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Pilot Evaluation Assessment
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I. Executive Summary

The goal of this evaluation was to measure change in student knowledge and actions toward preserving the watershed that resulted from participation in the watershed curriculum at "X" Middle School. In addition, we wanted to collect information about how successfully the course proceeded from both student and teachers' points of view. This assessment involved the teachers of the curriculum in the evaluation activities and in the development of evaluation materials to be used in the classes.

In order to evaluate change that resulted from course participation, students' knowledge of material covered in the course and their self-reports of watershed conservation behaviors were measured by a survey given at the beginning and the end of the course and the differences in their pre- and post- responses over this time period were compared.

In addition, at the end of the course, students were asked to identify activities in the course that were: (a) the most enjoyable and (b) they learned the most from in the courses. Finally, a focus group was held among teachers of the course at the end of Spring semester to discuss their experiences over the year.

The pre- and post- comparisons demonstrated substantial gains in knowledge at all three grade levels. While the gains in "actions" were not as substantial, even so, they were present and statistically significant.

In their answers to focus group questions, the teachers provided evidence from their classes of the advantages of place-based learning and they linked the unique features of the course with student learning.

The evaluation team of teachers made critical contributions to the evaluation process, both in terms of their insights into the effectiveness of program activities and the assistance they provided the evaluator in carrying out the evaluation.

II. Evaluation Goals

The primary goal of this evaluation was to measure change in student knowledge and actions toward preserving the watershed that resulted from participation in the place-based teaching of watershed curriculum at "X" Middle School--the summative evaluation. A secondary goal was to collect information about how successfully the course proceeded from both student and teachers' points of view—the process evaluation.

This assessment was done as a pilot in two respects. As mentioned, we were interested in student outcomes of participation in the courses and the evaluation served as a pilot test of the measures used to measure those outcomes. In addition, we were interested in involving the teachers of the curriculum in the evaluation activities and involving them in the development of evaluation materials to be used in future classes. Therefore, three teachers (the evaluation team) met with the Watershed coordinator and the outside program evaluator several times during the year to design and implement the evaluation. As a group they chose the ten items that were used in the pre- and post- survey of actions students took to preserve the watershed and they individually prepared the content questions of the pre- and post survey that pertained to the grade level and course they taught. They were also responsible for collecting students' completed surveys in one class (at least) at each grade level. Finally, they participated in an end-of-year focus group in which they discussed the course.

III. Methods

"Summative" evaluation: Change in Knowledge and Behaviors

In order to evaluate changes in knowledge and behavior on the part of participants, their knowledge of course content and their self-reports of actions they took that contributed to watershed conservation were measured by a survey given at the beginning and the end of the course and the differences in pre- and post- responses over this time period were compared. The surveys were divided into two sets of items, 10 content and 10 "actions" items. The content items were developed by each teacher and pertained to the content that was taught in the watershed course at each grade level. Therefore, they are analyzed separately for each grade. The "actions" items were developed jointly by the three teachers, the Director, and the program evaluator prior to the beginning of the course. The were derived from item lists constructed by BWET/NOAA and items on the Eco-literacy pre-post survey used in the 6th grade Eco-literacy classes. (See addendum for a copy of materials) The content items were scored as either correct or incorrect (1/0). The actions items were Likert-type 5-point scale items for which the students indicate how often they engaged in the given activity, from 1= "Rarely or never" to 5= "Always or very often."

"Process" evaluation at the post-survey: Student satisfaction and self-assessed learning and teacher focus group

In addition to the "summative" evaluation of change in knowledge and behaviors a limited evaluation of the class process was obtained through three questions asked of the students at the post-survey. The "process" questions asked students to identify activities in the course that were: (a) the most enjoyable and (b) they learned the most from in the courses. For each of these questions, students could choose from three options selected by the teacher and a fourth, blank, should they choose an activity different from those provided. The options given to students for the answers varied by grade. In addition, all students were asked to write out what was "the most important thing" they learned about the watershed this year.

Also at the end of Spring semester, four of the Watershed teachers met with the evaluator to discuss the course. Teachers were asked two broad questions: (1) How did this course differ from other, more conventional classroom courses they taught and (2) what new evidence had they gleaned of student learning during the outdoor experience. Their discussion was audio-taped and reviewed by the evaluator.

IV. Data Analysis

The pre- and post survey data were analyzed in the following ways: Pre- and post- scores were calculated and averages computed for each class and for each of the two question types (content and actions) and students' pre- and post- answers were compared. Student's scores on the content portion of the survey were also examined to find the proportion of students who answered questions correctly at each time point. In addition, paired t-tests of the change in individual student's scores at the two time points were used to verify the statistical significance of the observed changes.

The number of surveys examined for each class is reported separately. In each grade, a few more surveys were completed at each time point than are reported here, but these surveys were completed at one time-point only, and therefore could not be included in the analyses.

Student responses to the "process" questions are presented as the proportion of students in the class who chose each category of answer. Students' responses to the self-reported learning in the course were examined qualitatively and the themes observed in their responses are presented.

The audiotape of teachers' focus group was also analyzed qualitatively and the themes of the discussion regarding each question are presented.

V. Results
Summative Evaluation

Pre-post Content Items

6^{th} grade

The answers of 51-6^{th} grade students were analyzed from pre- and post-course surveys.

From pre- to post-survey, the average score on the 10 content questions increased 2 points, from 5.5 to 7.5. At the pre-survey, the standard deviation in responses was 1.75 points (scores ranged from 2-10 points), thus, students' scores increased on average more than one standard deviation from the beginning to the end of the course, a substantial gain. A t-test comparing paired scores from the pre- and post-surveys was significant for positive change ($t=2.45$, $p<.01$).

The improvement in students' score from pre- to post-survey was also demonstrated by the number of students who answered at least 8 of 10 questions correctly. At the pre-survey, only 5 of 51 (10%) did so, while at the post-survey, 33 (65%) of the students were able to answer at least 8 questions correctly. In total, 43 of the 51 students (84%) had higher scores on the post-survey than they had before the class began.

7th grade

Matched pre- and post-surveys were available for 18-7th grade students. Scores based on 8 of their content items were analyzed, because two questions had been scored incorrectly and had to be dropped from the analysis.

Students' scores increased 2.4 points on average from an average of 4.1 points to an average of 6.4 points from pre- to post- survey. Again, this increase was greater than one standard deviation (1.7) in the range of scores on the pre-survey. The paired t-test of the individual students' scores from pre- to post-survey showed a statistically significant increase ($t=5.57$, $p<.01$).

The number of students who answered at least ¾ of the items correctly (i.e., 6 of 8) increased from 3 on the pre-survey (16%) to 15 on the post (83%). A total of 17 (of 18) students had increased scores on the post-survey content questions.

8th grade

Matched pre and post surveys from 16 students in the 8th grade class were analyzed. Out of 10 possible points correct, students increased an average of 2 points, from 4.75 to 6.75. At pre-survey, the standard deviation of their scores was 1.4, therefore the average increase was greater than one standard deviation. The paired t-test of the statistical significance of individual students' increased scores at post-survey was again statistically significant ($t=3.32$, $p<.01$).

Examining improvement as a function of the number of students who scored at least 8 points, we found that only one student achieved this on pre-test, while 8 students, or half of those surveyed, scored between 8 and 10 on the post-test. In all, 11 of 16 students scored higher on the post-test than they had on the pre-test.

Pre- and post- Actions items

These consisted of 10 descriptions of actions (e.g. "Share what I know about nature with family/or friends." See Appendix). The values of students' selected responses were summed for one score in the analyses. A maximum total possible score was 50 points, with a minimum possible of 10.

The mean score for this section, across all grades (N of students=85) at the pre-survey was 28.6 and at post it was 30.2. The standard deviation on the pre-test was 7.9 points (range 13-45 points). Therefore, the average increase of 2.2 points, although in a positive direction and statistically significant (paired $t=3.26$, $p<.01$), was small, less than 1/3 standard deviation.

Individual Item Analysis

In an effort to better understand this small gain from pre- to post-survey, individual items were examined in two ways. First, in a pre-to-post score of individual items, only 5 items showed an average gain of at least 1/3 point from pre-to-post-survey. These were: a, b, e, f, and i. The rest of the items displayed no average increase or a very slight decrease in scores from pre- to post-survey.

Second, a pattern appeared at all three grades with respect to the highest and lowest scores on the items at the end of the course. For all three grades, the highest scores (on average) were for items b, f, and g and the lowest-scored three items were a, c, and d. I suggest that "action" items be re-examined and selected anew for the next evaluation period, paying particular attention to the relationship between the items and course content.

"Process" evaluation: Student satisfaction and self-assessed learning

Sixth Grade

When asked what activity they enjoyed most, a large majority (n=33) selected the hike up Bob Mountain. Second-most-often selected (n=17) was the scavenger hunt; third-most (n=4) were the videos, and no one selected the word map activity. The majority said that they had learned most from the videos (n=31); second-most-often selected was the scavenger hunt (n=11). The hike was selected by seven students and the word map by five.

The open-ended question—what was the most important thing you learned in this class?—was answered by students in a variety of ways. Among 6th graders, about 10 students each wrote about (a) the physical size and scope of the watershed; (b) the dependence of diverse animals on the watershed; (c) the responsibility of humans to protect and preserve the watershed. About 5 students each wrote about (a) the effects of humans on the watershed; (b) the interconnections and interdependence of animal and plant life in the watershed; (c) the loss of water in the watershed, and (d) the importance generally of the watershed.

Seventh grade

More than half of the seventh grade respondents (n=9) selected "Water chemistry" as the activity they enjoyed the most while an equal number (n=2) divided their responses among the other choices (lecture/discussion, tree identification and macroinvertebrate studies). Students were divided as to what activity caused them the most learning. Most frequent response was the water chemistry activity (n=6) and second-most (5) the macro-invertebrate studies. Seventh graders' answers to the open-ended "most-important-learned-in-class" question were grouped in the following ways:

- Determining the health and Ph of the river (9)
- The status of fish in the watershed (4)
- How to take care of the watershed (2)
- Tree identification (1)

Eighth grade

Eighth grade students were almost equally divided between "water testing" (8) and "calculating the speed of the river" (9) as their favorite activity. But they most often chose "lectures and discussion" (10) as the activity from which they learned the most. Answers to the open ended "most important learning" question among eighth graders identified the following groups of topics:

- Ph of river water (6)
- Water use conservation (5)
- How to help the watershed (2)
- The importance of the Carmel River (2)
- The status of the Carmel River (1)
- The number of different species in the watershed (1)

Process evaluation: Teacher focus group

In their answers, the teachers spontaneously provided evidence from their classes of the advantages of place-based learning which have been found in research. In the course of their discussion, the teachers also frequently made links between the unique features of the course and student learning.

(1) How the course was unique

- Students were engaged in hands on learning to a greater extent than most classes
- Students were actively "in control of" their own learning
- Non-traditional skills and students were validated by the experience
- Students' pre-existing (own) knowledge was put to use
- The course required more preparation time for teachers prior to the class (e.g., linking outdoor activities to curriculum)
- Required more supervision on the part of teachers once all were at the outdoor site

(2) Student learning

- Student enthusiasm was a measure of how much they felt they had learned
- Students showed more sensitivity to life in nature (e.g., not killing bugs)
- Students pointed out what "refuse" could, in fact, be recycled, to their peers and to the teacher
- Students articulated their desire for more classes "like this"

VI. Conclusions

The summative evaluation (pre- and post- comparisons) demonstrated substantial gains in knowledge at all three grade levels. While the gains in "action" were not as substantial, they were nonetheless present, and it is likely that greater change could have been demonstrated using items that were more directly related to course content (see recommendations.)

Both the teacher focus group and the student "process" questions included in the post-survey have the potential to inform future curricula.

The evaluation team of teachers made critical contributions to the evaluation process, both in terms of their insights into the effectiveness of program activities and the assistance they provided the evaluator in carrying out the evaluation.

VII. Recommendations

First, this evaluation report should be shared with the evaluation team of teachers, and any future team of teacher evaluators.

Regarding the pre-post survey: correction should be made to the two items deleted from the seventh grade content portion of the test, as well as any corrections the evaluation team feels are needed for other items. Otherwise, the "content" portion of the pre-post survey may be used as it was this year. The items in the "actions" section of the pre-post survey should be reviewed by the team, to determine how well they reflect the curricula of the courses. Consideration should be given to deleting those which are less relevant and including others that more closely reflect the actions being encouraged by the courses.

Regarding teacher focus group: this activity was merely introduced in this year's evaluation, and was not meant to contribute materially to the evaluation. However, it appeared to the evaluator that significant evaluative information could be gleaned using this methodology. The teacher's have a great deal of insight into the process of the course work which could be formally and meaningfully collected using one or more focus groups. In addition, a focus group could serve as a means to discuss/formulate changes to the curriculum. Finally, it would also be useful to give the teachers feedback from students' answers to the "process" questions prior to a teacher focus group and discuss these as well.

Regarding the teacher evaluation team: If feasible, it is highly recommended that the program include a teacher evaluation team in future years.

Appendix

6th GradeWatershed Assessment - CONTENT

1) Which of these statements best describes a watershed??
   A) Any area that is always wet of that floods regularly.
   B) The land area that drains water into a river or other body of water.
   C) The land along the bank of a river or stream.
   D) The area where a river flows into the ocean and the waters mix.

2) What is the name of the ocean the Carmel River flows into?
   A) Atlantic Ocean
   B) Pacific Ocean
   C) Carmel Ocean
   D) Gulf of Mexico Ocean

3) What is an aquifer?
   A) an underground storage and flow of water
   B) an irrigation ditch filled with water
   C) a hydrologic formation
   D) a river system

4) Which of the following does **NO**T pose problems to the environment because of dams?
   A) they silt up over time
   B) they present barriers to migrating fishes
   C) they lose water due to evaporation
   D) they trap and store water

5) How does the water that flows to our houses get out of the Carmel River Watershed?
   A) wells
   B) dams
   C) buckets
   D) rivers

6) How long is Carmel River?
   A) 3.6 miles
   B) 360 miles
   C) 36 miles
   E) 36 feet

7) Where does the water flowing into a storm drain end up?
   A) Ocean
   B) River
   C) Sewer
   D) lake

8) What major tectonic plate is the Carmel River Watershed located on?
   A) North American
   B) Pacific Plate
   C) Nazca Plate
   D) Antarctic Plate

9) What created the Carmel River Watershed?
   A) Glaciers
   B) Volcanoes
   C) Faulting
   D) Erosion

10) What is the major source of energy that powers the water cycle?
   A) Sun
   B) Gravity
   C) Wind
   D) Rain

7th Grade Watershed Assessment - CONTENT

11) Does the Carmel River flow into the ocean all year long?
   A) no
   B) yes

12) What are the names of the two dams on the Carmel River?
   A) Hetch Hetchy & Los Padres
   B) Shasta & Hetch Hetchy
   C) Los Padres & Shasta
   D) Los Padres & San Clemente

13) What is the definition of an indicator species?
   A) a species that signifies a threatened habitat
   B) an invasive species that dominates a particular habitat
   C) an extant species that is on the verge of extinction
   D) a species that signifies healthy environment

14) What is the present health of the Carmel River Watershed as compared to other watersheds?
   A) excellent
   B) good
   C) threatened
   D) poor

15) What two endangered species are found in the Carmel River Watershed?
   A) Peregrine Falcon & California Condor
   B) Steelhead & Red-legged frog
   C) Steelhead & Western Scrub Jay

16) Which land use practice has a positive affect on our water quality and watershed?
   A) farming
   B) cattle ranching
   C) logging
   D) habitat restoration

17) What is a riparian habitat?
   A) A habitat associated with embankments and water.
   B) A habitat associated with plants and animals.
   C) A habitat associated with people and buildings.
   D) A habitat associated with trees and mountains.

18) Which of the following trees is not indicator species of the Carmel River watershed?

A) Fremontia Cottonwood
B) Monterey Pine
C) Arroyo Willow
D) White Alder
F) California Sycamore

9) Which of the following pieces of data best represents a healthy stream?
A) pH; 4.5, Dissolved Oxygen: 2ppm, Temperature 45^0 F
B) pH: 6.5, Dissolved Oxygen: 8ppm, Temperature 55^0 F
C) pH; 8.5, Dissolved Oxygen: 2ppm, Temperature 75^0 F
D) pH; 10.5,Dissolved Oxygen: 6ppm, Temperature 65^0 F

10) Suppose you go to the Carmel River to collect macroinvertebrates with your science class. Your aim is to determine whether or not the river is healthy by examining and classifying various types of invertebrates that you collect. After analyzing your data, you find that 58% of the organisms are classified as tolerant,
23 % are classified as sensitive, and 27% are classified as less sensitive. After analyzing your data, how would you assess the health of the Carmel River?

A) Threatened
B) Poor
C) Good
D) Excellent

8th grade Watershed Assessment - CONTENT

1. Which of the following is **not** a use of the Carmel River?
a. Irrigation
b. Drinking water
c. Recreation
d. Generate power

2. In a straight stretch of river, velocity is greatest at…
a. The surface of the river
b. Medium depth in the river
c. At the bottom of the river
d. It is the same velocity throughout

3. On a curved stretch of river velocity is greatest at…
a. The inside of the curve
b. The outside of the curve
c. In the middle of the curve
d. It is the same velocity throughout

4. Which of the following is **not** a result of high turbidity levels?
a. Poor photosynthesis
b. Colder water temperatures
c. Decreased dissolved oxygen levels
d. Warmer water temperatures

5. The optimum pH level for steelhead eggs is…
a. 2.0-4.0
b. 6.0-7.2
c. 8.4-9.5
d. 10.5-12.0

6. Which of the following plants is an invasive species in our watershed?
a. Lupine
b. Willow
c. Sage
d. Hemlock

7. Dams affect rivers downstream in all of the following ways except which one
a. Remove sediment
b. Deep pools for spawning fish
c. Disrupt insect life
d. Decrease water temperature

8. What is the natural progression of habitat from our streambed to our surrounding ridges…
a. Forest, grassland, riparian, chaparral
b. Riparian, grassland, forest , chaparral
c. Riparian, chaparral, grassland, forest
d. Grassland, riparian, chaparral, forest

9. Factors that influence water velocity include all but which one…
a. Depth of stream channel
b. Width of stream channel
c. Roughness of stream bottom
d. Temperature of stream water

10. The extent to which rocks (gravel, cobbles, and boulders) are buried by silt, sand, and mud on the stream bottom is referred to as
a. Erosion
b. Turbidity
c. Embeddedness
d. Channelization

Watershed Class Evaluation – Actions

11. For each activity below, circle the number that best matches you and your efforts. (Honest answers please).

	Always, Very often	Often	Some	A little	Rarely or Never
a. Talk with my friends/peers about helping the environment.	5	4	3	2	1
b. Conserve water when washing the car, watering the lawn/plants, brushing my teeth, doing dishes, etc.	5	4	3	2	1
c. Learn more about local wildlife and their habitats.	5	4	3	2	1
d. Work on restoration of local habitats.	5	4	3	2	1
e. Think about being a good steward of the Earth and our local community.	5	4	3	2	1
f. Encourage my family to recycle at home.	5	4	3	2	1
g. Spend time outside hiking, biking, canoeing, hunting, fishing, gardening, etc.	5	4	3	2	1
h. Assist with increasing better wildlife habitat in my yard or environment.	5	4	3	2	1
i. Share what I know about nature with family and/or friends.	5	4	3	2	1
j. Learn about nature by reading, watching t.v., or going on the Internet.	5	4	3	2	1