Classroom Comparison Study

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Wonderwise Learning Kits

Funded by the Howard Hughes Medical Institute
Produced by the University of Nebraska State Museum

Evaluation Report

Center for Instructional Innovation

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Wonderwise Evaluation: Classroom Comparison Study
September 1997
Evaluation Report: Executive Summary

Wonderwise, a program funded by the Howard Hughes Medical Institute, is series of five learning kits being produced by the University of Nebraska State Museum in Lincoln, Nebraska. Each Wonderwise kit portrays a woman scientist through three mediums: a video, a written biography, and five classroom activities related to the scientist's field of study. Three of the kits also include a CD-ROM. The five kits are targeted toward fourth to sixth grade elementary students, and are intended to be a versatile element that can be readily incorporated into existing classroom curricula in Nebraska elementary classrooms.

The purpose of this evaluation was to find out whether students who have experienced the Wonderwise kits differ in their perceptions of scientists and of scientific work and have different attitudes toward science compared to students who have not experienced the kits. Four 5th grade classrooms (90 students total) were involved in this evaluation. Two of them were classrooms in which Wonderwise mentor teachers had used the Wonderwise kits as part of the science curriculum (the mentor classrooms) and two of them were comparable classrooms in which the kits had not been used (the comparison group classrooms).

The results provide some promising evidence of the impact of the kits on students views of science and scientists. This study also revealed some important differences between the way girls and boys perceive scientists.

With respect to the evaluation questions focusing on the impact of the kits, there were several significant findings that indicate that the students whose teachers had used the kits in their classrooms appear to have some different, broader, and more positive conceptions of scientists and their work than students in the comparison group. The mentor group students were able to describe more activities that scientists do and identify more scientific activities from a list presented to them. Mentor students were also more likely to attribute positive characteristics to an imaginary scientist of their choosing, such as being smart and a hard worker. These are important initial findings that suggest that the Wonderwise kits positively influence students' views of scientists and the work that scientists do. Because students who experienced the kits were more likely to mention hands-on activities and experiments as things in their science classes that they enjoy doing, the kit activities appear to be a critical component in producing this effect.

Patterns in the findings suggest that girls may be differentially affected, and may be more likely to remember things from the kits than the boys. Yet, girls were not more likely than boys to endorse statements about wanting to become more involved in science or to become scientists. Further investigation about how girls and boys respond to the kit components may uncover differences in how they perceive themselves in relation to science activities.

In addition to findings about the impact of the kits, another striking pattern was identified. Girls as a group across all classrooms differed from the boys in their responses to some questions about an imaginary scientist. Girls were much more likely to imagine a woman scientist with positive intellectual/work-related and personality traits than boys were. They were also more likely to envision their scientists with a lot of friends and as a parent. These differences were not attributable to the kits, but are worth noting because it indicates that girls at

this grade level appear to already differ from boys in their views of science and scientists and consequently may respond differently to the kits and the messages conveyed by the kits.

Because this study involves such a small number of classrooms, the results cannot be generalized across all classrooms that use the Wonderwise kits. However, the overall results appear consistent across several dimensions, and suggest that the use of the kits by the mentor teachers provides students with some added benefits that are not available in similar classrooms in Nebraska. The students who experienced the kits appear to remember the activities and ideas in the kits and to see the scientists portrayed as positive role models who are doing important work.

Wonderwise Evaluation: Classroom Comparison Study

Introduction and Description of Project

Wonderwise is a grant-funded program consisting of a series of five learning kits being produced by the University of Nebraska State Museum in Lincoln, Nebraska. This five-year program, funded by the Howard Hughes Medical Institute in 1992, was designed to support the museum in developing learning kits for use in schools. Each Wonderwise kit portrays a woman scientist through three mediums: a video, a written biography, and five classroom activities related to the scientist's field of study. Three of the kits also include a CD-ROM. The five kits are targeted toward fourth to sixth grade elementary students, and are intended to be a versatile element that can be readily used by teachers and easily incorporated into existing classroom curricula in elementary classrooms. These kits were designed to be a resource for any classroom, but particularly for rural classrooms, which do not typically have as many resources of this type as urban schools.

The Wonderwise project was designed to encourage upper elementary students to take a greater interest in science subjects. Using inquiry-based, fully-participatory science activities based on a particular scientist's actual work, these kits are designed to present science as an exciting, challenging activity. The materials interweave the role of women scientists throughout, and the scientists featured in the kits are intended to be accessible, realistic female role models. The desired outcomes of these kits include increasing all students' interest in science, particularly female students, expanding students' awareness and understanding of what scientists do, and expanding students' awareness of who does science. By providing real-life examples of scientists, both women and men from a variety of ethnic backgrounds, in current lab and field settings, it is hoped that students will gain a broader perspective of scientists and their work (University of Nebraska State Museum 1995-96 Annual Program Report).

To disseminate these kits throughout the state of Nebraska and encourage their use, nineteen individuals from around the state of Nebraska, one from each Educational Service Unit (ESU), were selected by the Wonderwise staff to participate in a week-long Wonderwise Mentors Workshop during Summer, 1996. When these individuals agreed to participate in the workshop and become "Wonderwise Mentor Teachers" they agreed to return to their ESU's and conduct workshops for their peers about the Wonderwise kits. Each mentor teacher is required to conduct three workshops of at least 10 teachers each. This means that over 500 teachers will be introduced to the Wonderwise kits by these mentor teachers. Every mentor teacher also received copies of the kits as they were completed and used the kits in their classrooms with their students.

The primary purpose of this pilot evaluation was to find out whether students who have experienced the Wonderwise kits differ in their perceptions of scientists and of scientific work and have different attitudes toward science compared to students who have not experienced the kits.

Audiences

Judy Diamond, project director; her staff at the University of Nebraska State Museum; and other interested staff and affiliates at the museum,

Nebraska Educational Telecommunications staff involved in the development of the Wonderwise Kits,

Howard Hughes Medical Institute, the funding agency of the program, and

The scientists featured in the Wonderwise kits.

This evaluation was originally designed to be summative in nature, and to provide the project development team and funding sponsor with information about the impact of the kits on how students view scientific work and scientists, and on students' attitudes toward science. The evaluation assesses the use of these kits in the classroom and provides the audiences with information about the potential impact of museum-designed kits on formal education. The results may also provide guidance about how to introduce or market the kits to potential users, or if some possible revision of the design could be helpful.

While this evaluation was being completed, the project staff learned that their application for an additional grant, "Wonderwise On-line," had been funded. Among other things, this grant provides for an expansion of the original Wonderwise project to include one additional kit, to add CD-ROMs to the two kits that do not currently have them, and to possibly revise the current kits. Consequently, this evaluation now also serves as a pilot investigation to guide future kit evaluation and provide direction for further avenues of investigation and assessment. This will also help inform the production of future kits and the implementation of their use in classrooms.

Evaluation Questions

The primary evaluation questions guiding this evaluation were:

1) How do students who have experienced the Wonderwise kits differ in their perceptions of scientific work compared to students who have not experienced the kits?

2) How do students who have experienced the Wonderwise kits differ in their attitudes toward science compared to students who have not experienced the kits? and

3) How do students who have experienced the Wonderwise kits differ in their perceptions of scientists compared to students who have not experienced the kits?

These three questions reflect the specific goals of the Wonderwise kits: to expand students' awareness and understanding of what scientists do, to increase their interest in science by providing engaging hands-on activities and real-life applications of science, and to expand their awareness of what scientists "look like" by providing real-life examples of female scientists. In addition, these evaluation questions provide information for answering larger questions about the emerging role of the museum in formal education, and the use of kits in facilitating the relationship between the museum and the classroom.

Methods

Four 5th grade classrooms (90 students total) were involved in this evaluation. Two of them were classrooms in which Wonderwise mentor teachers had used the Wonderwise kits as part of the science curriculum (the mentor classrooms) and two of them were classrooms in which the kits had not been used (the comparison group classrooms). The comparison group classrooms were selected as a match to the Wonderwise classrooms because the teachers in all four classrooms had been involved in professional development activities signifying that they were interested in providing a high quality science curriculum to their students. The Wonderwise teachers had participated in the week-long residential mentors' workshop offered through the 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 the Nebraska Math and Science Initiative (NMSI) workshops. These NMSI workshops were two-week long, NSF-funded standards-based workshops focused on providing teachers with professional development in mathematics and science teaching. Because both groups had taken the initiative to be involved in extra summer professional development and had gained science-related expertise, this comparison group was identified as being comparable with respect the type of teachers involved and their training. Consequently, the results of the evaluation 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, although in one of the rural classrooms the 5th and 6th grade teachers team-taught science.

All four classrooms were located in Central or Eastern Nebraska, however, two of them were urban classrooms and two were rural. The two urban classrooms (one mentor and one comparison) were located in the same city and were matched by size of school, number of students in the classroom, and socioeconomic status (defined by the percentage of students receiving reduced or free lunches). The sample size of the urban comparison-group classroom is considerably larger than the other classrooms because two separate 5th grade classrooms agreed to participate in the study. The data from both classrooms were combined into one larger group. The other two classrooms were located in two different rural environments. These classrooms were matched according to the population of the towns in which they were located and according to the number of students in the school and in the 5th grade. See Table 1 for the number of students in each classroom.

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

	Mentor-Urban	**Mentor-Rural**	**Comparison-Urban**	**Comparison-Rural**
Boys	**9**	**5**	**23**	**9**
Girls	**7**	**7**	**20**	**8**
Classroom Totals	**16***	**12**	**43****	**17**
Group totals***	**29**		**61**	

*Four girls and one boy in this classroom declined to participate in the survey.
**Two separate classrooms at the same school participated in the study and the data were combined into one group.
***Group totals do not equal the sum of the classroom totals due to missing demographic data.

Students in all classrooms completed a survey instrument of rating scale items and open-ended questions (see Appendix A for a copy of the survey). The survey was designed to assess students' perceptions of scientists and scientific work and to assess their attitudes toward science class and extracurricular science activities. The survey was structured so that students were first asked to generate open-ended responses to questions about scientific activities and activities in science class that they enjoy. Then, they were given checklists of activities and rating items that were designed to corroborate their open-ended responses. 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.

Student responses are summarized in the results section below. Where appropriate, statistical tests of significance were conducted. Most of the analyses consisted of two-tailed chi-square tests. A chi-square test assesses the likelihood that two variables are occurring independently of one another. We were primarily interested in the question of whether being exposed to the kits made a difference in student responses. The chi-square test was used to determine the likelihood that student responses were related to class membership (mentor vs. comparison). Other student characteristics of interest were gender and urbanicity, and chi-square tests were also conducted examining the relationship of student responses to these variables. In cases where the expected cell count was fewer than five, a chi-square test may be inappropriate. Because of the small sizes in this study, there were many instances where this was true. In these instances, Fisher's exact test, which is similar to but more conservative than a chi-square test, was used to determine the statistical significance.

If a relationship is reported as significant, this means the probability of occurrence by chance is less than one in twenty, which is symbolized as $p<.05$. If a relationship is reported as approaching statistical significance, it means the probability of occurrence by chance is less than one in ten, or $p<.10$. Because of the small sample sizes and the exploratory nature of this study, relationships that may not be significant, but appear to be meaningful are explored in the discussion, but are clearly identified as not statistically significant.

Limitations

First, the small number of classrooms in this study limits the conclusions that can be drawn from these results. In particular, the impact of the specific teachers involved is difficult to separate from the impact of the kits. However, an effort was made to minimize this limitation by selecting comparison teachers who were comparable in level of interest and recent experiences with professional development in science, and by developing items to solicit responses specific to the kits. Second, the recency of the use of the kits may have influenced mentor students' responses just as the recency of science activities in the comparison group may have influenced those students' responses. Consequently, students' responses may have differed if data was collected at another point in time. Finally, while the urban classrooms were matched on socioeconomic status, the rural classrooms, while matched on other criteria, may have differed from one another on the important dimension of SES. In contrast, the two urban teachers implemented a similar science curriculum and had similar resources available.

Results

Students' Perceptions of Scientific Activities

Students' perceptions of scientific activities were assessed several ways. Students were asked to list three things that scientists do when they work, to describe what kinds of things they would like to do <u>if</u> they were scientists, and to identify which activities scientists do from a list of activities provided to them.

<u>What Scientists Do When They Work</u>

First, students were asked in an open-ended question, "What are three things that scientists do when they work?" Most students were able to provide clear explanations of what scientists do, with most students including at least two different behaviors. Nearly half of all students said that scientists "study," "observe," or "examine" things, and one-third made comments about scientists learning new things or solving problems. One-third also mentioned scientists doing experiments or tests. One-quarter indicated that they knew scientists took notes on their work, such as recording data or writing down their work. Other things students spontaneously identified were scientists exploring, trying new things or investigating, communicating about their work with others, making predictions, and performing specific activities such as mixing chemicals.

In a comparison between the mentors' students and comparison group students, the mentor group students named more activities that scientists do, on average, than the students in the comparison group. This was a statistically significant difference. This suggests that the mentor group students had a more concrete and well-developed picture of a scientist at work than the comparison group. Across most of the specific categories, including "doing experiments," and "making predictions," the groups responded similarly. However, in two categories, a significantly higher percentage of students in the mentor group named the particular behaviors (see Figure 1). The mentor group was much more likely to mention that scientists took notes on their work through recording data or writing down what they do and that scientists communicate their work through talking with other scientists or sharing their work. There were no categories of responses in which the comparison group listed a significantly larger number than the mentor group.

Looking more closely at female and rural students, who may be differentially impacted by exposure to the kits, female students in the mentor classrooms were more likely than their female counterparts in the comparison classrooms to mention that scientists talk with one another and communicate with others about their work. Girls in the comparison classroom were more likely to mention scientists doing experiments than the mentor girls were. No significant differences were found between rural and urban groups.

In the mentor classrooms, both boys and girls listed an equally high number of activities that scientists do, while in the comparison classrooms, girls listed significantly more activities than the boys.

Because of the small number of students in the sample and the type of data collected, the tests of significance are a conservative measure of the differences between groups. A visual inspection of the graph in Figure 1 provides additional information about possible differences between the groups. For example, a higher proportion of mentor students named general scientific activities such as measuring, comparing, and estimating, while the comparison group students wrote more specific activities such as mixing chemicals or looking through a telescope. The mentor group also tended to identify exploring and researching activities more often than the comparison group.

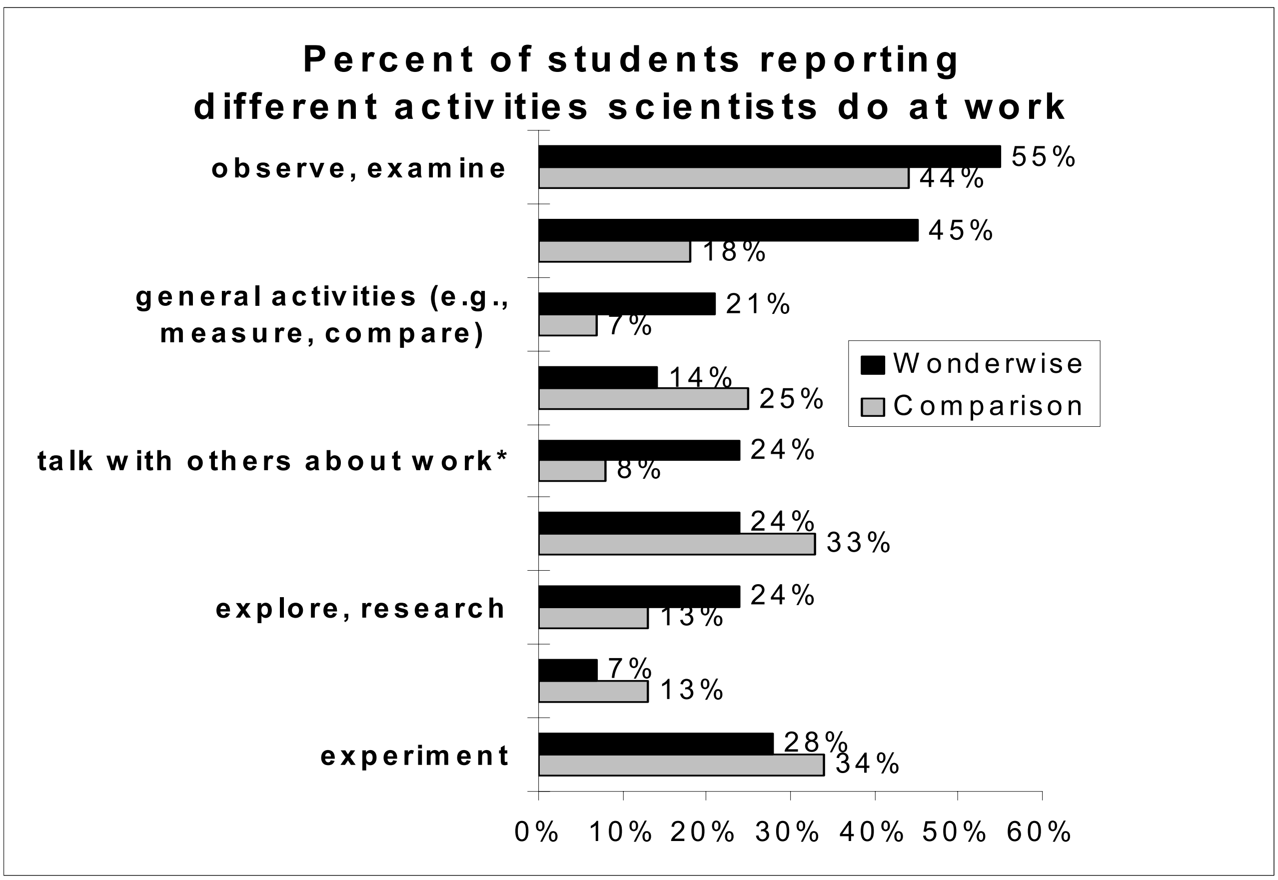

Figure 1.

*significant difference found between groups, $p<.05$.

<u>What Students Would Do if They Were Scientists</u>

In response to the question, "If you were a scientist, what kinds of things would you like to do?" students wrote about different specific activities they would do as well as different general areas of study. These included studying about animals, doing experiments, working with chemicals, finding cures for different diseases, studying plants, and studying other specific things such as weather patterns, the planets, or insects.

The students in the mentor group were significantly more likely to describe working with animals. There were also a few students in the mentor group, and none in the comparison group, who specifically mentioned activities similar to the professions of scientists featured in the kits, including being an ocean scientist and studying about allergies. Students in the comparison group were more likely to name other specific activities such as studying ecology or digging up fossils. These differences, because of the small number of students responding with these specific activities, are not statistically significant.

The girls and the boys were about equal in the number of ideas they wrote down. However, the girls in the mentor classroom had more ideas about what they would do as scientists than the girls in the comparison classroom (average of 1.7 versus 1.2), although this difference was not statistically significant. The boys in the mentor classroom were comparable to the boys in the comparison classroom in their ideas of what they would do if they were scientists.

No significant differences were found between urban and rural groups.

Activities Perceived as Being Scientific

After describing their perceptions of scientific activities, students were presented with a list of 12 activities and asked to identify which ones were activities that scientists do at work. Two of the 12 activities were stereotypical scientific activities (recording data and mixing chemicals), two were activities not associated with scientific work (building houses and fixing leaky faucets) and eight were activities that reflected content in the Wonderwise kits. Some of these eight activities were specific to the Wonderwise scientists' work (e.g., catching fish and collecting frogs) and some were more general activities that students do not typically associate with scientific work (e.g., teaching students and working outside). As Figure 2 shows, the girls in the mentor group identified significantly more of these eight scientific activities than the other student groups.

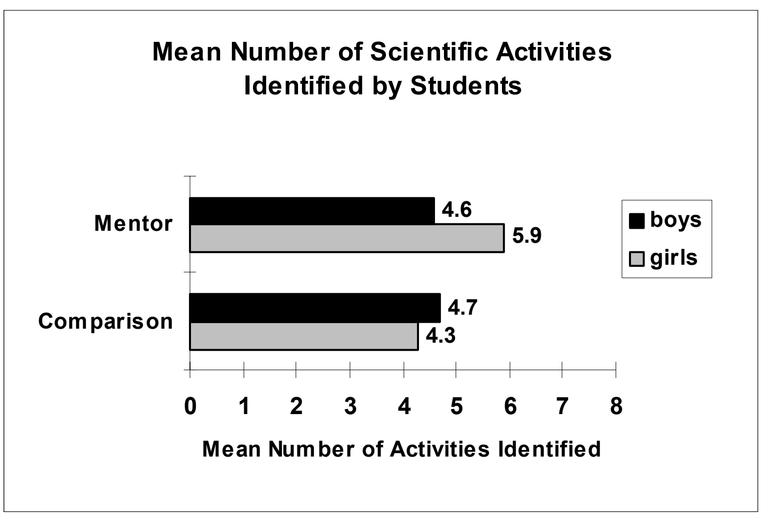

Figure 2.

Table 2 shows the percent of students by group who identified each activity as being one a scientist would do at work. As anticipated, almost all students recognized that scientists record data and mix chemicals and virtually no students said that scientists fix leaky faucets or build houses. For the eight activities where differences between the two groups were expected, a relatively high percentage of students in both groups recognized that scientists talk with other scientists at work, study things that make people sick, and write down what they observe. A significantly higher proportion of students in the mentor classrooms than the comparison classrooms said that scientists work outside and catch fish. And, the difference between the percentages of those who said scientists teach students approached statistical significance. There were no activities that were selected by a significantly higher percentage of students in the comparison group than the mentor group. These results indicate that students in the mentor group have a broader conception of the kinds of things that scientists do at work and that these activities correspond to the work activities of the scientists featured in the kits.

Table 2. Percent of students by group who identified each activity as being one a scientist would do at work.

At work, scientists...	**Mentor Group n=29**	**Comparison Group n=61**
talk with scientists	**83%**	**79%**
examine flowers	**62%**	**67%**
fix leaky faucets	**0%**	**2%**
mix chemicals	**97%**	**98%**
work outside*	**69%**	**43%**
teach students+	**79%**	**59%**
build houses	**0%**	**0%**
catch fish*	**24%**	**8%**
write down what they observe	**100%**	**92%**
study things that make people sick	**79%**	**79%**
record data	**100%**	**89%**
collect frogs	**35%**	**21%**

*significant difference found between groups, $p<.05$.
+difference found between groups, $p<.10$.

For the eight items where differences between the groups were expected, the percentages of female students and rural students in the mentor and comparison groups were then separately compared. Significantly higher percentages of girls in the mentor classrooms identified working outside, catching fish, and collecting frogs as science activities compared to girls in the comparison classrooms (see Figures 3-5). Although the differences between the boys and girls in the mentor group were not statistically significant, they are interesting to note and suggest that girls in the mentor classrooms may be cueing into the scientists activities to a greater degree than the boys. A significantly higher percentage of students in the rural mentor classroom than the rural comparison classroom identified teaching students and catching fish as scientific activities. There were no activities identified by significantly higher proportions of students in the comparison classrooms.

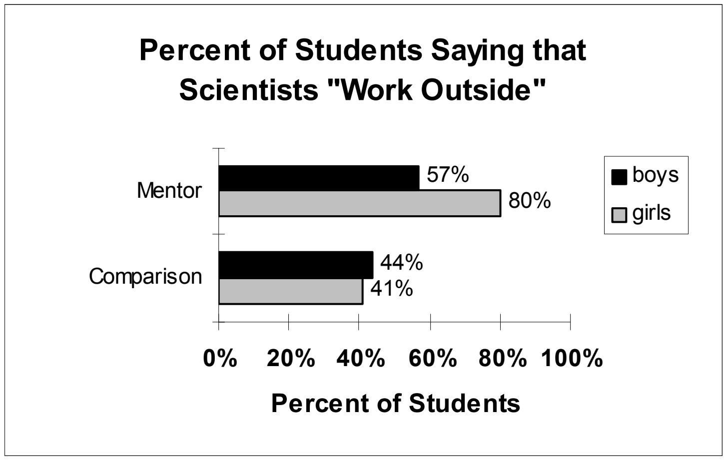

Figure 3.

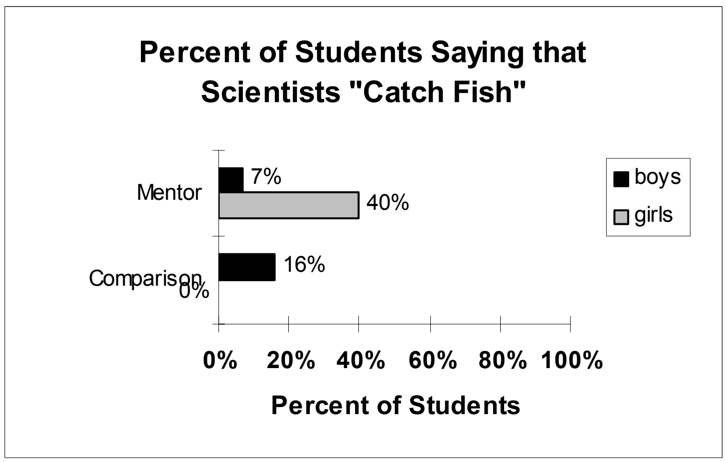

Figure 4.

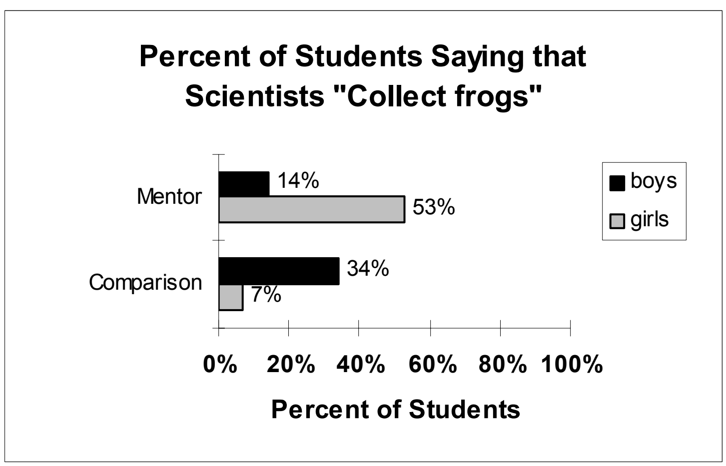

Figure 5.

Students' Attitudes about Science

Students' attitudes about science, particularly their interest in science, were assessed in several ways with both open- and close-ended questions. Students were asked to describe what they enjoyed in their science class, to identify which science-oriented extracurricular activities and which school subjects they would avoid, and to agree or disagree with statements about their attitudes toward science and being a scientist.

Science Classroom Activities Students Enjoy

First, students were asked in an open-ended format, “What do you do in science class that you like?” Responses to this question ranged considerably, with about half of the students writing about hands-on activities and experiments, and about half of the students naming specific topics such as studying about volcanoes, magnets, or rocks and minerals.

In a comparison between the mentor group and the comparison group, the students in the mentor group were more than twice as likely to mention hands-on activities and experiments, a statistically significant difference (see Figure 6). Some comments from the mentor students were, “We do hands-on experiments so it makes it fun and interesting” and “We do experiments instead of reading out of a book to learn.” A few students in the mentor group were also the only ones who wrote they enjoyed working with and studying about parasites and learning about pollen, which were two specific topics from the Wonderwise kits. For example, one student wrote, “We dissected worms and that was the funnest.” Students in the comparison classrooms mentioned other specific topics more frequently, and these areas clearly reflected their recent lessons. For example, many students wrote about studying magnets, colors, and mixing chemicals.

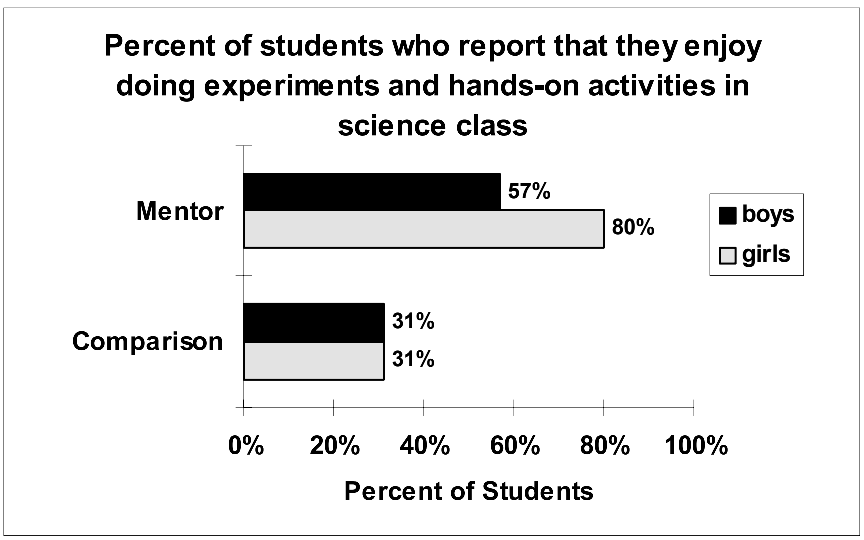

Figure 6.

Rural students in the mentor classroom were the only ones who specifically mentioned the activities from the pollen kits and rural boys were the only ones who named the parasite activities. The girls in the mentor classrooms mentioned enjoying the hands-on activities and experiments significantly more than their peers in the comparison group, while the girls in the comparison group identified other specific topics significantly more often than the mentor girls.

Extracurricular Science Activities Students Would Avoid

Students were then presented with a list of extracurricular science activities and asked to mark the ones that they would avoid doing if they could. The purpose of this question was to gauge students’ general interest in science-related pursuits. Table 3 shows the percentage of students in each group by sex who would avoid the activity listed. The only statistically significant difference found across these groups overall and for girls is that the mentor girls were more likely to avoid reading a science book at home than the comparison girls. It is interesting to note that overall, a higher percentage of boys than girls selected “none of the above,” providing some support for the notion that boys are more inclined to participate in extracurricular science activities, but the difference in this sample was not a significant one.

Table 3. Percent of students by group and sex who would avoid each of the activities listed.

Extracurricular science activities	Mentor Group		Comparison Group	
	Boys n=14	Girls n=15	Boys n=32	Girls n=29
Watch a science program on TV.	29%	7%	28%	28%
Belong to a science club.	43%	60%	47%	55%
Do science experiments at home.	7%	13%	16%	0%
Visit a science museum.	29%	20%	31%	14%
Visit a scientist at work.	29%	13%	16%	17%
Read a science book at home.*	43%	67%	44%	35%
None of the Above	36%	13%	34%	21%

*significant difference found between groups, p<.05
(accounted for by difference in girls).

School Subjects Students Would Avoid

Students were also presented with a list of school subjects and asked to identify which ones they would get rid of if they could. Table 4 shows that a significantly higher percentage of the students in the comparison group would get rid of English, Social Studies and Science. None of the students in the mentor group wanted to get rid of science class.

Table 4. Percent of students by group who would get rid of each of the classes listed if they could.

School Subjects	Mentor Group n=29	Comparison Group n=61
Reading	28%	26%
Math	31%	18%
English*	28%	61%
Science*	0%	13%
Social Studies*	10%	31%
None of the Above	28%	26%

*significant difference found between groups, p<.05.

Students' Views of and Interest in Science

The final way students' views of and interest in science were assessed was through their responses to 12 statements about science which were in a Likert-type format with three response categories: no, not sure, and yes. The items were designed to measure students' enjoyment of science class, their belief that they could do well in science and become a scientist, their views of the importance and purpose of science, and their views of being a scientist.

Overall, almost all students agreed that they learn about 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 also disagreed with statements that science class is boring and that studying science is a waste of time.

No significant differences were found between the mentor group and the comparison group on these items. However, some interesting patterns of responses, although not significant, suggest possible differences between the groups and between girls and boys in how they view themselves in the world of science. Higher percentages of students in the mentor classrooms said that they really like science, that they would enjoy being a scientist, and that science helps us understand the world better (see Figures 7-9). In addition, the boys in the mentor group were more likely to agree that they would enjoy being a scientist (see Figure 8) and that they could be scientists when they grow up than any other group (see Figure 10). The girls in the mentor classrooms responded similarly to the students in the comparison classrooms on these two questions.

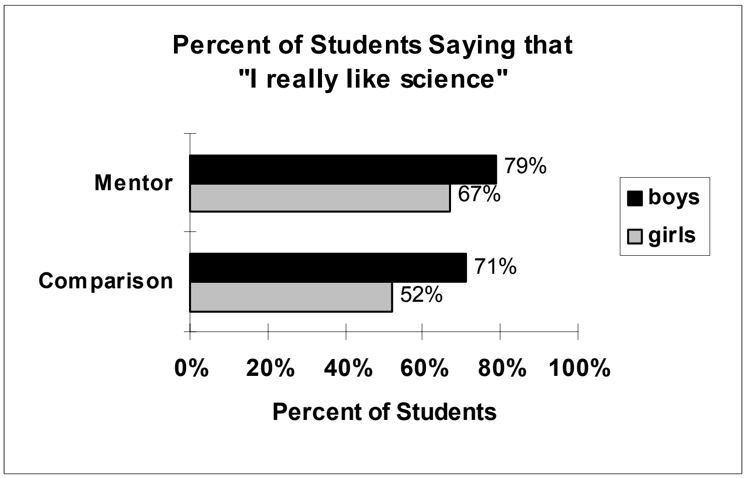

Figure 7.

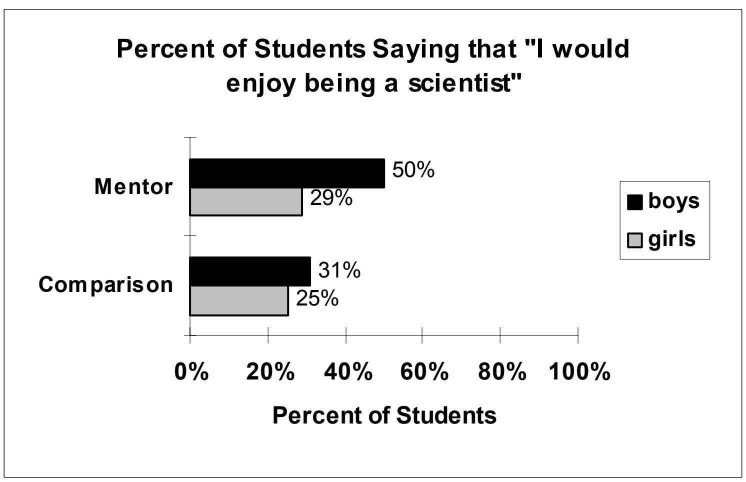

Figure 8.

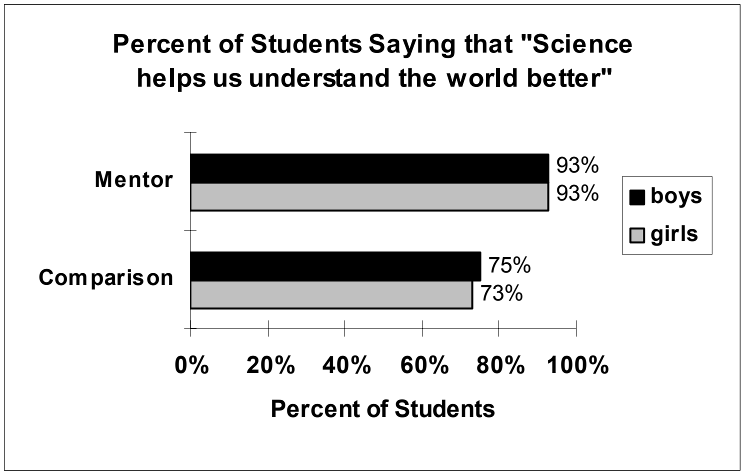

Figure 9.

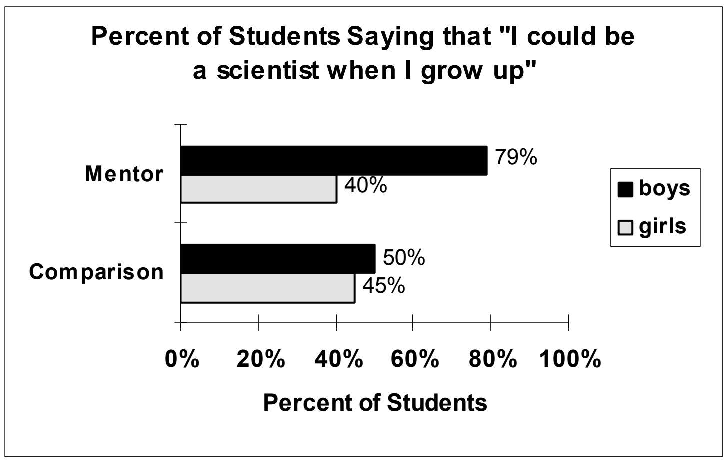

Figure 10.

Data from the four classrooms were combined to examine overall gender and rural/urban differences. Again, no significant differences were found. However, a somewhat higher percentage of the girls said they were not sure if they really like science compared to boys and disagreed that they would enjoy being a scientist compared to boys. A higher percentage of boys agreed that they could be a scientist when they grow up while a higher percentage of girls said that they were not sure if they could be a scientist. About 20% of boys and girls said they could not be a scientist when they grow up. See Table 5 for a detailed look at the percentage of boys and girls in each group who agreed with the statements presented. (One item, “I am not good at science” is omitted from the table and analyses because it appeared to be confusing to students)

Table 5. Percent of students by group and sex responding "yes" to each statement.

	Mentor Group			Comparison Group		
	Boys	**Girls**	**All**	**Boys**	**Girls**	**All**
I really like science.	**79%**	**67%**	**72%**	**71%**	**52%**	**62%**
We learn about important things in science class.	**100%**	**93%**	**97%**	**97%**	**89%**	**93%**
If we had more time in school, I'd like to do more science lessons.	**36%**	**27%**	**31%**	**34%**	**31%**	**33%**
I would enjoy being a scientist.	**50%**	**29%**	**39%**	**31%**	**25%**	**28%**
Science helps us understand the world better.	**93%**	**93%**	**93%**	**75%**	**73%**	**74%**
Science class is boring.	**7%**	**14%**	**11%**	**13%**	**10%**	**12%**
Everyone should learn about science.	**86%**	**60%**	**72%**	**56%**	**79%**	**67%**
Kids like me sometimes grow up to be scientists.	**57%**	**53%**	**55%**	**53%**	**59%**	**56%**
Studying science is a waste of time.	**7%**	**0%**	**3%**	**13%**	**0%**	**7%**
I would like to get a science kit as a present.	**57%**	**29%**	**43%**	**38%**	**45%**	**41%**
Science helps people.	**93%**	**87%**	**90%**	**81%**	**89%**	**85%**
I could be a scientist when I grow up.	**79%**	**40%**	**59%**	**50%**	**45%**	**48%**

Students' Perceptions of Scientists

Names Students Give An Imaginary Scientist

Finally, students were asked to imagine a scientist and give the scientist a first name. It was anticipated that students who had experienced the Wonderwise kits and thus been exposed to the kits' female role models in science would be more likely to give their scientist a female name. Half of the girls in the mentor classrooms gave their scientists female names compared to less than a third of the girls in the comparison group. Conversely, about a third of the girls in the mentor classrooms gave their scientists male names compared to about 50% of the girls in the comparison group. In contrast to the girls, none of the boys in this sample gave their scientists female names. (About 20% of the boys and girls gave names that were ambiguous and could not be classified as male or female.) Figure 11 shows the percent of students in each group giving their scientist a female or male name. The difference between the mentor group and the comparison group was not significant, however, the difference between the boys and girls across groups was a dramatic and significant difference. This indicates that girls, as a group, are much more likely than boys to give their scientist a female name and identity. No difference was found between rural and urban students.

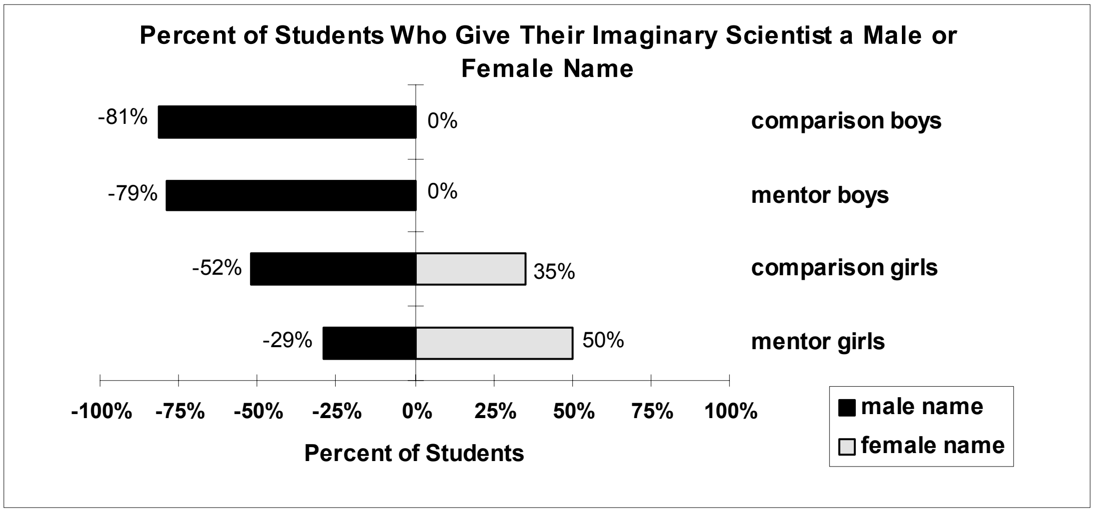

Figure 11.

Words Students Use to Describe An Imaginary Scientist

Students were then presented with a list of descriptors and asked to mark the ones that described their scientist. As Table 6 shows, there were very few differences between the two groups. However, one significant difference was that all of the mentor students said that their scientist was happy compared to a lower percentage of comparison group students. While very few students appeared to endorse negative qualities of the scientist they imagined, a sizable percentage in both groups reported that their scientist was weird. In addition, a significantly higher percentage of girls than boys said that their imaginary scientist liked work, worked with other people, and did not work alone.

Table 6. Percent of students by group and sex who selected each item as describing their imaginary scientist.

	Mentor Group		Comparison Group	
Descriptors of the scientist they imagined.	**Boys n=14**	**Girls n=15**	**Boys n=32**	**Girls n=29**
serious	**43%**	**40%**	**63%**	**38%**
likes work+	**86%**	**93%**	**72%**	**97%**
works alone+	**29%**	**13%**	**38%**	**14%**
friendly	**86%**	**100%**	**88%**	**97%**
unhappy	**0%**	**0%**	**3%**	**7%**
weird	**29%**	**47%**	**50%**	**31%**
funny	**71%**	**93%**	**78%**	**90%**
works with other people+	**64%**	**93%**	**63%**	**86%**
doesn't like work	**7%**	**0%**	**16%**	**0%**
happy*	**100%**	**100%**	**78%**	**83%**
not friendly	**0%**	**0%**	**9%**	**3%**

*significant difference found between mentor and comparison groups, $p<.05$.
+significant difference found between boys and girls, $p<.05$.

Students were also asked to add descriptors to the list provided. There appeared to be some confusion about this portion of the survey although most of the students appeared to complete it correctly. The adjectives that students generated were categorized as being positive or negative and as being related to one of the following dimensions: physical, intellectual/work-related, personality/social, or ambiguous (see Table 7 for examples of descriptors in each category).

Table 7. Examples of types of descriptors generated by students.

Dimension	Positive Descriptors	Negative Descriptors
physical	athletic, handsome, pretty	dresses funny, slow, ugly
intellectual/work-related	smart, intelligent, hard worker, on time, does his best	stupid
personality/social	cool, truthful, caring, kind	strange, boring, mean
ambiguous	conservative, different, works with plants	

In a comparison of the number of students who generated positive and negative descriptors, there were no significant differences between mentor comparison classrooms. However, looking at the mean number of positive and negative descriptors, the mentor group generated a significantly higher number of positive attributes than the comparison group (see Figure 12). In a more detailed analysis of the types of descriptors, the mentor students generated significantly more positive, work-related/intellectual descriptors compared to the comparison group. This was true both for the average number of traits named per student, as well as the number of students naming such traits. There were no significant differences found between groups on the average number of physical or social/personality traits, either positive or negative, that students generated. However, the percentage of students in the comparison group who wrote negative physical traits for their scientists was significantly higher than the percentage of students in the mentor group.

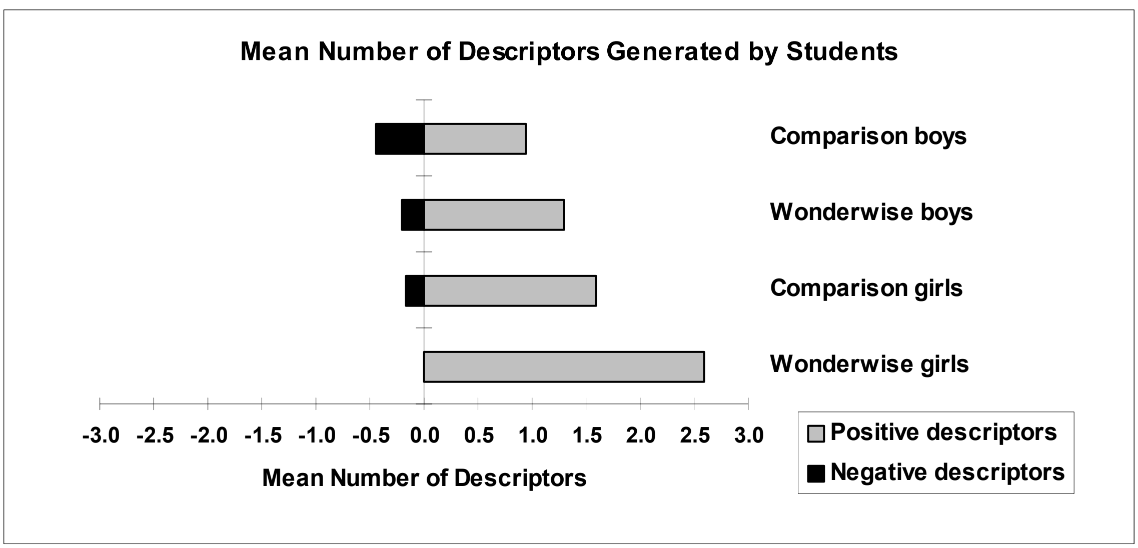

Figure 12.

Looking at overall gender comparisons, girls as a group generated a significantly higher number of positive attributes for their scientist than boys (see Figure 12). Girls also generated, on average, a significantly higher number of positive intellectual/work, and social/personality characteristics than the boys and were less likely to generate negative physical attributes. In a group by sex comparison, a greater proportion of girls in the mentor group generated positive intellectual/work traits than the girls in the comparison group. In a comparison of rural and urban groups, no significant differences were found.

Finally, students were presented with pairs of words or phrases and asked to select one from each pair that described their scientist. There was a significant difference between the mentor group and the comparison group in the percentage of students who said their scientist was interesting. More students in the mentor group thought this than students in the comparison group. There were no other significant differences between the groups. However, there were several significant differences by gender, when the classes were all grouped together. Higher percentages of girls than boys reported that their scientist had a lot of friends, was a woman, and had kids (see Table 8). Consistent with students' previous responses, virtually no boys in either group said that their scientist was a woman (see Figure 13).

Table 8. Percent of students by group and sex who circled dichotomously presented descriptors of their scientist.

My scientist...	Mentor Group		Comparison Group	
	Boys n=14	Girls n=13	Boys n=32	Girls n=28
has fun	**100%**	**100%**	**88%**	**93%**
doesn't have fun	**0%**	**0%**	**13%**	**7%**
is interesting *	**100%**	**100%**	**80%**	**93%**
is boring *	**0%**	**0%**	**20%**	**7%**
has a lot of friends +	**57%**	**100%**	**86%**	**93%**
doesn't have a lot of friends +	**43%**	**0%**	**14%**	**7%**
is a man +	**100%**	**23%**	**87%**	**55%**
is a woman +	**0%**	**77%**	**7%**	**45%**
has kids +	**64%**	**86%**	**48%**	**75%**
doesn't have kids +	**36%**	**14%**	**48%**	**25%**

*significant difference found between mentor and comparison groups, p<.05.
+significant difference found between boys and girls, p<.05.

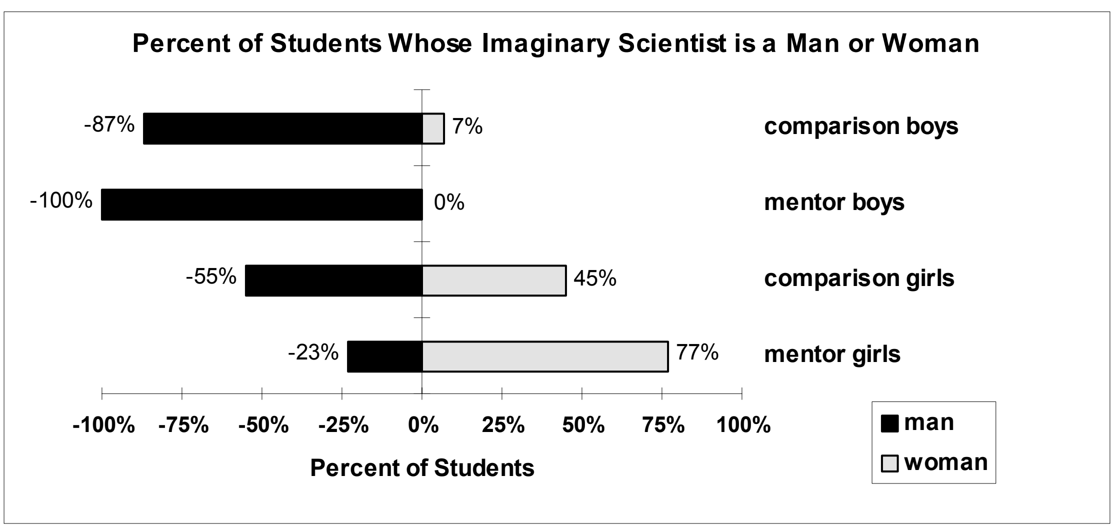

Figure 13.

Summary

1) How do students who have experienced the Wonderwise kits differ in their perceptions of scientific work compared to students who have not experienced the kits?

Mentor students appear to have a more detailed understanding of scientific work compared to students in the comparison group, and to have knowledge of scientific activities specific to the kits. Mentor students described significantly more activities that scientists do at work than the students in the comparison group did. In these descriptions, mentor students were more likely to mention that scientists take notes on their work through recording data or writing down what they do, and that they communicate their work through talking with other scientists or sharing their findings.

In response to the question, "If you were a scientist, what kinds of things would you like to do?" students in the mentor group were more likely to describe working with animals than the comparison group. A few students in the mentor group mentioned activities similar to the professions of scientists featured in the kits, including being an ocean scientist and studying about allergies. Students in the comparison group were more likely to name other specific activities such as studying ecology or digging up fossils which in all likelihood reflected their recent lessons in science class.

When students were presented with a list of activities, mentor students identified more of these activities as being scientific than the students in the comparison group did. These differences reflected mentor students' awareness of scientific activities that were displayed in the Wonderwise kits, including teaching students, working outside, and catching fish. Interestingly, girls in the mentor group mostly accounted for these differences between the two groups.

2) How do students who have experienced the Wonderwise kits differ in their attitudes toward science compared to students who have not experienced the kits?

When asked "What do you do in science class that you like?" students in the mentor group mentioned hands-on activities and experiments significantly more often than the comparison group students. Students in both groups also mentioned specific topics that they enjoyed, and a number of the mentor students mentioned topics covered in the Wonderwise kits.

No consistent differences between the two groups of students were seen in their attitudes toward extracurricular science activities. With respect to school subjects that students would avoid, a significantly higher percentage of the comparison group wanted to get rid of science, English, and social studies.

In response to statements about their views of the importance of science and their enjoyment of science, no significant differences were seen between the two groups. However, a few trends were suggestive of a pattern. Somewhat higher percentages of students in the mentor classrooms said that they really like science, that they would enjoy being a scientist, and that science helps us understand the world better. The boys in the mentor group were much more likely to agree that they would enjoy being a scientist and that they could be a scientist when they grow up than any other group while the girls in the mentor classrooms responded similarly to the students in the comparison classrooms on these questions. As a group, girls appeared less likely than boys to want to become more involved in science activities.

3) How do students who have experienced the Wonderwise kits differ in their perceptions of scientists compared to students who have not experienced the kits?

Some differences were seen between the mentor and comparison groups in several questions pertaining to their perceptions of scientists. First, when students were asked to imagine a scientist and give the scientist a name, somewhat but not significantly higher percentages of girls in the mentor group gave their scientist a female name compared to students in the other groups. None of the boys in either group gave their scientists female names.

When students were asked to select among a set of descriptors for their imaginary scientists, significantly more mentor students said their scientist was happy compared to the comparison group students. Students also generated their own descriptors of their imaginary scientists. On this task, the mentor group generated a significantly higher number of positive attributes than the comparison group, and also generated significantly more positive, work-related/intellectual descriptors than the comparison group.

Finally, students were presented with several pairs of descriptors and asked to select one in each pair that best described their imaginary scientist. All the mentor students said their scientist was interesting compared to lower percentages of students in the comparison group. Girls in the mentor group were also more likely to say that their scientist was a woman rather than a man compared to all other students.

In these comparisons of perceptions of scientists, more differences were found between boys and girls than between classroom groups. Girls as a group were much more likely to give their scientist a female name than the boys were. Girls generated more positive attributes, including intellectual, work-related, and social/personality characteristics, than boys, and generated fewer negative attributes. Also, higher percentages of girls than boys reported that their scientist had a lot of friends, was a woman, and had kids.

Discussion

These results provide some promising evidence of the impact of the kits on students' views of science and scientists. This study also revealed some important differences between the way girls and boys perceive scientists.

With respect to the evaluation questions focusing on the impact of the kits, there were several significant findings that indicate that the students whose teachers had used the kits in their classrooms appear to have some different, broader, and more positive conceptions of scientists and their work than students in the comparison group. The mentor group students were able to describe more activities that scientists do and identify more scientific activities from a list presented to them. Mentor students were also more likely to attribute positive characteristics to an imaginary scientist of their choosing, such as being smart and a hard worker. These are important initial findings that suggest that the Wonderwise kits positively influence students' views of scientists and the work that scientists do. Because students who experienced the kits were more likely to mention hands-on activities and experiments as things in their science classes that they enjoy doing, the kit activities appear to be a critical component in producing this effect.

Patterns in the findings suggest that girls may be differentially affected, and may be more likely to remember things from the kits than the boys. Yet, girls were not more likely than boys to endorse statements about wanting to become more involved in science or to become scientists. Further investigation about how girls and boys respond to the kit components may uncover differences in how they perceive themselves in relation to science activities.

Although no consistent differences were found between rural and urban students in their responses to the questions about scientists, science, and science activities, this variable should continue to be included in further evaluations to confirm this finding.

In addition to these findings about the impact of the kits, another striking pattern was identified. Girls as a group across all classrooms differed from the boys in their responses to some questions about an imaginary scientist. Girls were much more likely to imagine a woman scientist with positive intellectual/work-related and personality traits than boys were. They were also more likely to envision their scientists with a lot of friends and as a parent. These differences were not attributable to the kits, but are worth noting because it indicates that girls at this grade level appear to already differ from boys in their views of science and scientists and consequently may respond differently to the kits and the messages conveyed by the kits.

Because this study involves such a small number of classrooms, the results cannot be generalized across all classrooms that use the Wonderwise kits. However, the overall results appear consistent across several dimensions, and suggest that the use of the kits by the mentor teachers provides students with some added benefits that are not available in similar classrooms in Nebraska. The students who experienced the kits appear to remember the activities and ideas in the kits and to see the scientists portrayed as positive role models who are doing important work.

Evaluation involving a larger number of classrooms and students, and involving teachers who did not undergo intensive training with the kits is suggested to confirm these findings across a broader population of potential users of the Wonderwise kits.