MacGregor-Bates, Inc.

Hydroville Curriculum Project

Interim Evaluation Report: Water Quality (WQ)

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Evaluation Design – Overview.

The evaluation design for Water Quality (WQ)was essentially the same as for Indoor Air Quality (IAQ).

The evaluation design organized participating schools into two program groups: mainstream schools and alternative schools.

Schools participating in the WQ evaluation.

Mainstream Schools	Alternative Schools
Westview HS (N=263)	Ashland HS (N=13)
Mountain View HS (N=40)	Milwaukee Support House (N=45)
Skyview HS (N=101)	North Salem HS (N=15)
Tigard HS (N=58)	Phoenix School (N=10)
	Young Parent Program (N=18)
	Woodburn Success Program (N=49)

The total number of completed pre/post students in the mainstream schools was N=462, and in alternative schools was N=150. Alternative schools tended to have considerably lower enrollment than do mainstream schools, posing significant challenges to obtaining comparable sample sizes with mainstream schools.

Evaluation Design – Problems and Challenges.

The problems and challenges are generally the same as the previous years.

Key Results: Student Evaluations

Problem Solving Pretest and Post Test:

The Problem Solving Pretest and Post Test consisted of a 64-item evaluation instrument that was composed of three separate modules and seven distinct measurement scales or concepts:

Table 1 shows each of the six measurement scales in terms of (a) scale name, (b) scale code, and (c) a description of the scale in terms of the relationship between numerical and conceptual values. The scales are also summarized below:

- *Quality of Explanations*: This 10-item scale assesses the quality students assign to ten possible explanations for differences in cancer rates between two communities. Higher scores reflect higher quality assigned to explanations.

- *Information Seeking*: This 8-item scale assesses students' judgments of the informativeness of a number of pieces of information in the context of determining the possible cause(s) of difference in cancer incidence rates between two communities. Higher scores reflect greater informativeness of information items.

- *Personal Involvement*: This 6-item scale assesses students' self-evaluation of their capabilities working on a community committee to help identify the cause(s) of differential cancer rates between two communities. Higher scores reflect greater self-evaluations of personal capability.

- *Self-Protection:* This 10-item scale assesses students' attitudes toward self-protective behaviors from chemical and other hazards. Higher scale values reflect a more positive attitude toward self-protection. A separate 3-item scale assesses more general attitudes toward self-protection.

- *Value for Science*: This 7-item scale assesses students' perceptions and attitudes toward science in society and as part of their daily life. Higher scale values reflect a more positive attitude toward science.

- *Perception of Risk*: This 10-item scale assesses students' perceptions a range of risks both in the home and in society at large. Higher scores reflect greater perceived risk from all sources. Two separate sub-scales of three items each assess perceptions of risk from chemicals and from environmental allergens.

A complete description of each of the scales along with the wording of the items comprising the scales is available in the document titled "Water Quality (WQ) Student Problem Solving Pre/Post Test Evaluation Scales."

Table 1. Hydroville Evaluation Scales: 2005-2006 Implementation Year (Water Quality)

Scale Name	Scale Code	Number of Items	Description
Quality of Explanations	*Explain*	10	Higher score indicates higher quality of explanations.
Information Seeking	*InfoSeek*	8	Higher score reflects greater informativeness of items.
Personal Involvement	*PersInvolv*	6	Higher score reflects more positive self-evaluation of capabilities.
Self-Protection 1	*SelfPro1*	10	Higher score reflects more positive attitude toward self-protective behaviors.
Self-Protection 2	*SelfPro2*	3	Higher scores reflects more positive attitude toward self-protection
Value for Science	*ValueSci*	7	Higher score reflects a more positive value for science in daily life.
Perception of Risk	*PercRisk*	10	Higher score reflects greater perceived risk.
Perception of Chemical Risks (subscale)	*ChemRisk*	3	Higher score reflects greater perceived risk from chemicals.
Perception of Environmental Risks (subscale)	*EnviroRisk*	3	Higher score reflects greater perceived risk from environmental pollutants.

Scale Means by Program and All Schools Combined.

Table 2 shows the scale means by mainstream schools, alternative schools and for all schools combined. For each of the program types (i.e., mainstream vs. alternative schools) pretest and posttest means are shown as well as the number of students with complete pre/post protocols (N). Differences scores are shown along with a test of statistical significance of the value of the difference. At the far right of the table a between-program significance test is shown. This is test between the two program types done on their respective pretest, posttest and difference scores. Table 3 summarizes the results of Table 2 in terms of those scales have significant changes from pretest to posttest.

The WQ implementation evaluation had a much larger sample size than that for IAQ (see report for that year), resulting in a more powerful statistical analysis that demonstrated in greater detail the impact of the curriculum on student outcomes. Six of the evaluation scales for the all schools combined group exhibited highly significant pre/post change ($p<.001$ or greater). This same pattern of pre/post change was reflected as well in the mainstream schools, for which a relatively large sample size was also available. On a selected basis, alternative schools also exhibited highly significant changes on four of the evaluation scales ($p<.01$ or greater), and particularly for the *PersInvolv* scale ($p<.0001$). Given the relatively small sample size for the alternative schools group, these patterns of change are important and meaningful.

Overall, students demonstrated an increased appreciation for the value of science in daily life (*ValueSci* scale; $p<.001$ or greater) as well as a more positive regard for the importance of self-protection as well as increased sensitivity to environmental risks (*SelfPro2* and *EnviroRisk* scales). For all the school groupings (i.e., all schools, mainstream schools, alternative schools) students were more inclined (from pretest to posttest) to view different kinds of environmental science-type information as important for solving an environmental health problem (*InfoSeek* scale; $p<.01$ or greater). We infer that this is reflective of their greater awareness of how to use environmental science information in the context of identifying and analyzing a problem that may have an environmental cause.

Students in all three groups were much more inclined toward taking a personally involving role in working with others to solve an environmental health problem (*PersInvolv* scale; $p<.0001$). This was the strongest effect statistically across all of the scales for the alternative schools group. Again, we see the effect of the activity-oriented curriculum on improving the base of student skills with regard to group work, written reporting, and oral presentation of environmental science principles.

Table 2. Summary of scale means by mainstream schools, alternative schools, and all schools combined.

	All Schools Combined					*Mainstream Schools* [a]					*Alternative Schools* [b]					*Between-group Significance*		
Scale	N	Pre	Post	Diff[c]	*t-test* [d]	N	Pre	Post	Diff	*t-test*	N	Pre	Post	Diff	*t-test*	Pre	Post	Diff
EXPLAIN	577	2.39	2.54	0.16	p<.0001	423	2.37	2.52	0.16	p<.0001	154	2.44	2.60	0.16	p<.001	p=.10	p=.08	ns
INFOSEEK	609	3.03	3.21	0.18	p<.0001	441	3.02	3.23	0.20	p<.0001	168	3.05	3.18	0.13	p<.01	ns	ns	p=.14
PERSINVOLV	610	2.70	2.98	0.28	p<.0001	440	2.70	2.99	0.29	p<.0001	170	2.72	2.94	0.23	p<.0001	ns	ns	ns
SELFPRO1	611	3.27	3.31	0.04	ns	441	3.24	3.32	0.07	p<.05	170	3.35	3.29	-0.06	ns	p=.12	ns	p<.05
SELFPRO2	544	2.92	3.02	0.10	p<.0001	391	2.93	3.04	0.12	p<.001	153	2.90	2.98	0.08	p=.19	ns	ns	ns
VALUESCI	589	2.64	2.80	0.15	p<.0001	426	2.67	2.82	0.15	p<.0001	163	2.59	2.74	0.15	p<.001	p=.07	p<.05	ns
PERCRISK	591	2.77	2.82	0.05	p<.05	427	2.72	2.80	0.07	p<.01	164	2.89	2.88	-0.01	ns	p<.01	p=.14	p=.12
CHEMRISK	590	2.75	2.80	0.06	p=.08	428	2.69	2.78	0.09	p<.05	162	2.90	2.87	-0.03	ns	p<.001	p=.15	p=.10
ENVIRORISK	570	2.72	2.83	0.10	p<.001	417	2.67	2.79	0.12	p<.001	153	2.86	2.92	0.06	ns	p<.01	p<.05	ns

[a]Mainstream schools = Westview HS, Mountain View HS, Skyview HS, Tigard HS

[b]Alternative schools = Ashland HS, Milwaukee Support House, North Salem HS, Phoenix School, Young Parent Program, Woodburn Success Program

[c]Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

[d]T-test for signed difference scores: *p<.05; **p<.01; ***p<.001; ****p<.0001

Table 3. Summary of significant scale pre/post change scores by program type.

Program Type	Scales with Significant Pre/Post Change Scores
Mainstream Schools	Explain****, InfoSeek****, PersInvolv****, SelfPro1*, SelfPro2***, ValueSci****, PercRisk**, ChemRisk*, EnviroRisk***
Alternative Schools	Explain***, InfoSeek**, PersInvolv****, ValueSci***
All Schools Combined	*Explain****, *InfoSeek****, *PersInvolv****, *SelfPro2****, *ValueSci****, *PercRisk**, *EnviroRisk****

***p<.05, **p<.01, ***p<.001**

Individual Scales.

This section examines each of the scales separately in terms of the patterns of change exhibited by the individual scale items. In previous years' evaluations, a scale titled *IntuiTox* was included in the evaluation results. Despite several revisions of the scale, and acceptable level of internal consistency (i.e., Cronbach's alpha) was never obtained. Evaluation reports for Pesticide Spill and for MIO presented the scale but also presented a discussion and interpretation of the items comprising the scale, treating them as separate dependent variables. In this report, we drop the use of the *IntuiTox* scale altogether and present the items pertaining to Intuitive Toxicology as a separate group with its own discussion. The purpose of these items is to assess student change with respect to attitudes and perceptions of chemical and other hazards, and that reflect intuitive notions of the relationship between concepts such as exposure and harm.

Quality of Explanations *(Explain)*.

Results for items comprising this scale are shown in Table 4. This is the *Explain* scale and is an assessment of how students evaluated the quality of a number of explanations for a differential health effect (percentage of cancer cases) between the fictional community of Mayville and the state in which Mayville is located as a whole. Scale responses ranged from "1" (Not A Good Explanation) to "4" (Very Good Explanation).

This scale exhibited a strong pattern of pre/post change with respect to statistical significance for almost all of the items in the scale. All hazard source factors were rated higher from pretest to posttest as a possible explanation for the health effect in the scenario. Although there was less significance for alternative schools, likely due to the lower statistical power, the changes in mean responses were generally in the same direction as for mainstream schools. Typically, the pre/post change was on the order of 10% to 20% increase in ratings and in a direction favoring a more scientific perspective toward the problem. .

Table 4. *Explain* Scale: Summary of scale items by mainstream schools, alternative schools, and all schools combined.

	All Schools Combined					*Mainstream Schools* [a]					*Alternative Schools* [b]					*Between-group significance*		
Differences in:	N	Pre	Post	Diff[c]	*t-test* [d]	N	Pre	Post	Diff	*t-test*	N	Pre	Post	Diff	*t-test*	Pre	Post	Diff
Use of household chemicals	520	2.02	2.33	0.31	p<.0001	387	2.01	2.30	0.29	p<.0001	133	2.05	2.42	0.37	p<.001	ns	ns	ns
Use of agricultural chemicals	536	2.57	2.82	0.24	p<.0001	387	2.63	2.88	0.24	p<.0001	149	2.42	2.66	0.24	p<.01	p<.01	p<.01	ns
Lifestyles of people in Mayville	553	2.41	2.04	-0.37	p<.0001	409	2.40	1.98	-0.42	p<.0001	144	2.42	2.22	-0.21	p=.07	ns	p<.01	p=.09
Drinking water quality	552	3.18	3.40	0.23	p<.0001	405	3.21	3.46	0.26	p<.0001	147	3.09	3.24	0.15	ns	ns	p<.01	ns
Types of businesses/industries	534	2.04	2.72	0.68	p<.0001	391	2.01	2.70	0.69	p<.0001	143	2.13	2.79	0.66	p<.0001	ns	ns	ns
Natural environment	551	2.79	2.84	0.05	ns	403	2.79	2.87	0.08	ns	148	2.90	2.78	-0.02	ns	ns	ns	ns
How well scientific study done	513	2.42	2.59	0.18	p<.001	376	2.32	2.53	0.21	p<.001	137	2.67	2.77	0.09	ns	p<.001	p<.05	ns
How people perceive environmental health risks	526	2.45	2.33	-0.13	p<.01	390	2.42	2.29	-0.13	p<.05	136	2.55	2.42	-0.13	ns	ns	ns	ns
Geographic location of Mayville	535	2.06	2.54	0.49	p<.0001	395	2.06	2.54	0.49	p<.0001	140	2.06	2.54	0.49	p<.0001	ns	ns	ns
No real difference. Just a matter of chance	510	1.90	1.83	-0.07	ns	378	1.81	1.72	-0.09	ns	132	2.15	2.15	0.00	ns	p<.001	p<.0001	ns

[a]Mainstream schools = Westview HS, Mountain View HS, Skyview HS, Tigard HS

[b]Alternative schools = Ashland HS, Milwaukee Support House, North Salem HS, Phoenix School, Young Parent Program, Woodburn Success Program

[c]Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

[d]T-test for signed difference scores: *p<.05; **p<.01; ***p<.001; ****p<.0001

Information Seeking (*InfoSeek*).

The Information Seeking scale builds on the Mayville story problem by posing the context of a community program solving committee that has an opportunity to collect information. Students judge the usefulness of information gathered from each of a number of activities with respect to helping the committee solve the problem of Mayville's cancer rate. The response scale range from "1" (Not useful for helping solve the problem) to "4" (Very useful for helping solve the problem.). Results for the individual items associated with this scale are shown in Table 5.

The *InfoSeek* scale showed an overall pattern of statistically significant change from pretest to posttest, and the individual scale items reflected this as well. Looking at the pre/post change results for All Schools Combined, students tended to see more usefulness in (a) having soil tests done (b) checking the local library for new report, (c) testing drinking water, (d) consulting the Internet, and (e) determining where Mayville gets its water supply. Across the items comprising the scale, students appeared to become more sensitized to the possibility of chemical risks as an explanation for the health effect in the scenario. Overall, there were very few "not useful" responses, indicating a tendency for students to become more acutely aware of the need to gather detailed information.

Table 5. *Infoseek* Scale: Summary of scale items by mainstream schools, alternative schools, and all schools combined.

	All Schools Combined					*Mainstream Schools* [a]					*Alternative Schools* [b]					*Between-group significance*		
	N	Pre	Post	Diff[c]	*t-test* [d]	N	Pre	Post	Diff	*t-test*	N	Pre	Post	Diff	*t-test*	Pre	Post	*t-test*
Interview locals who have been ill in past year	599	2.84	2.90	0.06	ns	435	2.85	2.88	0.03	ns	164	2.80	2.95	0.15	p=.09	ns	ns	ns
Have soil test done to see what chemicals in soils	601	2.95	3.35	0.39	p<.0001	438	2.97	3.34	0.37	p<.0001	163	2.91	3.36	0.44	p<.0001	ns	ns	ns
Check local library for newspaper reports on enviro problems	602	2.69	3.08	0.39	p<.0001	436	2.64	3.08	0.44	p<.0001	166	2.80	3.06	0.26	p<.01	p=.06	ns	p=.08
Visit larger buildings to see how ventilated	604	3.30	3.30	0.00	ns	437	3.28	3.32	0.04	ns	167	3.34	3.25	-0.10	ns	ns	ns	ns
Check drinking water to see if elevated levels of contaminants	593	3.46	3.59	0.13	p<.001	431	3.46	3.62	0.16	p<.001	162	3.46	3.53	0.07	ns	ns	ns	ns
Check Internet for info on causes of illnesses	598	2.62	2.74	0.12	p<.01	435	2.58	2.73	0.15	p<.01	163	2.73	2.77	0.04	ns	p=.08	ns	ns
Determine where Mayville gets its water supply	590	3.15	3.47	0.32	p<.0001	430	3.16	3.48	0.33	p<.0001	160	3.13	3.44	0.31	p<.001	ns	ns	ns
Visit homes of people who were ill and how houses constructed	596	3.31	3.36	0.05	ns	434	3.30	3.39	0.09	p<.05	162	3.36	3.27	-0.09	ns	ns	ns	p<.05

[a]Mainstream schools = Westview HS, Mountain View HS, Skyview HS, Tigard HS
[b]Alternative schools = Ashland HS, Milwaukee Support House, North Salem HS, Phoenix School, Young Parent Program, Woodburn Success Program
[c]Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.
[d]T-test for signed difference scores: *p<.05; **p<.01; ***p<.001; ****p<.0001

Personal Involvement (*PersInvolv*).

Problem solving in the context of environmental health sciences issues often requires social participation, such as public meetings or committees. For students to utilize the environmental health science knowledge gained through the Hydroville Curriculum, they must also have acquired a base of teamwork skills upon which they can draw as well as the self-efficacy to utilize those skills in cooperation with others. The PERSINVOLV scale assesses, through self-evaluation, students' competence and capability with regard to a number of social participation activities in the context of group problem solving. A higher scale score indicates a more positive self-evaluation of how "qualified and capable" students view themselves with respect to a number of different roles and activities that are part of a hypothetical committee problem-solving exercise. The response scale for individual items ranged from "1" (Not qualified and capable) to "4" (Very qualified and capable). Table 6 summarizes pre/post responses to the individual items comprising this scale.

The *PersInvolv* scale generally exhibited the largest (most statistically significant) pre/post change. For mainstream schools, all scale items exhibited significant pre/post change. For alternative schools, most significant change was due to three items relating to:

(a) helping design a scientific study,
(b) preparing a written report of committee findings, and
(c) presenting an oral report to a large audience.

All three of these activities are consistent with elements of the WQ curriculum, particularly the oral presentation of group work. As with previous years' evaluations, the group work aspect of the curriculum and the oral presentation of results appears to greater student self-efficacy with respect to taking an active role in community problem solving around environmental health issues.

Table 6. *PersInvolv Scale*: Summary of scale items by mainstream schools, alternative schools, and all schools combined.

	All Schools Combined					*Mainstream Schools* [a]					*Alternative Schools* [b]					*Between-group significance*		
	N	Pre	Post	Diff[c]	*t-test* [d]	N	Pre	Post	Diff	*t-test*	N	Pre	Post	Diff	*t-test*	Pre	Post	Diff
Working with others to determine problem	602	3.06	3.31	0.24	p<.0001	438	3.05	3.35	0.30	p<.0001	164	3.09	3.18	0.10	p=.25	ns	p<.05	p<.05
Talking with other community members about the problem	599	2.99	3.13	0.13	p<.001	437	3.00	3.13	0.14	p<.01	162	2.99	3.11	0.12	p=.14	ns	ns	ns
Helping to design a scientific investigation of the community	601	2.47	2.79	0.32	p<.0001	434	2.45	2.77	0.32	p<.0001	167	2.53	2.85	0.32	p<.001	ns	ns	ns
Preparing a written report of the committee's findings	606	2.48	2.86	0.38	p<.0001	4.38	2.49	2.84	0.34	p<.0001	168	2.45	2.81	0.46	p<.0001	ns	ns	ns
Presenting an oral report of the committee's findings to a large audience	601	2.42	2.79	0.37	p<.0001	434	2.42	2.81	0.39	p<.0001	167	2.43	2.73	0.31	p<.001	ns	ns	ns
Interviewing a scientist who has specialized knowledge of the problem	594	2.80	3.02	0.22	p<.0001	430	2.79	3.07	0.28	p<.0001	164	2.85	2.90	0.05	ns	ns	p<.05	p<.05

[a]Mainstream schools = Westview HS, Mountain View HS, Skyview HS, Tigard HS
[b]Alternative schools = Ashland HS, Milwaukee Support House, North Salem HS, Phoenix School, Young Parent Program, Woodburn Success Program
[c]Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.
[d]T-test for signed difference scores: *p<.05; **p<.01; ***p<.001; ****p<.0001

Self Protection (*SelfPro1 & SelfPro2*).

Key objectives of the Hydroville Curriculum are for students to develop appropriate increases in self-protective behavior with respect to environmental health and safety risks. The *SelfPro* scale assesses student change with respect to self-protective behavior using student perceptions and attitudes toward chemical products in the home, product instructions and warning labels, and other self-protective behaviors in the home. Two self-protection scales were administered. One scale, *SelfPro1*, was comprised of 10 self-protective activities around the home. A higher scale score indicates a more positive attitude toward self-protective behaviors. The individual item response scale ranges from "1" (Never important to me or my family) to "5" (Always important to me and my family). Table 7 summarizes responses to the 10 self- protective activities.

The overall *SelfPro1* scale exhibited only a marginal and non-significant change from pretest to posttest for All Schools Combined (see Table 2). The item "having my drinking water tested for contamination" exhibited a significant pre/post change for mainstream schools, suggesting that the curriculum sensitized students to the health risks associated with water quality. For some individual items, however, pre/post changes were in the direction of *less* self protection, particularly for washing fruit/vegetables before eating.. It is unclear why students would perceive less importance in these activities from pretest to posttest. Perhaps the knowledge and information they received as part of the curriculum gave them greater confidence in their ability to understand environmental health risks. As a result, their more positive perspective on self-protection may have lead to lower assessments of risk from household hazards. A more careful analysis of the relationship between these factors is needed.

The *SelfPro2* scale was comprised of three attitude items relating to self protection. The response scale for these items ranged from "1" (Strongly Disagree) to "4" (Strongly Agree). Table 8 summarizes responses to these three items. The two items achieving significance were:

> "For most of the chemicals I am exposed to in daily life, including chemicals in the environment, I feel I know how to protect my health and safety."
>
> "For most of the chemicals in the environment, I feel I know how to protect my health and safety."

Pre/post change scores in response to these items were in the direction of more positive agreement suggesting that students were more likely to see themselves as knowledgeable about self-protection with respect to chemical risks.

Table 7. *SelfPro1* Scale: Summary of scale items by mainstream schools, alternative schools, and all schools combined.

	All Schools Combined					*Mainstream Schools* [a]					*Alternative Schools* [b]					*Between-group significance*		
	N	Pre	Post	Diff[c]	*t-test* [d]	N	Pre	Post	Diff	*t-test*	N	Pre	Post	Diff	*t-test*	Pre	Post	Diff
Wash fresh fruit and vegetables before eating.	610	4.19	4.05	-0.14	p<.01	440	4.20	4.13	-0.07	ns	170	4.15	3.84	-0.32	p<.001	ns	p<.01	p<.01
Read the directions for using household consumer products.	604	3.61	3.57	-0.05	ns	437	3.59	3.60	0.01	ns	167	3.68	3.48	-0.20	p<.05	ns	ns	p<.05
Read and understand my city's drinking water reports.	606	2.50	2.54	0.04	ns	437	2.42	2.48	0.05	ns	169	2.69	2.71	0.02	ns	p<.05	p<.05	ns
Read product ingredient labels and warning labels for household chemical products.	608	3.31	3.31	0.00	ns	439	3.26	3.33	0.08	ns	169	3.45	3.26	-0.19	p=.07	p=.07	ns	p<.05
Test smoke detectors and replace bateries regularly.	609	3.50	3.52	0.02	ns	439	3.55	3.54	-0.01	ns	170	3.39	3.49	0.10	ns	ns	ns	ns
Replace filters on home heating systems, such as furnaces.	608	3.26	3.36	0.10	p<.05	439	3.26	3.39	0.13	p<.05	169	3.25	3.29	0.04	ns	ns	ns	ns
Use protective equipment such as safety glasses or gloves when recommended.	607	3.45	3.51	0.06	ns	439	3.44	3.53	0.09	ns	168	3.47	3.47	0.00	ns	ns	ns	ns
Discuss safe use of products with other members of your family.	607	2.82	2.89	0.07	ns	437	2.76	2.85	0.09	ns	170	2.97	2.98	0.01	ns	p=.06	ns	ns
Provide adequate ventilation when using chemical products indoors.	605	3.66	3.70	0.03	ns	437	3.63	3.75	0.12	p<.05	168	3.74	3.55	-0.19	p<.05	ns	p<.05	p<.01
Have my drinking water tested for contaminants.	607	2.41	2.62	0.21	p<.001	439	2.31	2.54	0.23	p<.001	168	2.66	2.82	0.15	ns	p<.01	p<.05	ns

[a]Mainstream schools = Westview HS, Mountain View HS, Skyview HS, Tigard HS
[b]Alternative schools = Ashland HS, Milwaukee Support House, North Salem HS, Phoenix School, Young Parent Program, Woodburn Success Program
[c]Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.
[d]T-test for signed difference scores: *p<.05; **p<.01; ***p<.001; ****p<.0001

Table 8. *SelfPro2* Scale: Summary of scale items by mainstream schools, alternative schools, and all schools combined.

	All Schools Combined					*Mainstream Schools* [a]					*Alternative Schools* [b]					*Between-group significance*		
	N	Pre	Post	Diff[c]	*t-test* [d]	N	Pre	Post	Diff	*t-test*	N	Pre	Post	Diff	*t-test*	Pre	Post	Diff
For most of the chemicals I am exposed to in daily life, including chemicals in the environment, I feel I know how to protect my health and safety.	520	2.94	3.09	0.15	p<.0001	373	2.96	3.14	0.18	p<.0001	147	2.90	2.96	0.06	ns	ns	p<.01	ns
For most of the chemicals in the environment, I feel I know how to protect my health and safety.	523	2.72	2.89	0.17	p<.0001	373	2.73	2.90	0.16	p<.001	150	2.68	2.88	0.20	p<.05	ns	ns	ns
I have read and can understand most of the warning labels on chemicals in my home.	560	3.13	3.09	-0.05	ns	412	3.10	3.09	-0.01	ns	148	3.21	3.07	-0.14	ns	ns	ns	ns

[a]Mainstream schools = Westview HS, Mountain View HS, Skyview HS, Tigard HS

[b]Alternative schools = Ashland HS, Milwaukee Support House, North Salem HS, Phoenix School, Young Parent Program, Woodburn Success Program

[c]Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

[d]T-test for signed difference scores: *p<.05; **p<.01; ***p<.001; ****p<.0001

Value for Science (*ValueSci*).

Acquiring and using environmental health science knowledge both depends upon and results in more positive view of science in daily life as well as a positive view of science as a social enterprise. The items in the *ValueSci* scale assess student attitudes toward the value of science, both in general and specifically with regard to environmental health science and personal safety/risk decisions. The attitude items comprising the scale are rated from "1" (Strongly Disagree) to "4" (Strongly Agree). A higher rating indicates a more positive attitude toward science. Table 9 summarizes the individual item responses.

The pre/post change for the *ValueSci* scale was significant at a fairly high level for both the mainstream and alternative schools groups (see Table 2). Looking at the individual items comprising the scale reveals that student change was generally in the direction of a much more optimistic and positive view of the role that science can play in daily life as well as their personal involvement in science. Students were more positively inclined toward (a) knowing how to use environmental science to make health/safety decisions, (b) knowing how to use science to determine the safety of chemical exposures, (c) talking with environmental scientists about their work, and (d) talking about science with peers. Again, an effect of the curriculum may have been to heightened students' belief in their ability to determine when they are or are not at risk from chemicals and other environmental hazards. In addition, students involvement in the process elements of the curriculum may have promoted greater familiarity with science as a topic of conversation and social interaction. .

Table 9. *ValueSci* Scale: Summary of scale items by mainstream schools, alternative schools, and all schools combined.

	All Schools Combined					*Mainstream Schools* [a]					*Alternative Schools* [b]					*Between-group significance*		
	N	Pre	Post	Diff[c]	*t-test* [d]	N	Pre	Post	Diff	*t-test*	N	Pre	Post	Diff	*t-test*	Pre	Post	Diff
I feel I know how to use environmental science to help make decisions that protect my health and safety.	516	2.77	3.03	0.27	p<.0001	374	2.79	3.10	0.31	p<.0001	142	2.72	2.86	0.14	ns	ns	p<.001	p=.09
Most topics in science are relatively easy for me to learn.	562	2.80	2.91	0.11	p<.001	406	2.82	2.93	0.11	p<.01	156	2.75	2.87	0.12	p=.10	ns	ns	ns
I feel confident talking with environmental scientists about their work.	505	2.47	2.68	0.20	p<.0001	358	2.47	2.70	0.23	p<.0001	147	2.48	2.63	0.15	p=.09	ns	ns	ns
I am comfortable talking about science with other people like me.	536	2.80	3.00	0.20	p<.0001	386	2.85	3.05	0.19	p<.0001	150	2.66	2.87	0.21	p<.05	p<.05	p<.05	ns
I am generally interested in new developments in environmental science.	531	2.46	2.45	-0.02	ns	380	2.47	2.40	-0.07	ns	151	2.44	2.57	0.13	ns	ns	p<.05	p<.05
I feel that I know how to use science to determine when my exposure to chemicals is safe or not.	513	2.61	2.94	0.33	p<.0001	373	2.62	2.99	0.37	p<.0001	140	2.61	2.81	0.21	p<.05	ns	p<.05	p=.08
Whether or ot I get a good job in the future has very little to do with how well I do in my science classes.	498	2.60	2.65	0.05	ns	360	2.64	2.68	0.03	ns	138	2.49	2.59	0.09	ns	p=.10	ns	ns

[a]Mainstream schools = Westview HS, Mountain View HS, Skyview HS, Tigard HS

[b]Alternative schools = Ashland HS, Milwaukee Support House, North Salem HS, Phoenix School, Young Parent Program, Woodburn Success Program

[c]Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

[d]T-test for signed difference scores: *p<.05; **p<.01; ***p<.001; ****p<.0001

Perception of Risk (*PercRisk*).

As students develop increased knowledge skills and conceptual awareness of environmental health science, their perception of environmental health science risks may change with respect to other risks and hazards. The *items in the PercRisk* scale assesses change in students' perceptions of a broad range of health and safety risks, including those identified by environmental health science. A set of 10 health and safety risks were evaluated by students on a scale ranging from "1" (No Risk) to "4" (High Risk). Figure 1 shows the percentage of students in the Mainstream Schools who rated each of the items "Moderate" or "High Risk." Figure 2 shows the comparable data for students in the Single Teacher Program.

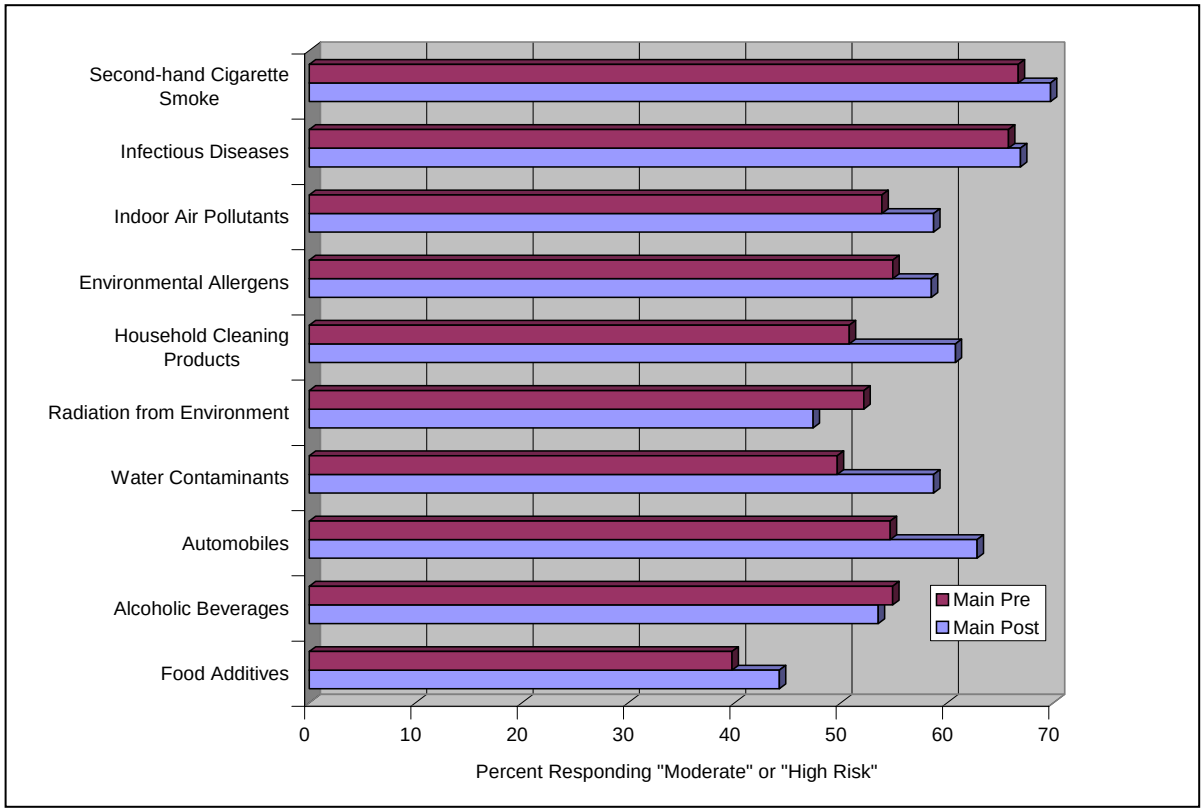

Figure 1. Percentage of students assigning a "moderate" or "high risk" rating to each of 10 risk perception items: Mainstream Schools.

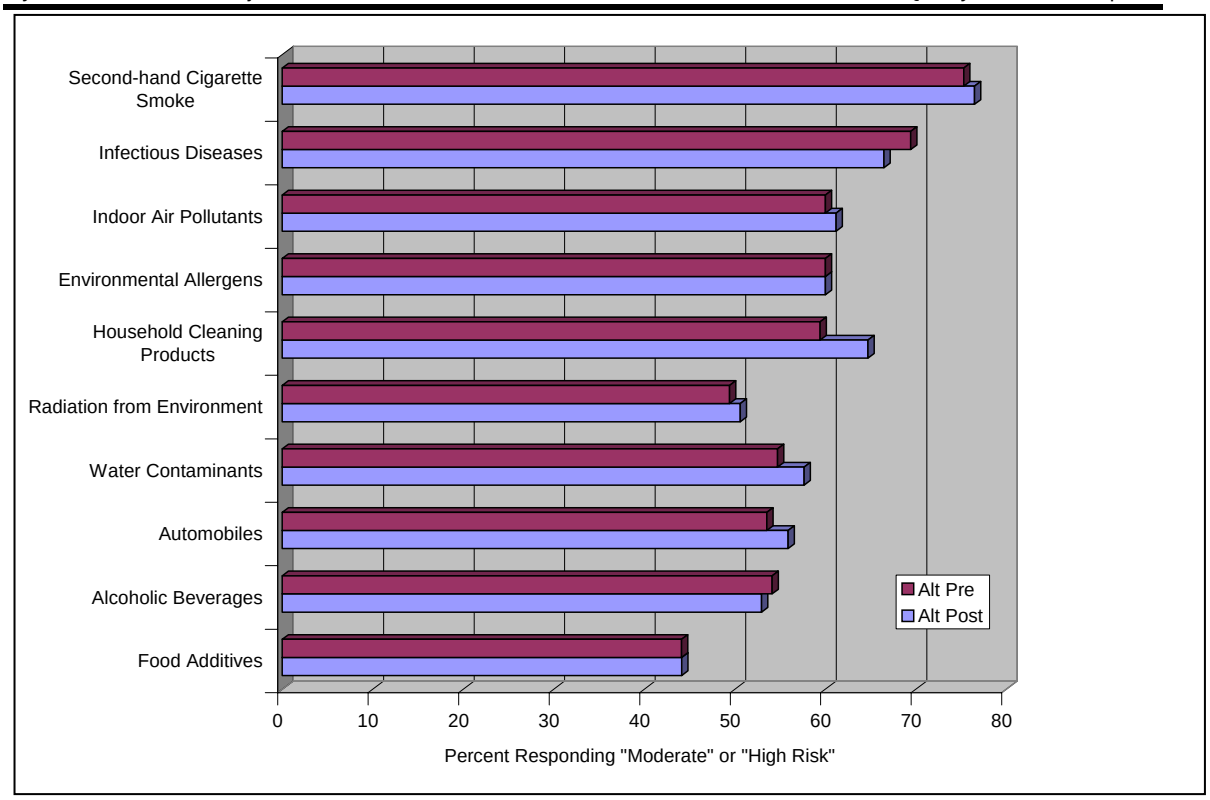

Figure 2. Percentage of students assigning a "moderate" or "high risk" rating to each of 10 risk perception items: Alternative Schools.

With respect to the ranking of the 10 risk items, based on pretest results the rankings were somewhat similar for both program. "Second-hand cigarette smoke", "infectious diseases", "indoor air pollutants" and "environmental allergens" were the top four hazards in terms of perceived risk. For the Single Teacher Program (Figure 2) there was very little change from pretest to posttest in risk ratings. None of the changes reached statistical significance. However, for the Mainstream Schools (Figure 1) there were significant changes in perceived risk for "Automobiles" ($p<.01$), "Household cleaning products" ($p<.01$), "Water contaminants" ($p<.0001$), and "Environmental allergens" ($p<.05$). For alternative schools the only significant change was for "Infectious diseases" ($p<.05$). In general, students in the mainstream schools appear to be have been sensitized by the curriculum to the risks associated with a number of potential hazards, and particularly those associated with water quality.

Intuitive Toxicology (*IntuiTox*)

A concept that we assessed was based on the notion that interaction with scientific and technical experts (either personally or through the curriculum) would produce student change in the direction of attitudes and intuitions about exposure to environmental hazards that are more consistent with those of the scientific community. We called this concept "Intuitive Toxicology" to reflect the intuitive models and ideas students have regarding the relationship between hazards, exposure, dose-response, and health-related outcomes. The evaluation of the Pesticide Spill, Mysterious Illness Outbreak and Indoor Air Quality curricula used a multiple-item scale to assess change in the *IntuiTox* concept. Although important changes did occur in the direction hypothesized, the scale itself tended to exhibit weak psychometric properties with a low and marginal internal consistency index (Cronbach's alpha < .50). This low alpha argues against combining the individual items into a single scale. A significant pre/post change was observed for the following two *IntuiTox* items:

> "If a chemical is released into the environment, then everyone in that environment is exposed to the chemical."
>
> "If a person is exposed to a chemical that can cause cancer in humans, then that person will probably get cancer someday."

Results for these two items are shown in Table 10. Responses to all seven items in this group are shown in Table 11.Students responded to each item on four-point categorical scale: "strongly disagree," "disagree," "agree," and "strongly agree."

These items are important for a number of reasons. First, they have been studied extensively in the context of risk perception where both toxicological experts and non-scientists (e.g., general public) have provided their attitudes concerning them. The general finding has been that they lay public tends to hold the attitude that, for example, a chemical release always leads to exposure and that mere exposure is sufficient to result in a health effect. Second, taken together these items embody two critical concepts necessary to appreciate the relationship between a hazard source and exposure, and between exposure and a health outcome. And, third, problem solving based on environmental science principles necessitates understanding and appreciating these distinctions, as well as knowing how to apply this knowledge as part of identifying a problem and tracing it to a health effect.

Table 10. Student pre/post difference scores for two concept items relating to chemical release, exposure and health effects.

Concept	All Schools Combined	Mainstream Schools	Alternative Schools
"If a chemical is released . . ."	Diff=-0.13 *p<.01* N=522	Diff=-0.12 *p<.01;* N=372	Diff=-0.16 *p<.05* N=150
"If a person is exposed . . ."	Diff=-.08 *p<.05* N=510	Diff=-.09 *p<.05* N=367	Diff=-.08 *n.s.* N=143

For the all schools combined group, a significant change was exhibit from pretest to posttest with regard to both items: students' responses moved in a direction more consistent with the principles of environmental science and more akin to those expected from environmental science specialists. Although there was less statistical power to detect effects for the alternative schools group, the direction of change was consistent with the mainstream schools group.

Table ___. *IntuiTox* Scale: Summary of scale items by mainstream schools, alternative schools, and all schools combined.

	All Schools Combined					*Mainstream Schools* [a]					*Alternative Schools* [b]					*Between-group significance*		
	N	Pre	Post	Diff[c]	*t-test*[d]	N	Pre	Post	Diff	*t-test*	N	Pre	Post	Diff	*t-test*	Pre	Post	Diff
If a chemical is released into the environment, then everyone in that environment is exposed to the chemical	522	2.89	2.75	-0.13	p<.01	372	2.85	2.74	-0.12	p<.01	150	2.96	2.80	-0.16	p<.05	ns	ns	ns
If a person is exposed to a chemical that can cause cancer in humans, then that person will probably get cancer someday.	510	2.79	2.70	-0.08	p<.05	367	2.76	2.68	-0.09	p<.05	143	2.85	2.77	-0.08	ns	ns	ns	ns
Risks from chemicals usually seem larger to people who don't understand very much about environmental science.	527	2.55	2.49	-0.06	ns	3.86	2.53	2.49	-0.04	ns	141	2.60	2.49	-0.11	ns	ns	ns	ns
Making good decisiions about things that affect my health and safety, such as chemicals in the environment, is basically just a matter of getting a good feel for what might harm me.	533	3.26	3.28	0.02	ns	392	3.27	3.33	0.06	ns	141	3.23	3.12	-0.11	ns	ns	p<.01	p=.08
In general, if a person is not exposed to a hazard then they are not at risk.	535	2.51	2.56	0.05	ns	389	2.50	2.58	0.08	p=.10	146	2.54	2.50	-0.04	ns	ns	ns	ns
If a person is exposed to a hazard, then they will always experience some degree of harm.	505	2.45	2.50	0.06	ns	364	2.41	2.45	0.04	ns	141	2.54	2.64	0.10	ns	p=.07	p<.05	ns
When it comes to managing risks that affect all of us, such as chemicals in the environment, we should leave the decisions to the experts.	538	2.83	2.78	-0.05	ns	394	2.84	2.82	-0.02	ns	144	2.81	2.67	-0.14	p=.12	ns	p=.07	ns

[a]Mainstream schools = Westview HS, Mountain View HS, Skyview HS, Tigard HS

[b]Alternative schools = Ashland HS, Milwaukee Support House, North Salem HS, Phoenix School, Young Parent Program, Woodburn Success Program

[c]Mean Difference Scores are computed across subjects by taking the average difference of the posttest minus the pretest.

[d]T-test for signed difference scores: *p<.05; **p<.01; ***p<.001; ****p<.0001

Conclusions

The WQ implementation yielded a more powerful statistical evaluation than any other in the HCP. This provided an opportunity to view in greater depth and with great reliability the impact of the curriculum on outcomes. Overall students gained significantly in terms of a number of important dimensions relevant to attaining environmental science principles, including the perception of environmental science risks, the importance of self-protective behaviors in the home, and the importance of environmental science information in problem solving. One of the strongest effects observed was that due to changes in students' perceived ability to participate in group problem solving and to use environmental science concepts as part of their writing and speaking with others. In addition, students gained significant conceptual richness in how they view environmental science concepts that relate to the meaning of exposure and dose-response relationships. The gains achieved in self-efficacy provide a valuable adjunct to the attainment of concepts from the curriculum and provide a base from which students have the potential for greater engagement with science in society.