommendations for several NWO activities and projects.

STEM in the Park

Consider making STEM in the Park longer than three hours.

Many of the attendees commented that there was not enough time to participate in all of the activities at STEM in the Park. In fact, the only negative comment made by many attendees was that the event did not last long enough. A few exhibitors also suggested that the event be extended.

Reorganize the lunch area to shorten the lunch line for attendees and give volunteers and exhibitors easier access to lunch.

Most attendees stood in line for lunch for more than 20 minutes, and many went to eat inside the Student Union to avoid the long line. In addition, many of the exhibitors did not get to eat lunch. The lunch area could be reorganized by creating two serving lines instead of one. Also, a separate serving line could be created for volunteers and exhibitors.

Make it easier for attendees to locate certain activity stations.

Many of the attendees suggested that a map should be distributed that allows the attendees to find certain activity stations. While mapping every specific activity station may be unreasonable, NWO could designate several "zones" in which certain activity stations can be found. A map displaying these zones and the activity stations within them could be distributed to the attendees at the registration table.

Recruit more volunteers to facilitate the event.

Several attendees and exhibitors mentioned that the some of the activity stations were crowded. To alleviate the congestion, it is suggested that either 1) exhibitors bring additional staff or 2) NWO recruit more student volunteers to interact with the attendees at the activity station. This would allow for more of the attendees to engage in the activities at the same time.

Make curricular and instructional decisions regarding the content of the project based on teachers' previous experience and current needs.

The findings of the project indicated that while some teachers had very little experience with technology, while other teachers had a lot of experience with technology. As a result, some teachers suggested that the pace of instruction be slowed down, while other teachers suggested that the pace be sped up. In order to enact this recommendation, facilitators might consider formatively assessing the teachers in the project regarding their knowledge and experience with certain types of technology. These data could then be used to guide the development of the professional development sessions. Formative assessment could also be used to identify the types of technology that teachers want and need to learn about.

Provide more structured examples regarding the use of technology for science teaching.

The project would likely be more beneficial to science teachers if the technology addressed during the project were situated within a science context. For example, facilitators might do an actual science lesson with the teachers as the students, using technology throughout the lesson. This way, teachers could explicitly see how the technology might be used in their science classroom.

Allow teachers more time to explore the technologies that are being addressed, specifically in how they could be used in the classroom.

Many teachers suggested that they be given more time to explore the technologies being addressed during the project. According to the professional development observations, teachers were given a fairly large amount of time to play around with the technology in each session, but this time seemed to be aimed at understanding the technical aspects of the technology (e.g., the features of the technology, how to find one's way around the technology). However, perhaps teachers could be given time to explore how the technology might be used in the classroom. Teachers could be encouraged to try out their idea in their classroom before the next professional development session, and then share with the rest of the class how their idea worked.

Continue to allow teachers to "share out" at each of the monthly sessions.

Throughout the project, teachers were given several opportunities to share with the other teacher participants how they were implementing technology in their classroom. This seemed to be valuable aspect of the project, and would be worthwhile to ensure that teachers were given the opportunity to have these discussions at each professional development session. Teachers' comments on the session evaluations illustrated that sharing their progress and listening to other teachers' progress was an important and beneficial part of the monthly sessions.

Designate a specific time during the NWO Symposium when attendees can visit the vendor exhibits.

The vendors gave many positive comments about the "split lunch" format, and overall seemed to encourage the continuation of the format for future Symposia. One vendor, however, stated that the format might have been better if sessions had not been offered at the same time. Along the same line, some teachers reported not eating because they did not want to miss any of the sessions that were offered during the lunch hours. Therefore, it is recommended that the split lunch format be continued but that sessions not be offered during those hours. This would reduce crowding, provided greater flexibility, and explicitly provide time for browsing vendor exhibits.

Include a keynote presentation at the beginning of the Symposium

Some of the presenters and vendors commented about the absence of a keynote speaker for the 2010 NWO Symposium. The addition of a keynote presentation at the beginning of future Symposia would provide an opportunity for staff to welcome attendees and make announcements, and would allow attendees to greet each other and organize their day (e.g., choose which sessions they want to attend). A keynote speaker may also motivate more people to attend future Symposia.

Decrease the number of sessions that are offered at the Symposium.

The most salient comment among the presenters was the low attendance at the 2010 NWO Symposium. Attendees also commented about the low attendance, mostly suggesting that session discussions would have been stronger and more meaningful if more people had attended. The low session attendance (average of 10) was likely due to the combination of low overall attendance and an increased number of offered sessions for the 2010 NWO Symposium. Therefore, one potential solution is to decrease the number of sessions that are offered for future Symposia. The removal of the lunch sessions and addition of a keynote speaker will help to reduce the number of sessions in the future. In addition, repeated sessions could be eliminated in order to decrease the number of sessions during each hour of the Symposium. Therefore, even if the overall attendance remains low, a smaller number of sessions would result in higher per session attendance.

Include a chart of sessions in the program book.

A few attendees suggested that a chart of sessions be included in the program book in order for attendees to visualize all of the sessions offered during the day. Although this suggestion was not mentioned by a large number of people, it may be a useful planning tool for NWO Symposium attendees.

Develop a new system of labeling sessions in the program book.

In 2010, as has been the practice in the past, sessions were labeled in the program book as Earth/Space Science, General Science, Life Science, Mathematics, Pedagogy, Physical Science, Pre-Service, and/or Technology according to their content. These labels, in addition to the session summary, are meant to provide the attendees with an idea of what the session is about, and whether or not it would be meaningful to attend. However, in many cases, all of the labels were applied to one session, thus making it difficult to discern what the session was really about.

Offer more technology and mathematics sessions, as well as sessions that focus on special needs education, cross-curricular education, and the new Ohio standards.

This suggestion is based on the attendees' responses to the following question: What educational issues/topics would be beneficial to address at the NWO Symposium next year? The most common responses were mathematics and technology integration. Even though the 2010 NWO Symposium was more balanced than in the past in terms of its content, attendees still suggested that more technology and mathematics sessions be offered. Attendees also suggested that is would be helpful to learn about cross-curricular education, special needs education, and the new Ohio standards.

Offer different food choices than what was offered for the 2010 NWO Symposium.

While some participants made positive comments about the food, many attendees, presenters, and vendors suggested that different food choices be offered in the future. The food was the only aspect of the NWO Symposium that received substantially lower ratings in 2010 than in 2009.

Modify the system by which posters are judged

This general suggestion is actually comprised of two more specific suggestions about the poster judging system. One suggestion, which came mostly from participating students, was to ensure a greater variety among the judges in terms of their expertise. Some students perceived that most of the judges came from the "hard science" fields, and suggested that more judges be recruited from fields like psychology and other social sciences. Another suggestion that was given by students and non-students alike was to have two judges evaluate each poster. This suggestion could be based on the fact the judging rubric contains several large scales that might be used differently by two different judges. Having a team of judges for each student might help to standardize the scoring process.

Re-organize the space for poster presentations

Issues regarding the space for poster presentations were among the most commented on by the 2011 OJSHS participants. Both students and non-students believe that changes need to be made to improve the poster space. The greatest concern was the lack of space that students had to present their posters. One non-student participant suggested that a ballroom be used instead of the room that was used this year. Another issue regarding the poster space was the lack of consistency in the amount of room that each student had to set up their poster. Since the poster space was made up of a series of tall panels, students who arrived early could potentially use more space than those who arrived late. One solution might be to establish measurement standards (for how tall and wide a poster can be) to which students must adhere. Not surprisingly, the poster presenters were the main source for this suggestion.

Continue to offer ice skating, curling, and campus lab tours

Many students provided positive comments regarding the non-presentation activities. Specifically, the students mentioned that they enjoyed ice skating, curling, and the campus lab tours. Some students, however, suggested that the lab tours be made optional or that students should be allowed to choose which lab(s) they tour. This would allow students to have more free time if they chose to, which was another common message among the students.

Provide opportunities for teachers to "network" during the workshop

A few teachers mentioned that having time to network with other teachers (i.e., discuss ideas among themselves as a group or in grade level groups) would have improved their experience at the CRW.

Add more/different resources to the CRW.

This recommendation is based on teachers' comments about two different issues related to the content of the CRW. First, teachers suggested a few resources that could be added to the CRW in the future. These resources included the S.S. Boyer, the Toledo Fire Museum, Kelly's Island, and Ritter Planetarium. Second, a few teachers suggested changing the resources every year to allow the same teachers to attend the workshop more than once. While it is probably not feasible to completely change the workshop every year, it does seem possible to add a few new resources each year (in place of some others). Also, continuing to focus on a new theme each year may allow repeat participants to learn how resources can be used in multiple ways for multiple subjects.

Seek out sources of funding that would decrease/eliminate participants' registration fee and provide teachers with some free resources to use during the school year.

Although some of the community resources presented at the workshop are free for teachers, many resources are not, and therefore are unlikely to be used by teachers due to their schools' budget constraints. If the Community Resources Consortium could locate external funding, they could provide participants with a free community outreach program for their classroom. In addition, external funding could be used to reduce or eliminate the participants' registration fee, which would likely increase the number of participants who attend the CRW, and expand the reach of the partnering community organizations.

Developing and Validating an Instrument to Measure Motivation, Engagement, & Attitudes in College Biology

by Matthew L. Partin, Eileen Underwood, and W. Robert Midden

Student engagement is seen as an indicator of successful classroom instruction. Instruments are available to assess student engagement, but these can be long and cumbersome to administer. We set out to design and test an instrument that would examine not only engagement but also motivation and attitude. By modifying existing instruments, we have developed a tool of reasonable length that should allow us to assess student motivation, engagement and attitudes toward Biology in a non-majors Biology course and draw correlations between these constructs and student success in the course, as measured by grade. The instrument was tested in Fall 2010 with 183 nonmajor marine biology students. Multiple Regression results using Emotional Engagement, Control of Learning Beliefs, and Self Efficacy to predict Attitude Toward Biology explains 72% of the variance in Attitude Toward Biology (see Tables 2 & 3). Multiple Regression results using Intrinsic Goal Orientation, Self Efficacy, and Behavioral Engagement to predict Grades explains 50% of the variance in Grades (see Tables 4 & 5). The reliability of each construct was acceptable (see Table 1) with the exception of behavioral engagement (alpha=.547). This construct should be examined with factor analysis.

Use of Help Sheets on Exams to Motivate Students in College Algebra

by Beth Burns and Lindsey Haubert

As the coordinators for Math 1120 (College Algebra I) and Math 1220 (College Algebra II); we have been experiencing unmotivated students that do not complete the necessary components of the course. This is resulting in a high failure rate for College Algebra I and College Algebra II. Our goal is to find effective ways to motivate the unmotivated students. It seems as though most students who do not perform well in a College Algebra class do not feel as though they are capable or doing the work and so give up immediately without trying. Some of them also assume that since they have seen the material in high school they don't need to attend class or do the homework.

We began with looking at what students were not doing. Beyond scoring poorly on exams, students were not completing their MyMathLab homework. This is a required online homework program that allows students to work through problems as many times as it takes to get the problem correct. The program offers help on problems and shows students how to do similar problems. We thought if students took the time to complete this effectively they should feel better about their skills and therefore should be in a better position to do will on the exams.

We looked into what would motivate a student to complete his/her homework assignments beyond assigning point values. During the Fall 2009 semester, we decided that every student who earned a 90% or better on every MyMathLab assignment would earn the right to use a Help Sheet on the final exam. The Help Sheet would contain useful information that was covered throughout the course; including properties, formulas, and directions for using the calculator.

Based on the extent of this project, at this time we are only going to look at the data for Math 1120. We are going to compare the final exam scores from the Fall 2008 semester to the Fall 2009 semester when the students could use the Help Sheet.

For Math 1120 only about 40% of the student's completed the necessary requirements to use a Help Sheet. We want to see if being able to use the Help Sheet by completing the homework made a difference in students' exam scores. We have looked at the difference in the student exam scores for those students who were able to use the Help Sheet versus those students that were not allowed to use the Help Sheet.

Technology Integration in Early Childhood Science Education

by Rick Worch, Lan Li, and Terry Herman

This project examined the self-efficacy of preservice early childhood teachers for integrating technology into their science instruction. The treatment group (28 students) received special instruction in a variety of software tools and an annotated bibliography of software tools in their science methods course. The control group (26 students) received only the annotated bibliography. Self-efficacy was measured on two scales: Personal Efficacy scale and Outcome Expectancy scale. There was no significant difference on either self-efficacy scale between the treatment and control group prior to the treatment. Both groups showed a significant positive change in their personal self-efficacy for technology integration; however, only the treatment group showed a significant change in its outcome expectancy for technology integration. That is, only the treatment group was significantly more positive in its belief that if they integrate technology into their science instruction, students will benefit from it. The results suggest that even minor intervention can positively affect the self-efficacy of preservice teachers. Future studies may wish to examine the strength and persistence of self-efficacy gains and their impact on classroom instruction.

Effectiveness of In-Class Activities on Student Learning and Motivation in Introductory Astronomy

by Kate Dellenbusch and John Liard

In an effort to enhance student learning, a current trend in education is to make the classroom a more active learning environment, with less emphasis on traditional lecture. In this study we examine the effectiveness of including collaborative, in-class worksheets on student learning in large introductory astronomy classes. Worksheets were given to students in ASTR 2120 ("The Solar System") during the semester. These worksheets were designed to help students work through the reasoning necessary to understand some of the more difficult concepts in introductory astronomy. To study the effectiveness of the worksheets, one section of ASTR 2120 was given the worksheets, while a second section of the course, taught by the same instructor, was not. The class that did not receive the worksheet was given similar content through traditional lecture. This study has been conducted over multiple semesters. Although not statistically significant, the data from one semester suggest that students may gain a better fundamental understanding of concepts through the inclusion of collaborative in-class worksheets.