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Summative Evaluation of *Kinetic City Omega/Sigma After School*

Report for

AAAS
(American Association for the Advancement of Science)
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by

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Table of Contents

Summative Evaluation of
Kinetic City Omega/Sigma After School

Executive Summary

July 20, 2007

The summative evaluation reported here focuses on *Kinetic City Omega/Sigma After School*, a program developed by AAAS (The American Association for the Advancement of Science). The program combines on-line stories and interactive challenges with off-line hands-on learning activities and resources.

Research Issues and Goals

The primary goals for this summative evaluation study are (1) to assess the learning outcomes of using *Omega/Sigma After School* resources and participating in project learning activities, and (2) to discern changes, if any, in participating students' attitudes toward science. Towards these ends, both descriptive and explanatory findings are reported, based upon feedback obtained from urban minority children in Grades 3-5. Summative evaluation efforts were designed to be naturalistic studies that are intended to inform the project's decision-making process. Researchers looked for patterns in the quantitative data specified in the following section of this report.

Research Procedures and Measures

Research for this project involved pre- and post-use written student feedback about *Omega/Sigma* learning activities and materials off-line, as well as on-line use of the project's Web site in its designated informal educational context with the appropriate target group (i.e., students in grades 3-5). Evaluation activities extended over the course of six months, beginning in November 2006, with students performing 8 *Kinetic City* missions, each extending for a period of 2-3 weeks. Test responses and feedback were elicited from students at three elementary school sites located in the Washington, DC metropolitan area. Data was analyzed to discern the degree to which the project was able to meet its intended learning outcomes.

The research procedure involved placing *Omega/Sigma* learning materials/activities in their designated context (i.e., informal after school learning programs) with the project's elementary school audience. The intent for this phase of evaluation is to examine the effectiveness of project components under normal use conditions with the intention of implementing changes that will better serve the learning needs of its users. Toward this end, pre- and post-use questionnaires were administered to assess students' acquisition of standards-based science information; changes in their interests and attitude toward science as a consequence of performing project designed activities; changes of interest in a career that involves science; and changes in motivation to perform science-related activities at home for fun.

In addition to providing responses to pre- and post-use behavior, attitude, and content questions; changes in students' reading comprehension skill were also assessed via three sentence-completion tasks and two open-ended questions. Toward this end, students were asked to read three passages about rainforests and then complete each of three sentences by checking the appropriate ending or endings from a list of options. As a follow-up question, students were asked if many of the plants in a rainforest died, would that have any effect on carnivores? They were then asked to explain why or why not. Further, students were given the option of an extra credit task which asks them to pretend that they are a plant or animal that lives in the rainforest and write a letter to a friend who lives in the desert describing the rainforest habitat and wildlife.

The intent of this activity is to assess changes in students' ability to write a clear letter making appropriate use of content in the reading samples and to amplify upon the content using information they had acquired over the course of performing project designed learning activities.

Demographics

A total of 73 minority elementary school students (37 male, 36 female) from three urban field-test sites located in Washington, DC performed project designed learning activities and responded to paired pre- and post-use questionnaires. At the time of the study, 17 of the sample students (23.3%) were third graders, 32 students (43.8%) were fourth graders, and 24 students (32.9%) were fifth graders.

Summary of Findings

Information from demographic, background, content, and reading comprehension questions was used to determine that the three student groups are equivalent samples. Similarly, the three samples did not differ significantly with respect to the classifications of gender, ethnicity, content knowledge, initial attitudes about science, self reported ability to use a computer, experience with exploring the World Wide Web, and interest in a job that involves science.

Prior to participation in this study, 25.0% of the sample students described their ability to use a computer as "Advanced," 20.8% rated their ability as "Above Average," 19 26.4% indicated their ability to use a computer is "Average," and 27.8% rated themselves as "Just Beginning" computer users. In a similar vein, 27.8% of the students reported that they were "Advanced" Web explorers. Another 20.8% indicated that they were "Above Average" explorers, and 23.6% viewed themselves as "Average" Web explorers. An additional 27.8% of the sample describe themselves as "Just Beginning" Web explorers. Asked if they are able to visit the Internet from home, 54.9% of the responding students said "Yes" and 45.1% said "No."

Both prior to and after participating in *Omega/Sigma After School* learning activities, students were asked to indicate what types of things they do on the Internet, if anything. Approximately half of the pre-use responses and a third of the post-use response indicated playing games as something students do on the Internet. This is a 15.8% decrease from pre to post-use. In contrast, searching for information rose from a single reference to seventeen references, resulting in a 15.7% increase in student activity. Other popular Internet activities include e-mailing friends and doing homework. Students identified *kineticcity.com* and *disneychannel.com* as the most popular sites.

To probe for changes in students' attitudes about science, they were asked at the beginning and end of this study to complete the sentence stem: "I think science is...." The largest attitudinal changes from pre- to post-use can be summarized as follows:

- More students think science is interesting, fun, and important.
- More students think science is something they can do.
- More students would like to know more about science.
- Fewer students think science is boring, uninteresting, too hard, and not for them.

Probing for further insights into changes regarding attitudes about science, students were asked whether or not they had engaged in any science-related activity at home, just for fun. Prior to performing project designed learning activities 50.7% of the 73 students in the sample reported that they had. Afterwards, 58.9% said that they had. This is an increase of 8.2%.

Prior to performing project designed activities, participants in this study were also asked to indicate how likely it is that they will want to work in a job that involves science. The percentage of students reporting that they "definitely will" or "might" have a job that involves science increased by 2.7% and 12.3%, respectively. In contrast, the percentages of students saying that they "won't" have such a job decreased by 15.1% from pre- to post-use.

While, on average, the three participating schools, both genders, and all three grade levels (i.e., 3-5) are equivalent with respect to students' initial knowledge of *Omega/Sigma* content and their initial reading skill, each school, gender, and grade had significantly improved scores on the post-use content and reading tests, compared to their pre-use results, overall.

Having established the equivalency of students' initial content knowledge, their score data was combined into a single group for further analyses. The post-use mean achievement score for the whole 73 student sample is 8.77, significantly higher than the pre-use mean score of 4.08, as tested by a paired t-test. Thus, on average, the learning outcomes resulting from performance of project activities are statistically significant. In addition, there is also statistically significant improvement on all content questions when considered independently, except for Questions 6 and 12. The results for Questions 6 reveal that students generally displayed difficulty identifying the following statement as being incorrect: "Some fish can swim, and other fish can't." Similarly, Question 12 results indicate that they also had difficulty discerning the correct procedure to compute the answer to the following question: "Sarah starts with $25, gives half of her money to her little brother and then buys a brownie for $1.75. How would you figure out how much money she has left?"

Having established the equivalency of students' initial reading comprehension skill, their score data will be combined into a single group for further analyses. The post-use mean reading achievement score for the whole sample is 3.08, significantly higher than the pre-use mean score of 1.14, as tested by a paired t-test. Thus, on average, the reading comprehension outcomes resulting from performance of project activities are statistically significant.

Students' post-use letters generally contain more extensive, detailed, accurate writing than their pre-use letters. The letters are also more reflective of the three passages they read and sometimes accurately extend beyond passage content. Fewer post-use letters received a zero score (indicating a response that is incorrect, no response, or wrote "I don't know." In addition, a larger number of post-use letters received an additional 1, 2, or 3 points. Each of these increases is statistically significant, as tested by a paired t-test.

With an interest in interaction effects, ANOVAs (analyses of variance) with interactions and nested factors were calculated for *Content Knowledge* (i.e., Pre, Post) and individual demographic/background variables of *gender*, *school*, *grade*, *computer experience*, *Internet experience*, and *science attitudes*. None of the interactions are statistically significant. Performing the same analyses for *Comprehension Skill* (i.e., Pre, Post) and demographic/background variables yielded similar results. Thus, learning outcomes are attributable to participation in *Kinetic City Omega/Sigma After School* learning activities.

Summative Evaluation of
Kinetic City Omega/Sigma After School

July 20, 2007

Introduction

The summative evaluation reported here focuses on *Kinetic City Omega/Sigma After School*, a program developed by AAAS (The American Association for the Advancement of Science). *Omega/Sigma* resources contain a variety of hands-on activities, research activities, and educational games. An associated interactive Web site provides users with a variety of episodic adventures intended to teach children about standards-based science and to help them better comprehend the complexities of the world around them. The program combines on-line stories and interactive challenges with off-line hands-on science, creative writing, art, and physical education activities. The program is based on Project 2061: Benchmarks for Science Literacy learning goals and pedagogy. The producers intend that by engaging children in a fun, adventure-based after school club in which they become familiar with standards-based learning goals, children will enter the classroom with confidence, with an understanding of critical core science concepts, and with an eagerness to learn more.

Research Issues and Goals

The primary goals for this summative evaluation study are (1) to assess the learning outcomes of using *Omega/Sigma After School* resources and participating in project learning activities, and (2) to discern changes, if any, in participating students' attitudes toward science. Towards these ends, both descriptive and explanatory findings are reported, based upon feedback obtained from urban minority children in Grades 3-5. Summative evaluation efforts were designed to be naturalistic studies that are intended to inform the project's decision-making process. Researchers looked for patterns in the quantitative data specified in the following section of this report.

Research Procedures and Measures

Research for this project involved pre- and post-use written student feedback about *Omega/Sigma* learning activities and materials off-line, as well as on-line use of the project's Web site in its designated informal educational context with the appropriate target group (i.e., students in grades 3-5). Evaluation activities extended over the course of six months, beginning in November 2006, with students performing 8 *Kinetic City* missions, each extending for a period of 2-3 weeks. Test responses and feedback were elicited from students at three elementary school sites located in the Washington, DC metropolitan area. Data was analyzed to discern the degree to which the project was able to meet its intended learning outcomes.

The research procedure involved placing *Omega/Sigma* learning materials/activities in their designated context (i.e., informal after school learning programs) with the project's elementary school audience. The intent for this phase of evaluation is to examine the effectiveness of project components under normal use conditions with the intention of implementing changes that will better serve the learning needs of its users. Toward this end, pre- and post-use questionnaires were administered to assess students' acquisition of standards-based science information; changes in their interests and attitude toward science as a consequence of performing project designed activities; changes of interest in a career that involves science; and changes in motivation to perform science-related

activities at home for fun. Questionnaire responses are divided into the following three categories:

Demographic and Background Variables. The pre-use questionnaire established respondents' status with respect to demographic classification variables (gender, grade level, and school) and background classification variables (computer experience, experience exploring the Web, and access to the Internet from home.)

Science Interests. Students conveyed their attitudes about science both prior to and after participation in project activities. They also reported their science-related activities at home, the types of things they like to do on the Internet, and their interest in a job that involves science.

Science Knowledge. Both the pre- and post-use questionnaires included a knowledge test to assess understanding of science content associated with the project's learning goals. Sixteen multiple-choice questions comprised the 16-point test about *Kinetic City* science content. The questions/statements, choices, and correct answers drawn from project resources/activities appear below. Note that correct answers are highlighted by a checked box.

1. The time it takes your body to respond to something you see or hear is called _____.
   - 1☒ reaction time
   - 2☐ sensory lag
   - 3☐ brain freeze
   - 4☐ nerve gap
   - 5☐ I don't know.
2. Which of the following is true?
   - 1☐ You can learn new facts, but you can't learn new skills.
   - 2☐ The brain is the largest organ in the body.
   - 3☒ Some skills can be practiced until they become automatic.
   - 4☐ Learning is the ability to memorize information.
   - 5☐ I Don't know.
3. Which of these works most closely with the heart to do a job?
   - 1☐ The stomach
   - 2☒ The lungs
   - 3☐ The brain
   - 4☐ The esophagus
   - 5☐ I Don't know.
4. Why does the heart beat faster when you exercise?
   - 1☒ Your muscles need more blood pumped to them when you exercise.
   - 2☐ Exercise tires the heart out.
   - 3☐ Beating fast is your heart's way of getting you to slow down.
   - 4☐ Exercising gets you excited.
   - 5☐ I Don't know.
5. What is the best way to classify animals?
   - 1☐ By the way they look.
   - 2☐ By where they live.
   - 3☒ There is no "best way" to classify animals.
   - 4☐ By where they are on the family tree.
   - 5☐ I Don't know.

6. Which statement is NOT true?
   1. ☒ Some fish can swim, and other fish can't.
   2. ☐ Some birds can fly, and other birds can't.
   3. ☐ Some mammals can fly, and other mammals can't.
   4. ☐ Some plants eat animals.
   5. ☐ I Don't know.
7. Which statement about bird beaks is true?
   1. ☒ Some beaks are best for eating one type of food, and other beaks are best for eating other types of food.
   2. ☐ The largest beak is the best, because the bird can eat the most types of food.
   3. ☐ A bird's beak is designed to let the bird eat the most possible different food types.
   4. ☐ All of the above.
   5. ☐ I Don't know.
8. If you saw a wild animal with very large ears, you could be fairly sure that _____.
   1. ☐ its hearing is better than its eyesight.
   2. ☒ the big ears somehow help it survive.
   3. ☐ it is probably a mutation.
   4. ☐ other animals make fun of it.
   5. ☐ I Don't know.
9. A group of stars that form an image in the night sky is called _____.
   1. ☐ Comet
   2. ☐ Nebula
   3. ☒ Constellation
   4. ☐ Solar System
   5. ☐ I Don't know.
10. Which statement is TRUE about the Big Dipper?
    1. ☐ It is made up of stars, planets, and asteroids.
    2. ☒ If you looked at it from the side, it would look totally different.
    3. ☐ The stars in it are only a few miles apart.
    4. ☐ It is an optical illusion caused by sunspots.
    5. ☐ I Don't know.
11. Sam's Sneaker Shop ordered 120 boxes of sneakers with 16 pairs of sneakers in each box. How would you figure out how many pairs of sneakers they ordered?
    1. ☐ Add
    2. ☐ Subtract
    3. ☒ Multiply
    4. ☐ Divide
    5. ☐ I Don't know.
12. Sarah starts with $25, gives half of her money to her little brother and then buys a brownie for $1.75. How would you figure out how much money she has left?
    1. ☒ Divide, then subtract
    2. ☐ Subtract, then divide
    3. ☐ Multiply, then subtract
    4. ☐ Divide only
    5. ☐ I Don't know.
13. A good model always _____.
    1. ☐ looks and works just like the real thing.
    2. ☒ imitates the real thing in some important ways.
    3. ☐ makes studying the real thing unnecessary.
    4. ☐ All of the above.
    5. ☐ I Don't know.

14. Which of these is NOT a kind of model?
    1. ☐ An architect's plan for a building
    2. ☐ A computer simulation of hurricane
    3. ☒ An instruction manual for a toaster
    4. ☐ A mobile of the Solar System
    5. ☐ I Don't know.
15. What radical idea did Nicolas Copernicus and Galileo support?
    1. ☐ That the Moon revolves around the Earth
    2. ☐ That the Sun revolves around the Earth
    3. ☐ That the Earth is round
    4. ☒ That the Earth revolves around the Sun
    5. ☐ I Don't know.
16. What causes night and day?
    1. ☐ The sun revolves around the Earth
    2. ☐ The Moon revolving around the Earth
    3. ☒ The Earth rotating
    4. ☐ The Sun and the Earth revolving around each other
    5. ☐ I Don't know.

In addition to providing responses to pre- and post-use behavior, attitude, and content questions; changes in students' reading comprehension skill were also assessed via three sentence-completion tasks and two open-ended questions. Toward this end, students were asked to read three passages about rainforests and then complete each of the following three sentences by checking the appropriate ending or endings (Note that correct answers are highlighted by a checked box or boxes.):

17. There are lots of plants and animals living in the rainforest because:
    1. ☒ it is warm.
    2. ☐ it is dry.
    3. ☐ it is cool.
    4. ☐ it has deep, rich soil.
    5. ☐ it has very few diseases.
18. Plant-eating animals in the rainforest like to eat:
    1. ☒ roots
    2. ☒ fruit
    3. ☐ bugs
    4. ☒ leaves
    5. ☐ pine-cones
    6. ☒ wood
19. Carnivorous creatures like to eat:
    1. ☐ fruit
    2. ☐ nuts
    3. ☒ bugs
    4. ☒ worms
    5. ☐ leaves
    6. ☒ snakes
    7. ☒ birds

As a follow-up question, students were asked if many of the plants in a rainforest died, would that have any effect on carnivores? They were then asked to explain why or why not. A correct response indicated the indirect connection between plants and

carnivores showing that the student knows that without plants, there can be no plant-eaters, and no plant-eaters means no food for carnivores.

Further, students were given the option of an extra credit task which asks them to pretend that they are a plant or animal that lives in the rainforest and write a letter to a friend who lives in the desert describing the rainforest habitat and wildlife. The intent of this activity is to assess changes in students' ability to write a clear letter making appropriate use of content in the reading samples and to amplify upon the content using information they had acquired over the course of performing project designed learning activities.

Scoring of the writing assignment is based on a 3-point system that took into account variations in the quality of both correct and incorrect responses. The following rubric outlines the scoring method:

3 – *a clearly written letter that makes appropriate use of content in the reading passages and contains responses that are correct;*

2 – *an essentially correct letter, but one that omits key detail(s) or underlying explanations, such as events related to food webs and other themes contained in the readings;*

1 – *a response that is very skimpy, but generally correct, and demonstrates a grasp of the assignment;*

0 – *a response that is incorrect, no response, or wrote "I don't know."*

Demographics

A total of 73 minority elementary school students (37 male, 36 female) from three urban field-test sites located in Washington, DC performed project designed learning activities (See Table 1). All of the sample students responded to written questionnaires before and after using *Omega/Sigma* leaning resources and visiting the *Kinetic City* Web site for a period of eight weeks.

Table 1. Urban Field-Test Sites in Washington, DC

	Gender			*Grade*		
Elementary School	*Boys*	*Girls*	***N***	*3rd*	*4th*	*5th*
Park View Elementary School	9	12	***21***	*10*	*7*	*4*
Smothers Elementary School	6	6	***12***	*6*	*6*	–
Thomson Elementary School	22	18	***40***	*1*	*19*	*20*
Total	***37***	***36***	***73***	***17***	***32***	***24***

Note that at the time of the study, 17 of the sample students (23.3%) were third graders, 32 students (43.8%) were fourth graders, and 24 students (32.9%) were fifth graders. Note also that there is approximately the same percentage of male and female participants (i.e., 37 vs. 36, respectively). Table 2, on the following page, presents the distribution of the participants' gender by grade.

*Table 2. Distribution of Gender by Grade**

N	*Grade/Gender*	*Number (Percent)*
24	**Fifth**	
	Male	*15 (62.5%)*
	Female	*9 (37.5%)*
32	**Fourth**	
	Male	*14 (43.8%)*
	Female	*18 (56.2%)*
17	**Third**	
	Male	*8 (47.1%)*
	Female	*9 (52.9%)*

EVALUATION FINDINGS

As noted in the Demographics section, above, minority elementary school students from three urban field-test sites located in Washington, DC performed project designed learning activities for a period of eight weeks. Paired pre- and post-use questionnaires were obtained from a total of 73 students (37 male, 36 female). Information from demographic, background, content, and reading comprehension questions was used to determine whether or not the three student groups are equivalent samples. Pooled t-test analyses and analysis of variance (ANOVA) revealed that the three samples did not differ significantly with respect to the classifications of gender, ethnicity, content knowledge, initial attitudes about science, self reported ability to use a computer, experience with exploring the World Wide Web, and interest in a job that involves science. The sample students performed activities contained in the project's *Omega/Sigma* print materials and on the *Kinetic City* Web site. Findings from evaluation research are reported below.

Prior Computer Experience

As specified in Table 3, a total of 18 (25.0%) students described their ability to use a computer as "Advanced," 15 (20.8%) rated their ability as "Above Average," 19 (26.4%) indicated their ability to use a computer is "Average," and 20 (27.8%) rated themselves as "Just Beginning" computer users. One student did not respond to this inquiry.

Table 3. Self-Reported Ability to Use a Computer

Variable	*N*	*Categories*	*Number (Percent)*
Computer Background	72	Advanced	18 (25.0%)
		Above Average	15 (20.8%)
		Average	19 (26.4%)
		Just Beginning	20 (27.8%)

Prior Internet Experience

As indicated in Table 4, on the following page, a total of 20 (27.8%) students reported that they are "Advanced" Web explorers. Another 15 (20.8%) indicated that they are "Above Average" explorers, and 17 (23.6%) view themselves as "Average" explorers. An additional 20 (27.8%) members of the sample describe themselves as "Just Beginning" Web explorers. One student did not offer a response. When asked if they are able to visit the Internet from home, 39 (54.9%) of the responding students said "Yes" and 32 (45.1%) said "No."

Table 4. Self-Reported Experience With Exploring the World Wide Web

Variable	*N*	*Categories*	*Number (Percent)**
Internet Background	72	Advanced	20 (27.8%)
		Above Average	15 (20.8%)
		Average	17 (23.6%)
		Just Beginning	20 (27.8%)

Both prior to and after participating in *Omega/Sigma After School* learning activities, students were asked to indicate what types of things they do on the Internet, if anything. Some respondents identified the general categories presented in Table 5a and others listed specific Web sites, shown in Table 5b. Note that approximately half of the pre-use responses and a third of the post-use response indicated playing games as something students do on the Internet. This is a 15.8% decrease from pre to post-use. In contrast, searching for information rose from a single reference to seventeen references, resulting in a 15.7% increase in student activity. Other popular Internet activities include e-mailing friends and doing homework.

Table 5a. Popular Categories of Student Internet Activity

Category	*Pre-Use* Number (%) N=91*	*Post-Use* Number (%) N=101*	*Change*
Play games	45 (49.5%)	34 (33.7%)	– 15.8%
Homework	7 (7.7%)	7 (6.9%)	– 0.8%
Math	6 (6.6%)	5 (5.0%)	– 1.6%
E-mail friends	5 (5.5%)	7 (6.9%)	+ 1.4%
Write stories	5 (5.5%)	3 (3.0%)	– 2.5%
Draw pictures	3 (3.3%)	4 (4.0%)	+ 0.7%
Visit educational sites	3 (3.3%)	6 (5.9%)	+ 2.6%
Listen to music	2 (2.2%)	5 (5.0%)	+ 2.8%
Practice typing	2 (2.2%)	2 (2.0%)	– 0.2%
Find facts about history	2 (2.2%)	–	– 2.2%
Look at cloths	2 (2.2%)	–	– 2.2%
Search for information	1 (1.1%)	17 (16.8%)	+ 15.7%
Read	1 (1.1%)	5 (5.0%)	+ 3.9%
Watch videos/movies	1 (1.1%)	3 (3.0%)	+ 1.9%
Make movies	1 (1.1%)	1 (1.0%)	– 0.1%
Buy things	1 (1.1%)	1 (1.0%)	– 0.1%
Information about animals	1 (1.1%)	1 (1.0%)	– 0.1%
Use the dictionary	1 (1.1%)	–	– 1.1%
Science	–	2 (2.2%)	– 2.2%

*Totals may not equal exactly 100.0% due to rounding.

Table 5b, on the following, presents a list of Web sites that participating students identified as places they visit on the Internet. Note than visiting *kineticcity.com* and *disneychannel.com* are the most popular sites.

Table 5b. Popular Web Sites

Web Site	*Pre-Use* (Percentage) N=33*	*Post-Use* (Percentage) N=81*	*Change*
kineticcity.com	8 (24.2%)	24 (29.6%)	+ 5.4%
disneychannel.com	4 (12.1%)	11 (13.6%)	+ 1.5%
kidbiz3000.com	4 (12.1%)	4 (4.9%)	– 7.2%
pokemon.com	3 (9.1%)	2 (2.5%)	– 6.6%
kidbiz.com	2 (6.1%)	4 (4.9%)	– 1.2%
myspace.com	2 (6.1%)	3 (3.7%)	– 2.4%
cartoonnetwork.com	2 (6.1%)	3 (3.7%)	– 2.4%
pokemoncrater.com	2 (6.1%)	–	+ 0.0%
funbrain.com	1 (3.0%)	3 (3.7%)	+ 0.7%
yahoo.com	1 (3.0%)	3 (3.7%)	+ 0.7%
nick.com	1 (3.0%)	2 (2.5%)	– 0.5%
google.com	1 (3.0%)	1 (1.2%)	– 1.8%
youtube.com	1 (3.0%)	–	– 3.0%
dreamworks.com	1 (3.0%)	–	– 3.0%
millsberry.com	–	3 (3.7%)	+ 3.7%
miniclip.com	–	3 (3.7%)	+ 3.7%
stardool.com	–	3 (3.7%)	+ 3.7%
myscene.com	–	2 (2.5%)	+ 2.5%
wwe.com	–	2 (2.5%)	+ 2.5%
eduplace.com	–	1 (1.2%)	+ 1.2%
polly.com	–	1 (1.2%)	+ 1.2%
krumpkings.com	–	1 (1.2%)	+ 1.2%
ebay.com	–	1 (1.2%)	+ 1.2%
freestuff.com	–	1 (1.2%)	+ 1.2%
channel70.com	–	1 (1.2%)	+ 1.2%
dragongamez.com	–	1 (1.2%)	+ 1.2%
pimpmyride.com	–	1 (1.2%)	+ 1.2%

*Totals may not equal exactly 100.0% due to rounding.

Changes in Attitudes About Science

To probe for changes in students' attitudes about science, they were asked at the beginning and end of this study to complete the sentence stem: "I think science is...." by checking as many of the sentence endings contained in Table 6 as are expressive of their feelings. Note that the largest attitudinal changes from pre- to post-use can be summarized as follows:

- More students think science is interesting, fun, and important.
- More students think science is something they can do.
- More students would like to know more about science.
- Fewer students think science is boring, uninteresting, too hard, and not for them.

Table 6. Pre- and Post-Use Attitudes About Science

Variable	*Sentence Stem* **I think science is. . .**	*Pre-Use Count**	*Post-Use Count**	*Change*
Attitudes About Science	something I can do.	33	44	+11
	boring.	6	0	– 1
	fun.	38	43	+ 5
	interesting.	41	51	+10
	too hard.	7	0	– 7
	something I would like to know more about.	35	39	+ 4
	not for me.	4	0	– 4
	important.	35	43	+ 8
	uninteresting.	5	0	– 5

Probing for further insights into changes regarding attitudes about science, students were asked whether or not they had engaged in any science-related activity at home, just for fun. Prior to performing project designed learning activities 37 (50.7%) of the 73 students in the sample reported that they had. Afterwards, 43 (58.9%) said that they had. This is an increase of 8.2%.

Changes in Attitudes About Jobs Involving Science

Prior to performing project designed activities, participants in this study were asked to indicate which of the sentences contained in Table 7 best describes how likely it is that they will want to work in a job that involves science. The percentage of students indicating that they "definitely will" or "might" have a job that involves science increased by 2.7% and 12.3%, respectively. In contrast, the percentages of students saying that they "won't" have such a job decreased by 15.1% from pre- to post-use.

Table 7. Pre- and Post-Use Attitudes About a Job Involving Science

Variable	*N*	*Categories*	*Pre-Use Count*	*Post-Use Count**
Job Involving Science	73	I definitely will have a job that involves science.	10 (13.7%)	12 (16.4%)
		I might have a job that involves science.	40 (54.8%)	49 (67.1%)
		I won't have a job that involves science.	23 (31.5%)	12 (16.4%)

Learning Outcomes

Learning from project designed content was assessed via the same 16 multiple-choice content questions administered both prior to and at the conclusion of participation in project activities. In addition, changes in students' reading comprehension skill were assessed via three reading tasks and two writing tasks. As previously specified, paired pre- and post-use questionnaires were obtained from a total of 73 students (37 male, 36 female).

Impact on Content Knowledge

There are 16 points that were attainable on the content test portion of the pre- and post-use questionnaires. An analysis of variance (ANOVA) indicates that the pre-use content score means are not significantly different across schools, $F(1,72) = 1.0682$, $p = 0.3492$ [Note: A p value greater than 0.05 (i.e., 95% confidence level) indicates there is no statistically significant difference among the score means.]. Thus, the schools are equivalent with respect to students' initial knowledge of *Omega/Sigma* content. Table 8 presents the pre- and post-use content score means for each of the schools. Note that each school had significantly improved scores on the post-use test, compared to their pre-use results, overall.

Table 8. School Pre- and Post-Use Content Score Means

School	*N*	*Pre-Use* Score Mean	*Post-Use* Score Mean	*Mean Difference*	*Statistical Significance**
Park View	21	3.57	7.10	+ 3.53	$p \leq .0001$**
Smothers	12	4.17	9.67	+ 5.50	$p \leq .0001$**
Thomson	40	4.33	9.38	+ 5.05	$p \leq .0001$**

* Paired t-Test

** Statistically significant at the .05 p level (i.e., 95% confidence level)
A p level ≤ .05 indicates a treatment affect occurred (i.e., post-viewing score is significantly higher or lower than pre-viewing score. See sign in difference column for direction.)

An analysis of variance also indicates that the pre-use content score means are not significantly different across genders, F(1,72) = 1.2093, *p* = 0.2752 [A *p* value greater than 0.05 indicates there is no significant difference.]. Thus, participating male and female students initially had equivalent knowledge of *Omega/Sigma* content. Table 9 presents the pre- and post-use content score means for each gender. Note that, on average, both males and females had significantly improved scores on the post-use test, compared to their pre-use results.

Table 9. Gender Pre- and Post-Use Content Score Means

Gender	*N*	*Pre-Use* Score Mean	*Post-Use* Score Mean	*Mean Difference*	*Statistical Significance**
Male	37	3.84	9.00	+ 5.16	*p* ≤ .0001**
Female	36	4.33	8.53	+ 4.20	*p* ≤ .0001**

* Paired t-Test

** Statistically significant at the .05 *p* level (i.e., 95% confidence level)
A *p* level ≤ .05 indicates a treatment affect occurred (i.e., post-viewing score is significantly higher or lower than pre-viewing score. See sign in difference column for direction.)

Probing further, an analysis of variance indicates that the pre-use content score means are not significantly different across grade levels, F(1,72) = 0.5958, *p* = 0.5539 [A *p* value greater than 0.05 indicates there is no significant difference.]. Thus, the participating grade levels are also equivalent with respect to students' initial content knowledge. Table 10 presents the pre- and post-use content score means for each grade level. Note that the three grade levels had significantly improved scores on the post-use test, compared to their pre-use results, overall.

Table10. Grade-Level Pre- and Post-Use Content Score Means

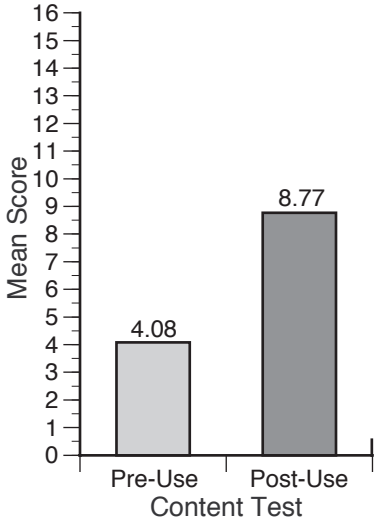
Grade	*N*	*Pre-Use* Score Mean	*Post-Use* Score Mean	*Mean Difference*	*Statistical Significance**
5th	24	4.38	9.42	+ 5.04	*p* ≤ .0001**
4th	32	4.06	8.63	+ 4.57	*p* ≤ .0001**
3rd	17	3.71	8.12	+ 4.41	*p* ≤ .0001**

* Paired t-Test

** Statistically significant at the .05 *p* level (i.e., 95% confidence level)
A *p* level ≤ .05 indicates a treatment affect occurred (i.e., post-viewing score is significantly higher or lower than pre-viewing score. See sign in difference column for direction.)

Having established the equivalency of students' initial content knowledge, their score data will be combined into a single group for further analyses. The post-use mean achievement score for the whole 73 student sample is 8.77, significantly higher than the pre-use mean score of 4.08, as tested by a paired t-test, *t* (1.72) = 12.51, *p* ≤ 0.0001. Thus, on average, the learning outcomes resulting from performance of project activities are statistically significant. Figure 1, on the following page, presents the mean achievement scores for the pre- and post-use content test.

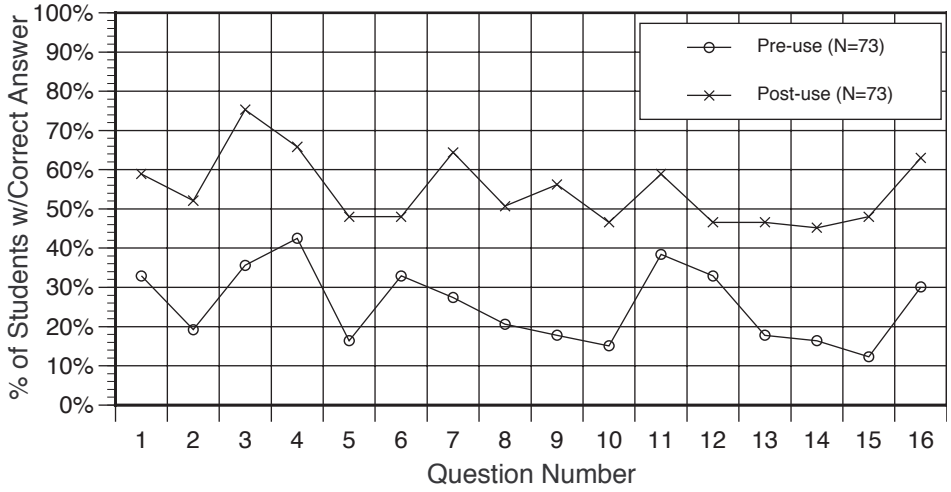
Figure 1. Distribution of Mean Achievement Scores for Pre- and Post-Use Content Test



With an interest in interaction effects, ANOVAs with interactions and nested factors were calculated for *Content Knowledge* (i.e., Pre, Post) and individual demographic/background variables of *gender*, *school*, *grade*, *computer experience*, *Internet experience*, and *science attitudes*. None of the interactions are statistically significant.

Figure 2 shows the distribution of students' achievement scores for each content question prior to and after performing project designed learning activities. Note that the percentage of correct answers increased for each of the questions from pre- to post-use.

Figure 2. Distribution of Content Test Scores by Question for Pre- and Post-Use Questionnaires



As previously specified, the student sample had significantly improved scores on the post-viewing test, compared to their pre-viewing results, overall. Table 11 reveals that, more specifically, there is also significant improvement on all content questions when considered independently, except for Questions 6 and 12 (See the Research Procedures and Methods section at the beginning of this report for wording of the multiple-choice questions and answer options.).

The results for Questions 6 reveal that students generally displayed difficulty identifying the following statement as being incorrect: "Some fish can swim, and other fish can't." Similarly, Question 12 results indicate that they also had difficulty discerning the correct procedure to compute the answer to the following question: "Sarah starts with $25, gives half of her money to her little brother and then buys a brownie for $1.75. How would you figure out how much money she has left?"

Table 11. Comparison of Pre- and Post-Use Content Test Results (N=73)

Question Number	*Pre-Use* Score Mean	*Post-Use* Score Mean	*Mean Difference*	*Statistical Significance**
1	.33	.59	+ .26	p = .0010**
2	.19	.52	+ .33	$p \leq$ .0001**
3	.36	.75	+ .39	$p \leq$ .0001**
4	.43	.66	+ .23	p = .0044**
5	.16	.48	+ .32	$p \leq$ .0001**
6	.33	.48	+ .15	***p* = .0702**
7	.27	.64	+ .37	$p \leq$ .0001**
8	.21	.51	+ .30	$p \leq$ .0001**
9	.18	.56	+ .38	$p \leq$ .0001**
10	.15	.48	+ .33	$p \leq$ .0001**
11	.38	.59	+ .21	p = .0081**
12	.33	.47	+ .14	***p* = .0958**
13	.18	.47	+ .29	$p \leq$ .0001**
14	.16	.47	+ .31	$p \leq$ .0001**
15	.13	.48	+ .35	$p \leq$ .0001**
16	.31	.63	+ .32	p = .0002**

* Paired t-Test

** Statistically significant at the .05 *p* level (i.e., 95% confidence level)
A *p* level ≤ .05 indicates a treatment affect occurred.

Impact on Students' Reading Comprehension Skill

As previously specified, changes in students' reading comprehension skill were assessed via three sentence-completion tasks and two open-ended questions. There are 7 points that were attainable on the reading comprehension portion of the pre- and post-use questionnaires.

An analysis of variance indicates that the pre-use reading score means are not significantly different across schools, $F(1,72) = 0.6412$, $p = 0.5297$ [Note: A *p* value greater than 0.05 indicates there is no statistically significant difference among the score means.]. Thus, on average, the schools are equivalent with respect to students' initial reading comprehension skill. Table 12 presents the pre- and post-use reading score means for each of the schools. Note that each school had significantly improved scores on the post-use reading test, compared to their pre-use results, overall.

Table 12. School Pre- and Post-Use Reading Score Means

School	*N*	*Pre-Use* Score Mean	*Post-Use* Score Mean	*Mean Difference*	*Statistical Significance**
Park View	21	1.00	2.62	+ 1.62	$p \leq$ .0001**
Smothers	12	0.92	2.67	+ 1.75	p = .0116**
Thomson	40	1.28	3.45	+ 2.17	$p \leq$ .0001**

* Paired t-Test

** Statistically significant at the .05 *p* level (i.e., 95% confidence level)

In addition, an analysis of variance indicates that the pre-use reading score means are not significantly different across genders, F(1,72) = 1.5146, *p* = 0.2225 [A *p* value greater than 0.05 indicates there is no significant difference.]. Thus, participating male and female students initially demonstrated equivalent reading comprehension skill, on average. Table 13 presents the pre- and post-use reading score means for each gender. Note that they both had significantly improved scores on the post-use reading test, compared to their pre-use results, overall.

Table 13. Gender Pre- and Post-Use Reading Score Means

Gender	*N*	*Pre-Use* Score Mean	*Post-Use* Score Mean	*Mean Difference*	*Statistical Significance**
Male	37	0.97	3.08	+ 2.11	*p* ≤ .0001**
Female	36	1.31	3.08	+ 1.77	*p* ≤ .0001**

* Paired t-Test

** Statistically significant at the .05 *p* level (i.e., 95% confidence level)
A *p* level ≤ .05 indicates a treatment affect occurred (i.e., post-viewing score is significantly higher or lower than pre-viewing score. See sign in difference column for direction.)

Probing further, an analysis of variance indicates that the pre-use reading score means are not significantly different across grade levels, F(1,72) = 1.2363, *p* = 0.2967 [A *p* value greater than 0.05 indicates there is no significant difference.]. Thus, the participating grade levels are equivalent with respect to students' initial reading comprehension skill. Table 14 presents the pre- and post-use reading score means for each grade level. Note that they each had significantly improved scores on the post-use reading test, compared to their pre-use results, overall.

Table14. Grade-Level Pre- and Post-Use Reading Score Means

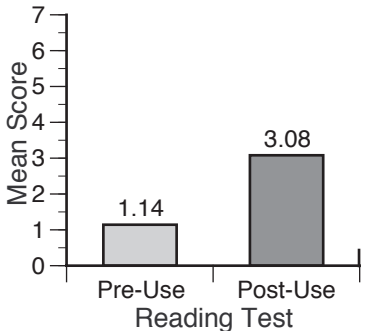
Grade	*N*	*Pre-Use* Score Mean	*Post-Use* Score Mean	*Mean Difference*	*Statistical Significance**
5th	24	0.92	3.63	+ 2.71	*p* ≤ .0001**
4th	32	1.38	2.97	+ 1.59	*p* ≤ .0001**
3rd	17	1.00	2.53	+ 1.53	*p* = .0016**

* Paired t-Test

** Statistically significant at the .05 *p* level (i.e., 95% confidence level)
A *p* level ≤ .05 indicates a treatment affect occurred (i.e., post-viewing score is significantly higher or lower than pre-viewing score. See sign in difference column for direction.)

Having established the equivalency of students' initial reading comprehension skill, their score data will be combined into a single group for further analyses. The post-use mean reading achievement score for the whole sample is 3.08, significantly higher than the pre-use mean score of 1.14, as tested by a paired t-test, *t* (1,72) = 8.888, *p* ≤ 0.0001. Thus, on average, the reading comprehension outcomes resulting from performance of project activities are statistically significant. Figure 3, on the following page, presents the mean achievement scores for the pre- and post-use reading test.

Figure 3. Distribution of Mean Achievement Scores for Pre- and Post-Use Reading Test



ANOVAs with interactions and nested factors were calculated for *Comprehension Skill* (i.e., Pre, Post) and individual demographic/background variables of *gender*, *school*, *grade*, *computer experience*, *Internet experience*, and *science attitudes*. None of the interactions are statistically significant.

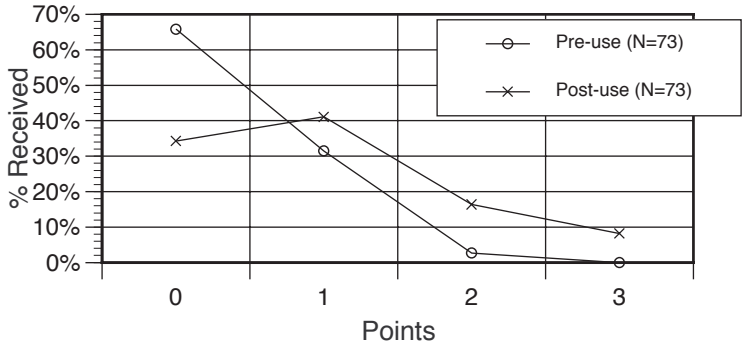
Generally, students' post-use letters contain more extensive, detailed, accurate writing than their pre-use letters. The letters are also more reflective of the three passages they read and sometimes accurately extend beyond passage content. Table 15 presents the distribution of pre- and post-use points received by each student for the letter writing assignment. Note that fewer post-use letters received a zero score (indicating a response that is incorrect, no response, or wrote "I don't know." In addition, a larger number of post-use letters received an additional 1, 2, or 3 points. Each of these increases is statistically significant, as tested by a paired t-test.

Table 15. Distribution of Pre- and Post-Use Letter Scores (N=73)

	Number (Percentage) of Points			
Test	*0*	*1*	*2*	*3*
Pre-Use	48 (65.8%)	23 (31.5%)	2 (2.7%)	–
Post-Use	25 (34.3%)	30 (41.1%)	12 (16.4%)	6 (8.2%)

Figure 4 illustrates the difference between the percentage of points received for the pre- and post-use extra credit writing assignment.

Figure 4. Comparison of Pre- and Post-Use Letter Scores



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