Hydroville Curriculum Project

STUDENT OUTCOMES QUANTITATIVE EVALUATION SCALES AND RESULTS: 2001 - 2006

Donald G. MacGregor, Ph.D.

MacGregor-Bates, Inc.
1010 Villard Ave.
PO Box 276
Cottage Grove, OR 97424
Phone: (541) 942-5727
Email: donaldm@epud.net

NIEHS

Oregon State University | Environmental Health Sciences Center

Hydroville, USA

INTRODUCTION

The Hydroville Curriculum Project (HCP) spanned a 7-year time frame, during which curricula were developed for four content areas. Each content area emphasized a distinct aspect of environmental health science (Click on the curriculum name in Table 1 for a complete description of the curricular modules). Table 1 indicates each of the curriculum content areas along with the school year in which the curriculum was implemented. No curriculum was implemented during the 2003-2004 school year to allow for review and evaluation of the previous two implementations before continuing with the program.

Table 1. Curriculum implementations by school year.

Curriculum Name	School-Year Implemented
Pesticide Spill (PS)	2001-2002
Mysterious Illness Outbreak (MIO)	2003-2003
Indoor Air Quality (IAQ)	2004-2005
Water Quality (WQ)	2005-2006

EVALUATION SCALES

A set of seven key concepts formed the basis for the evaluation of student outcomes. Each concept was used to develop a measurement scale comprised of a set of individual pretest/posttest items. The evaluation of the HCP with respect to student outcomes was broken down into two phases. The first phase corresponded to the first two implementation years (i.e., Pesticide Spill, Mysterious Illness Outbreak). During this phase the evaluation underwent development and testing that led to changes to the evaluation approach and the evaluation instrument. Although the same concepts were examined in both years, the number of evaluation items was significantly different. The second phase corresponded to the second two implementation years (i.e., Indoor Air Quality, Water Quality). The evaluation in each of these two implementations was the same. Each scale is identified and explained below, and summarized in Table 2. The scales form the basis for evaluation in all four implementations, but the specifics of each scales are those used in the second phase of the evaluation. A dictionary of evaluation scales and samples of the pre/post test documents can be found on this website.

Quality of Explanations *(Explain)*. An important component of problem solving using environmental health science principles is the ability to distinguish between the quality of various explanations that could be hypothesized to account for an observed health effect. In daily life, health effects are often reported in newspaper or media accounts. The 10-point *Explain* scale uses a media-style reporting of a health effect in the fictitious town of “Mayville” as the background for an evaluation exercise in which students judge the relative quality of each of a number of possible explanations. The set of explanations is based on factors that relate to differences in community contexts, potential exposures to environmental contaminants, and individual susceptibilities to health effects. For each explanation, the student provides one of five categorical responses ranging from "not a good explanation" to "slightly good . . .," "moderately good . . .,", "very good . . .," and "don't know."

Information Seeking *(InfoSeek).* Problem solving using environmental health science principles requires the collection and interpretation of information. In doing so, students demonstrate their acquisition of knowledge about environmental health science concepts. The 8-point *InfoSeek* scale builds on the "Mayville" story problem by posing the context of a community problem solving committee that has an opportunity to collect information. Students judge how informative each of a number of activities are for helping the committee accomplish its purpose. The activities include interviewing local residents, having soil and water tests done, consulting the Internet for more information, and examining local buildings where people have become ill. A higher scale score indicates a more positive evaluation of how informative an activity would be for "helping solve the problem" of why the community of Mayville has higher incidence of serious illness.

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 Curriclum, they must also have acquired a base of teamwork skills upon which they can draw, and the self-efficacy to utilize those skills in participation with others. The 6-point *PersInvolv* scale uses self-evaluation to assess students' competence and capability with regard to a number of participation activities in the context of group problem solving. These include working with others, talking with community members, written and oral reporting, and interviewing a scientist. Students rate each item on a "Not . . . ," "Slightly . . . ," "Moderately . . . ," "Very Qualified and Capable" scale. 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.

Intuitive Toxicology *(IntuiTox).* A core objective of the Hydroville Curriculum is to improve the quality of students' problem solving abilities through interaction with experts in environmental health science. Many of the concepts in environmental health science are complex and some are counterintuitive. A goal of student interaction with curriculum elements and with subject-matter experts is to increase their awareness and understanding of environmental health science and to learn to apply the same reasoning principles as do environmental health scientists to solve problems. The 7-point *IntuiTox* scale assesses student change with respect to a set of concepts in environmental health risk assessment and provides a basis for evaluating the degree to which students develop attitudes about environmental health science that are more consistent with those of science professionals. The scale items include perceptions of chemical exposure, the meaning of exposure, and the relationship between exposure and health-related outcomes. Students rate each item on a four-point "Strongly Agree/Disagree" scale. A higher scale score indicates perceptions and attitudes about chemicals and chemical risks that are more consistent with those of environmental science professionals.

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 10-point *SelfPro1* scale assesses student change with respect to self-protective behavior associated with a number of activities in the home, including washing fresh food, reading directions and warning labels, using self-protective equipment, and testing environmental components (e.g., air, water). Students rate each of the items on a five-point scale ranging from "not important," "seldom," "important once in a while," " . . . most of the time," and "always important to me or my family." A higher scale score indicates a more positive attitude toward self-protective behaviors with respect to sources of environmental health and safety risk.

The 3-point *SelfPro2* scale assesses students' attitudes toward environmental health and safety in general. Students evaluate a set of attitude statements regarding their perceived ability to recognize and manage health and safety risks in the home, including their ability to read and understand warning labels. Each item is rated on a four-point "Strongly Agree/Disagree" scale. A higher scale score indicates a more positive attitude toward self-protection in the home.

Value For Science *(ValueSci).* Acquiring and using environmental health science knowledge depends upon and contributes to a positive view of science in daily life, and a positive view of science as a social enterprise. The 7-point*ValueSci* scale assesses students' attitudes toward science in general, environmental health science in particular, and the value of science for making personal health and safety decisions. Items include interest in science, confidence in talking about science with others, and views about science as a possible career direction. Students rate each item on a four-point "Strongly Agree/Disagree" scale. A higher scale score indicates a more positive value for science in daily life.

Perception of Risk *(PercRisk).* As students develop greater knowledge skills and conceptual awareness of environmental health science, their perception of environmental health science risks should change with respect to other risks and hazards. The 10-point RiskPerc scale assesses change in students' perceptions of a broad range of health and safety risks (e.g., smoking, alcohol use, food additives), including those identified by environmental health science (e.g., air pollutants, water contaminants, environmental allergens). Scale items are rated on a five-category scale ranging from "no risk," slight risk," "moderate risk," high risk," and "don't know." A higher scale score indicates greater perceived risk.

Two derived scales are based on a subset of the 10 items comprising the overall *PercRisk* scale: *ChemRisk*, a 3-item scale based on the chemical risk items (i.e., second hand cigarette smoke, household cleaning products, food additives), and *EnviroRisk*, a 3-item scale based on the environmental risk items (i.e., indoor air pollutants, water contaminants, environmental allergens.)

Table 2. Hydroville Student Evaluation Scales 2004/2005 & 2005/2006 Implementation Years (Indoor Air Quality & Water Quality Curricula)

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.

SUMMARY OF RESULTS

This summary will show a detailed explanation of results for each of the two implementations in the second phase of the evaluation, followed by an overall summary of all four years of implementations.

Indoor Air Quality (IAQ) Curriculum.

The evaluation design organized participating schools into two program groups: single teacher schools and integrated team schools. The individual schools are shown in Table 3 along with the number of completed pretest-posttest evaluation protocols for each school. (Click on the school name for a complete description of each pilot school.)

Table 3. Schools participating in the IAQ evaluation.

Single Teacher	Integrated Team
Benson (N=133)	Reynolds HS (N=51)
	Westview HS (N=27)
	Fir Ridge Campus (N=3)
	Young Parent Program (N=24)
	The Community Schoolhouse (N=39)

The total number of completed pre/post evaluation protocols for the integrated team schools was N=145. The small N's for the integrated team schools provided very low statistical power for significance tests conducted on the results of individual schools. The data for the five integrated team schools were combined to yield a larger group for comparison with the single teacher school.

Scale Means by Program and All Schools Combined. Table 4 shows the scale means by single teacher, integrated team and for all schools combined. For each of the program types (i.e., single teacher vs. integrated team) 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.

Of the nine scales shown in Table 4 three evidenced significant pre/post changes for the Integrated Team schools. These were for the scales *PersInvolv*, *ValueSci*, and *EnviroRisk*. For the Single Teacher Program, only the *SelfPro2* scale resulted in significant pre/post change.

The largest (and most statistically significant) pre/post change was for the scale *PersInvolv*, but only for the Integrated Team schools. From pretest to posttest, students were more likely to express positive attitudes about their capability to participate in a variety of activities relating to discovering the causes of health effects in the hypothetical community of Mayville.

A moderately significant effect was obtained on the *EnviroRisk* scale for students in the Integrated Team schools. This three-item subscale of the Perception of Risk scale assessed students' perceptions of risks from environmental allergens. Change scores were in the direction of greater perceived risk in the posttest than in the pretest assessment.

A significant result was obtained for pre/post change scores on the *SelfPro2* scale for the Single Teacher Program. This result was largely due to responses to a single item: "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." Pre/post change scores in response to this item 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. This change was significant for both the Single Teacher and Integrated Team Program at the $p<.05$ level, and was significant at the $p<.01$ level for All Schools Combined, owing to the larger sample size and greater statistical power.

A significant result was obtained for the *Explain* scale for All Schools Combined. Here again, the greater statistical power obtained from combining all schools in the analysis of pre/post change scores contributed to the observation of a significant result overall that was not observed for either of the two school groups.

Looking at the pattern of result overall we see that student change over the course of the IAQ curriculum implementation has some important dimensions. Students tended to be more confident taking on a personal role in group activities relating to identifying and solving a problem relating to an environmental issue. This was the strongest outcome of the IAQ evaluation. In addition, students tended to be more sensitive to environmental risk issue, particular relating to curriculum components, suggesting that students did attend and assimilate important environmental science concepts through the IAQ curriculum implementation. Students were also more responsive to the need for self-protection with regard to environmental health and safety risks, and gained an additional appreciation for the value of science, both in general and in their personal lives.

Intuitive Toxicology (*IntuiTox*). An important concept in the evaluation of student outcomes is based on the notion that interaction with scientific and technical experts (either personally or through the curriculum) produces student change in the direction of attitudes and intuitions about exposure to environmental hazards that are more consistent with those of the environmental science community. We called this concept "Intuitive Toxicology" (*IntuiTox*) to reflect the intuitive models and concepts students have regarding the relationship between sources of hazards, exposure to hazards, dose-response relationships, and health-related outcomes. During Phase I of the evaluation (i.e., Pesticide Spill and Mysterious Illness Outbreak) a multiple-item scale was developed to assess change in the 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 (For specific items used to measure *IntuiTox* see the Dictionary of Evaluation Scales). Instead the individual items were analyzed separately. All were rated on a scale from "1" (Strongly Disagree) to "4" (Strongly Agree) scale. A significant pre/post change was observed for the following *IntuiTox* item:

> "If a person is exposed to a chemical that can cause cancer in humans, then that person will probably get cancer some day."

Students in the Integrated Team schools tended to express greater disagreement with the statement in the posttest than the pretest ($p<.01$), an attitude reflecting greater awareness of the distinction between exposure and the dose-response relationship required to lead to a health outcome. This perspective is more consistent with how toxicological experts would respond. Students in the Single Teacher Program showed no significant pre/post change for this item.

Taking Stock. Looking across all of the student outcome results for the IAQ implementation one of the first things we notice is the limited statistical power available for pre/post significance tests. Despite this limitation in statistical power, some very important student outcomes were observed. Significant gains were made in students' self-efficacy and confidence in their personal involvement with others working in a group to identify and analyze a community problem involving a potential environmentally-related health effect. These activities involved information seeking, interviewing community members and environmental experts, as well as preparing written and oral reports. The scenario aspect of the curriculum directly exposed students to the complexities of solving environmental problems through work with others and gave them an opportunity to learn and implement writing and oral presentation skills. These elements of the curriculum made a distinct and measurable impact on students and are important contributors to their ability to use environmental science concepts in the future.

Students also made gains in terms of their value for science and its role in their personal life, including self-protective behaviors in the home. Their increased sensitivity to environmental risk issues coupled with their increased ability to recognize how to use environmental science principles as part of everyday problem solving contributes to their overall skill set as effective decision makers.

Table 4 Indoor Air Quality (IAQ) Curriculum – Scale means by single teacher, integrated team and all schools combined.

	All Schools Combined					*Single Teacher* [a]					*Integrated Team* [b]					*Between-program 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	255	2.37	2.44	0.07	*	123	2.36	2.45	0.09	p=.07	132	2.37	2.43	0.06	ns	ns	ns	ns
INFOSEEK	273	2.86	2.87	0.01	ns	132	2.82	2.79	-0.03	ns	141	2.90	2.95	0.05	ns	ns	**	ns
PERSINVOLV	275	2.63	2.79	0.16	***	132	2.61	2.72	0.10	ns	143	2.64	2.85	0.21	***	ns	p=.09	ns
SELFPRO1	276	3.41	3.32	-0.09	*	133	3.30	3.22	-0.08	ns	143	3.51	3.42	-0.09	ns	*	*	ns
SELFPRO2	247	2.86	2.94	0.07	p=.09	119	2.82	2.95	0.13	*	128	2.90	2.93	0.02	ns	ns	ns	ns
VALUESCI	270	2.62	2.68	0.06	p=.07	131	2.65	2.67	0.02	ns	139	2.59	2.70	0.10	*	ns	ns	ns
PERCRISK	257	2.81	2.86	0.06	ns	125	2.79	2.81	0.02	ns	132	2.82	2.90	0.09	ns	ns	ns	ns
CHEMRISK	258	2.85	2.89	0.04	ns	126	2.83	2.82	-0.01	ns	132	2.87	2.97	0.10	ns	ns	p=.07	ns
ENVIRORISK	249	2.77	2.88	0.12	*	122	2.76	2.82	0.05	ns	127	2.78	2.95	0.17	**	ns	p=.10	ns

[a]Single teacher school = Benson HS
[b]Integrated Team = Reynolds HS, Westview HS (Catapult), Fir Ridge Campus, Young Parent Program, The Community Schoolhouse
[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

Water Quality (WQ) Curriculum.

For the WQ curriculum implementation, a special effort was made to engage alternative schools. From Phase I evaluation results, it was learned that alternative schools with populations of "at risk" students yield some of the most significant gains in terms of student outcomes, particularly in team-related activities where students are challenged to learn new cooperative working skills, as well as gaining experience with both written and oral presentation. For at risk students who may be on the margins of educational achievement, the development of self-efficacy and self-confidence with respect to working with others and in demonstrating their written and oral presentation abilities may be a significant step in promoting both their personal and career development.

The evaluation design for WQ organized participating schools into two program groups. The individual schools are shown in Table 5 with the number of completed pretest-posttest evaluation protocols for each school. (Click on the school name for a complete description of each pilot school.)

Table 5. 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 evaluation protocols for the mainstream schools was N=462, and for the alternative schools was N=150. (The actual N for a given analysis will vary due to missing data. These N's indicated reflect an upper bound on the number of data points available. In actuality the N's for a given analysis may be reduced as much as 5%.) Alternative schools tended to have considerably lower enrollment than do mainstream schools, posing significant challenges to obtaining comparable sample sizes with mainstream schools.

Scale Means by Program and All Schools Combined. Table 6 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.

The WQ implementation evaluation had a much larger sample size than that for IAQ (see previous section), 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.

Intuitive Toxicology (*IntuiTox*). 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 7. 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 (MacGregor, D. G., Slovic, P., & Malmfors, T. (1999). "How exposed is exposed enough? Lay inferences about chemical exposure." *Risk Analysis*, 19(4), 649-659.) 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 7 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. 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.

Taking Stock. 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 student 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.

Table 6. Water Quality (WQ) Curriculum – 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

SUMMARY OF RESULTS FOR THE FOUR YEARS OF PILOT IMPLEMENTATION

This section presents an overview of the Hydroville evaluation for all four curriculum implementations. The Phase 1 evaluations provided a piloting basis for developing the instrumentation and methodology applied to Phase 2. Although the conceptual basis for the evaluation was generally unchanged from Phase 1 to Phase 2, significant revisions were made to instruments and administration procedures. The following two exhibits show evaluation outcomes in terms of patterns of significance for the scales in use at the time of each curriculum implementation. From this picture it is, perhaps, easier to see the general trends that emerged with respect to student outcomes.

During the Phase I evaluation schools were not groups according to an instructional model. Nonetheless, it is visible in Table 8, particularly from the all schools combined results, to see the general trend even early in the project toward gains in students' comprehension of environmental science principles, the role of information seeking in problem solving, and more appropriate attitudes toward self protection. The Pesticide Spill (PS) curriculum implementation in Phase I placed emphasis on group work, which was evident from the evaluation results.

Table 8. Overview of Phase I Results By Curriculum and Implementation Site.

Pesticide Spill (PS) Curriculum	
Site	**Scales with Significant Pre/Post Change Scores**
Benson HS	IntuiTox*
Corvallis HS	IntuiTox[a], Explain**, ImmedAction[a], InfoSeek**
Gateway	IntuiTox*
Reynolds HS	PersInvolv**
Westview HS	IntuiTox[a], Explain*, PersInvolv*, ValueSci[a]
All Schools Combined	**PersInvolv****

[a]p<.10, *p<.05, **p<.01, ***p<.001

Mysterious Illness Outbreak (MIO) Curriculum	
Site	**Scales with Significant Pre/Post Change Scores**
Benson HS	IntuiTox***, SelfPro**
AIM	IntuiTox*, Explain**
Gateway LC	IntuiTox*
Reynolds HS	SelfPro**, Explain*, InfoSeek*, PersInvolv*
Westview HS	SelfPro[a], InfoSeek**
Crescent Valley HS	IntuiTox[a], ValueSci**
La Grande Alt. HS	InfoSeek*, PersInvolv**, ValueSci**
All Schools Combined	**Intuitox***, SelfPro***, Explain*, Infoseek****

[a]p<.10, *p<.05, **p<.01, ***p<.001

Table 9 presents a summation of the IAQ and WQ curriculum evaluation results. Here again we see the strong trend toward student gains in a number of areas relating to the attainment of environmental science concepts, as well as an increase ability to work with others and to have confident in their personal ability take an active role in environmental problem solving. Taken across the entire four years of curriculum implementations, it is evident that the objectives of the HCP with respect to student outcomes have been affirmed in many key areas that promote environmental science as a basis for learning problem solving skills that have direct application to students' lives, both as life-long learners and as part of a science-literate society.

Table 9. Overview of Phase II Results By Curriculum and Implementation Site.

Indoor Air Quality (IAQ) Curriculum	
Program Type	**Scales with Significant Pre/Post Change Scores**
Single Teacher	SelfPro2*
Integrated Team	PersInvolv***, ValueSci*, EnviroRisk**
All Schools Combined	**PersInvolv***, Explain*, SelfPro1*, EnviroRisk*,**

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

Water Quality (WQ) Curriculum	
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**