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Museum Kits in the Classroom:

Lessons Learned from the Wonderwise Project

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Abstract

Museum kits have become an important resource for elementary science classrooms. Wonderwise kits, developed by the University of Nebraska State Museum, are drop-in science kits that introduce women scientist role models to upper elementary students. This article describes the development of the Wonderwise kits and presents a recent evaluation on the impact of the museum kits on students' views of science and scientists. Results showed that students who had experienced the Wonderwise kits generated more scientific activities and more positive descriptors about an imaginary scientist than students involved in another science reform initiative. Overall, results suggested that museum kits that include a role model component can have a positive impact on children's views of science and scientists and can provide a viable drop-in science curriculum for upper elementary teachers.

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Introduction

In the last decade, elementary teachers have been asked to provide more science content in their classrooms. From the National Science Education Standards (National Research Council, 1996) to Benchmarks for Science Literacy (Project 2061, American Association for the Advancement of Science, 1993), hands-on, inquiry-based science has been emphasized as an effective way to encourage students' scientific interests. Unfortunately, elementary teachers often have little expertise in the science arena, and also insufficient time and resources to create inquiry-based experiences for students (Bartels, 1999). Museums are an often-overlooked resource that can provide rich materials for elementary classrooms. The vast majority of museums provide several types of K-12 educational programming, and the most heavily served population is third to sixth grade students (Institute of Museum and Library Services, 1998). One of the most familiar types of museum outreach for elementary classrooms is the science resource kit.

Museum kits have become more important and popular among elementary teachers in the last few decades for several reasons. Although elementary level science is becoming more visible through the work of such groups as the National Research Council and Project 2061, many classrooms are unable to devote the blocks of time or the resources necessary to develop a comprehensive inquiry-based science program at the elementary level. In recent years, several national foundations have recognized that museum kits can help fill the void for classrooms that cannot commit large blocks of time and other resources to science teaching. In the past decade, the National Science

Foundation (NSF) and the Howard Hughes Medical Institute (HHMI) have responded to the need for supplementary science materials by funding museum-based kits.

Half of all natural history museums offer science outreach kits to schools, and some institutions have been providing this service for over a hundred years (Patton, 1991). Only recently, however, have these kits, which have traditionally comprised trunks of museum mounts and preserved specimens, been designed with up-to-date pedagogy. Today museum kits are being developed to meet national and local science education standards through inquiry-based lessons. Generally designed as “drop-in” curricula that can be readily incorporated with other studies, current museum kits are typically complete units that require few other resources. They may be provided on a loan basis or for sale, with specialized materials and curricula for classroom teachers. These museum kits can provide interesting, hands-on, accurate science content for students that requires little science training on the part of the teachers and relatively little classroom preparation. Little is known, however, about the use and impact of these kits in elementary science classrooms.

Description Of Wonderwise Kits: Development And Design

Beginning in 1992 HHMI funded the University of Nebraska State Museum to develop a series of outreach kits based on the work of women scientists. This project called Wonderwise: Women in Science, comprises kits designed for classroom use with upper elementary students, grades four through six. The focus of Wonderwise is to learn science through identification and experience: identification with women scientists through closely following their lives and activities; and experience with science by engaging in related inquiry-oriented activities. These kits and the initiative that funded them are a response to two national issues: 1) the need at the elementary level for accessible, high quality, inquiry-based curricula that conform to the new national standards, and 2) the concern that relatively few women choose to pursue scientific careers. Wonderwise funding was extended in 1997 by HHMI and again in 1999 through a grant from the National Science Foundation. The kits are nationally distributed and are currently used by more than four million students throughout the U.S. and Canada.

Each Wonderwise kit focuses on the research of a different woman scientist and contains the following:

- A 15- to 20-minute video profile of the scientist and her work, filmed on location at her laboratory and field sites at different locations around the world.
- Five 1-hour classroom activities. Hard-to-get materials and specimens needed to support the activities are available through the project web site.
- An interactive CD-ROM, in Spanish and English, that includes the video with an interactive glossary, and supplemental activities and resources.

The kits were based on both the national science standards and the Nebraska state standards for science teaching. As such, the kits provide participatory, inquiry-based science activities for students. The classroom activities are closely based on the work of the featured scientist and are stand alone activities, enabling teachers to select some or all for use in the classroom. They are “drop-in” curricula, which can be tied to textbooks or used independently. For example, in one activity from the Sea Otter Biologist kit, students examine the properties of oil in water and then test the effects on shells and fur. This activity is being variously used in classroom units on mammals, chemistry, Alaska, and environmental studies. In the African Plant Explorer kit, one activity asks students to use iodine to test for starch in various foods. This activity is being used in classroom units on chemistry, social studies, and plant biology. A more complete description of the Wonderwise kits and their development is described in Diamond et. al., 1996 (see also Fox, 1993 and http://wonderwise.unl.edu).

Evaluation of Wonderwise

The Wonderwise project has undergone extensive evaluation over the past decade, and much has been learned about how these museum kits are used in classrooms and their impact on teachers and students. Before the kits were developed, project staff conducted a needs assessment using surveys and a teleconference with Nebraska teachers from rural and urban schools. This assessment revealed what kinds of science materials teachers were currently using and how they used them; how teachers envisioned incorporating new kits; what format, size, and price of kit would be most readily accepted; and what technology teachers had available to support a multimedia kit.

Activity development in the Wonderwise kits also was influenced by the OBIS (Outdoor Biology Curriculum Strategies) project developed at the Lawrence Hall of Science. The Wonderwise project director's experience on the OBIS staff led her to model various aspects: like OBIS, each Wonderwise activity is one hour in length, requires little advance preparation on the part of teachers, is self-contained, and the activities can be used in any order. Each activity involves an active, participatory component that requires students to develop their own solutions to problems through investigation. Wonderwise differs from OBIS by its focus on role models, inclusion of multimedia as part of the kit, and conducting the activities inside the classroom.

One of the most profound lessons learned from the OBIS project was to trial test all of the activities with typical users, and then continue to make revisions until the activities worked well. Consequently, the Wonderwise project included extensive trial testing with children and teachers, with feedback and revisions following every stage. This iterative process was designed to ensure that the Wonderwise activities were shaped by real-life classroom and teacher constraints, and to avoid having activities that looked great on paper but were impossible for teachers to actually use in their classroom.

Ongoing feedback from teachers and other evaluation experiences also helped to shape the course of the project. Evaluation activities continued even as Wonderwise kits were disseminated and began to be used throughout the state in elementary classrooms. Evaluation included gathering demographic data, observing classroom use, and informal interviews and surveys with teachers and students. We found teachers to be enthusiastic about the kits, and demand for the kits was strong not only from teachers and schools, but from museums, zoos, and educational TV stations. The kits proved to be adaptable to a wide variety of settings, and teachers were modifying the kits in many ways to fit into their classrooms.

To provide a more complete assessment of the impact of the Wonderwise kits, the project must be compared with other science activities. A National Science Foundation (NSF) Statewide Systemic Initiative (SSI) provided the ideal test bed for this assessment. In the SSI, kindergarten through high school teachers were given special training in the use science materials in their classrooms. By comparing students' views of science and scientists in the Wonderwise and the SSI classrooms, we could assess the similarities and differences in impact of these two science reform initiatives.

Results of the evaluation provided information in three areas:

1) We learned how the Wonderwise kits influenced children's perceptions of science and scientists,
2) We gained insight into some similarities and differences between boys and girls in their attitudes about science and scientists,
3) We learned that kits can be a valuable and flexible means for enhancing elementary classroom science.

Methods

Selection of classes and students

Four 5th grade classroom groups (90 students total) were involved in this evaluation study. Two of the groups had teachers who had used the Wonderwise kits as part of the science curriculum (WW or Wonderwise classrooms) and two groups had not used the kits, but had used other inquiry-based, hands-on science materials (comparison classrooms) (see Table 1).

The comparison group classrooms were selected as a match to the Wonderwise classrooms because all teachers had been involved in substantial professional development activities, signifying that they were interested in providing high quality science curriculum to their students. The Wonderwise teachers had participated in a week-long residential mentors' workshop in June 1996 offered through the University of Nebraska State Museum, experiencing the camaraderie and intensity of a week with colleagues interested in teaching elementary science.

Similarly, the comparison group teachers were chosen from the pool of teachers who had participated in the 1995 or 1996 Nebraska Math and Science Initiative (NMSI) summer workshops, conducted by the Nebraska Statewide Systemic Initiative. These NMSI workshops were two-week-long, NSF-funded, standards-based workshops focused on providing teachers with professional development in mathematics and science teaching. While these workshops did not provide teachers with a specific curriculum, they provided teachers with a variety of tools, such as Brock magiscopes, balances, stopwatches and measuring tapes, and instruction and practice in using these hands-on materials. Because both groups had taken the initiative to be involved in extra summer professional development, had gained science-related expertise, and had received current inquiry-based materials and activities for use in their classrooms, this comparison group was identified as being similar to the Wonderwise teachers with respect to the type of teachers involved and their training. Consequently, the results of the study could more readily be attributed to the impact of the kits themselves, rather than the enthusiasm or specialized knowledge of the particular teachers involved. None of the teachers were science specialists.

All four classroom groups were located in Central or Eastern Nebraska; two were urban and two were rural. These classrooms were matched using geographic, population, and socioeconomic information. No significant differences were found between the urban and rural students in their attitudes toward science and perceptions of scientists, so the two groups were combined in the subsequent analyses.

Design and administration of instrument

In May 1997, students in the selected classrooms completed a survey instrument of rating scale items and open-ended questions designed to assess students' perceptions of scientists and scientific work and to assess their attitudes toward science. No existing instrument was identified that addressed the specific issues under investigation for this age group. Consequently, the evaluators developed the survey using previously published instruments (Ashby & Wittmaier, 1978; Chambers, 1983; Evans, Whigham, & Wang, 1995; Schoenfeld, 1989; Yager & Yager, 1985), as well as working from other evaluation studies and using the goals and objectives of the kits themselves to guide the instrument development. The survey was structured so that students were first asked to generate open-ended responses to questions about scientific activities and activities that they enjoy in science class. They were then given checklists of activities and rating items that were designed to corroborate their open-ended responses.

Similarly, students were asked to provide responses about an imaginary scientist of their choosing, and then provided with closed-ended choices about the scientist they were imagining. The survey was administered to each of the classrooms by one of the researchers. Students were allowed as much time as they needed to complete the survey although most of the students completed it in less than 20 minutes. This posttest only control group design (Campbell & Stanley, 1963) was used to ensure that exposure to pre-testing would not affect posttest responses. Informed consent was obtained from all subjects participating in this study. Consent forms and all survey instruments were approved in advance by the University of Nebraska Institutional Review Board.

Results

Students' attitudes about Science

Students who were exposed to either the NSF science reform activities or the Wonderwise project had generally very positive attitudes about science. The students' responses to 12 statements about science in a Likert format revealed that most students agreed that they learn important things in science class and that science helps people. Most students also agreed that they really like science, that science helps us understand the world better, and that everyone should learn about science. Most students disagreed with statements that science class is boring and that studying science is a waste of time. No significant differences were found between the Wonderwise and the comparison group on these items, nor were there significant differences between boys and girls.

Students' Understanding of Scientific Work

Students' understanding of scientific work was assessed by asking them to list three things that scientists do when they work and to describe things they would like to do if they were scientists. Students in the Wonderwise classroom named significantly more activities that scientists do, on average, than the students in the comparison group ($p<.05$). The Wonderwise group was significantly more likely to mention that scientists took notes on their work through recording data or writing down what they do, that scientists do things such as estimate and measure, and that scientists communicate their work through talking with other scientists or sharing their work ($p<.05$) (see Table 2). In looking specifically at the girls, the female students in the Wonderwise classrooms were more likely ($p<.01$) than their female counterparts in the comparison classrooms to mention that scientists talk with one another or communicate with others about their work. Girls in the NSF reform classrooms were more likely to mention scientists doing experiments than the Wonderwise girls were ($p<.05$).

In response to the question, "If you were a scientist, what kinds of things would you like to do?" both groups mentioned wanting to discover things and do experiments;

working with chemicals; finding cures for different diseases; and studying plants, outer space, and fossils. Responses from the Wonderwise students included, "Study different things about different kinds of animals," and "I would dig up ancient fossils and bone. I would also study the stars." Responses from the comparison group included, "Look at different parts of plants and learn about them," "I would like to experiment with things," and "I would try to find cures for AIDS, cancer and other diseases." The girls in the Wonderwise group were significantly more likely ($p<.05$) to describe working with animals, and to specifically mention working with marine life.

Students' Perceptions of Scientists

Students were asked to imagine a scientist and give that scientist a first name. Then students selected descriptors from a list provided to describe their imaginary scientists. Students were asked to generate descriptors of their own, and these were categorized as being positive or negative and as being related to one of the following dimensions: physical (i.e., "athletic" or "ugly"), intellectual/work-related (i.e., "hard worker" or "stupid"), personality/social (i.e., "caring" or "boring"), or ambiguous (i.e., works with plants). Finally, students were asked to choose between pairs of phrases, such as "has kids/doesn't have kids" to describe their scientists. Girls, as a group, differed from boys in some significant ways of their perceptions of scientists.

Girls were significantly more likely ($p<.01$) than boys to give their scientist a female name and identity. Girls as a group generated a significantly higher number of positive attributes for their scientist than boys ($p<.01$). In particular, girls generated, on average, a significantly higher number of positive intellectual/work attributes ($p<.05$) than the boys. In addition, girls were significantly more likely than boys ($p<.05$) to agree that their imaginary scientist worked with other people and did not work alone, while boys were more likely to agree that their scientist didn't like work ($p<.05$). When choosing between pairs of dichotomous descriptors, more girls than boys reported that their scientist had a lot of friends ($p<.05$), was a woman ($p<.01$), and had kids ($p<.05$). Consistent with students' previous responses, virtually no boys in either group said that their scientist was a woman.

Differences between Wonderwise and comparison students were also evident in their perceptions of scientists. When asked to select among descriptors such as "serious," " friendly," "likes work," "unhappy," and "works alone," the Wonderwise students were more likely ($p<.01$) to characterize their scientist as happy. When asked to choose between pairs of descriptive phrases about their scientist, significantly more Wonderwise students said their scientist was interesting ($p<.05$) rather than boring.

The Wonderwise group also generated a significantly higher number of positive attributes ($p<.01$) than the comparison group (see Table 3). In particular, the Wonderwise students generated significantly more positive, work-related/intellectual descriptors ($p<.01$). This difference was primarily attributable to the girls in the Wonderwise group, who generated more positive intellectual/work traits than the girls in the comparison group ($p<.05$). There were no significant differences found between groups on the average number of physical or social/personality traits generated.

Summary and Discussion

The results suggest that museum kits can be a positive addition to the elementary science classroom. Students in both the Wonderwise group and the comparison group had positive and accurate ideas about science and what scientists do. The Wonderwise kits appear to be no less effective in influencing students' attitudes about science than other standards-based science reform activities.

Students in the Wonderwise group had a more positive and detailed view of scientists and what scientists do than the comparison group, and this was particularly true for the girls in the Wonderwise group. Students in the Wonderwise group were also able to generate more activities that scientists do and described an imaginary scientist in more positive terms. This suggests that the curriculum-based role models in the museum kits helped to elevate students' ideas of who scientists are, how they work, and what they do.

Across both the Wonderwise group and the comparison group, boys showed differences from girls. Girls were more likely than boys to view scientists as liking their work, working with other people, having a lot of friends and having kids. Girls were also more likely to view scientists as women and as having positive work and intellectual personality traits, and this was particularly evident in the Wonderwise group.

This evaluation study sheds some light on the role that museum kits can play in enhancing the school science experiences of elementary children. Gender issues in learning science have been the focus of intense interest in recent years (Bae, Choy, Geddes, Sable & Snyder, 2000; Baker & Leary, 1995; Catsambis, 1995; Eccles, 1986; Farenga & Joyce (1999); Greenfield, 1997; Javanovic & Dreves, 1998; Kenway & Gough, 1998; O'Sullivan, Reese, & Mazzeo, 1997; Piburn & Baker, 1993; Sadker & Sadker, 1994), and several authors have suggested that role modeling may be a factor that improves girls' performance in science (Ashby & Wittmaier, 1978; Baker, 1987; Bandura & Bussey, 1984; Evans, Whigham, & Wang, 1995; Hill, Pettus, & Hedin, 1990; Hoffner, 1996; Nauta, Epperson, & Kahn, 1998; Ochman, 1996; Smith & Erb, 1986; Steinke &

Long, 1996). This study suggests that a drop-in curriculum that focuses on role models can have an impact on children's views of science and scientists. Additional studies involving larger numbers of teachers and students are needed to provide a more complete picture and to confirm the findings from this evaluation.

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For more information on the Wonderwise kits call Great Plains National at 1-800-228-4630 or visit the Wonderwise website at http://wonderwise.unl.edu.

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Table 1. Number of 5th grade students participating in each classroom by sex.

	Wonderwise		Comparison	
	Urban	Rural	Urban	Rural
Boys	9	5	23	9
Girls	7	8	20	9
Classroom Totals	16	13	43*	18
Group Totals	29		61	

*Two separate classrooms at the same school participated in the study and the data were combined into one group.

Table 2. Percent of students generating different scientific activities

Activities	Wonderwise		Comparison	
	Boys	Girls	Boys	Girls
	n=14	n=15	n=32	n=29
Record data, take notes[a]	43%	47%	16%	21%
Do experiments or tests[b]	36%	20%	19%	52%
Make predictions or hypothesize	14%	0%	9%	17%
Study, observe, examine	50%	60%	38%	52%
Research, explore, investigate	29%	20%	13%	14%
Solve problems, invent, make cures	21%	27%	25%	41%
Talk with others, communicate[ab]	7%	40%	9%	7%
Mix chemicals, use equipment	7%	20%	25%	24%
Measure, compare, estimate[a]	21%	20%	6%	7%
Other (have fun, persist, work hard)	21%	13%	22%	14%

[a]Significant difference between Wonderwise and comparison groups

[b]Significant difference between Wonderwise girls and comparison girls

Table 3. Mean number of descriptors generated by students about their imaginary scientist

	Wonderwise n=29		Comparison n=61	
Descriptors	Positive	Negative	Positive	Negative
Physical	.10	.03	.03	.11
Intellectual/work-related	.72*	0	.25*	.03
Personality/social	1.31	.07	.89	.15
Group Totals	2.14*	.10	1.16*	.30

*Difference between the groups is statistically significant ($p<.01$)