Measuring The Effectiveness of U.S. Environmental Education Programs

A Presentation at the Mid-Atlantic Environmental Summit

Chevy Chase, MD

Bill McBeth

1. NELA Phase One: Baseline Study
2. NELA Phase Two: Comparative Study
3. Environmental Literacy Framework

National Environmental Literacy Assessment Project (U.S.)

Methods and Results from The Phase One Baseline Study, 2006 – 2008

Research Team, Funders & Support

- Research Team Members
  - -William McBeth
  - -Tom Marcinkowski
  - -Ron Meyers
  - -Harold Hungerford
  - -Trudi Volk
- Funders
  - U.S. Environmental Protection Agency
  - National Oceanic and Atmospheric Administration
- Support
  - North American Association for Environmental Education

Purpose of Research

To establish a baseline measure of environmental literacy among U.S. middle school students.

Research Questions

1) What is the level of environmental literacy of sixth and eighth grade students across the United States on each of the following variables:
   a. ecological knowledge;
   b. verbal commitment [intention to act];
   c. environmental sensitivity;
   d. general environmental feelings [environmental attitudes];
   e. environmental issue and action skills;
   f. actual commitment [environmentally responsible behavior];?

2) What is the general level of environmental literacy of sixth and eighth grade students across the U.S.?

Sampling Technique

- Random sampling was used to ensure representativeness and to allow the data from Phase I to be used as an initial baseline for future comparison
- GfK-Roper was contracted to draw a random national sample to reduce the potential for bias and to enable generalizability to U.S. population of 6th and 8th graders
- GfK-Roper used a multi-stage form of clustered random sampling: 50 counties, then 1 school from a list of candidate schools, and then two 6th and two 8th grade classes per school
- The resulting sample is referred to as a probability- proportional sample (PPS)

Overview of the Sample

- Counties were located in 30 states
- School sample included: public (31), private independent (4), and private religious (13) schools
- Student sample included: 1,042 6th graders and 962 8th graders, for a total sample of 2,004 students

Instrumentation

1. Student Assessment
   - Middle School Environmental Literacy Survey (MSELS)
     - Validity determined by a 16 member panel of experts, contrasted groups comparison, and exploratory and confirmatory factor analysis
     - Reliability estimates determined using Cronbach's Alpha
       Field test: Total instrument reliability = .82
2. Information about Schools and Programs
   - School Information Form
   - Program Information Form
   - Teacher Information Form
3. Parental Consent Forms: Active and Passive

Data Collection

- Dr. Ron Meyers recruited, contracted, assigned, and oriented Data Collectors (DC)
- DCs organized with Principals and Teachers to schedule data collection on a mutually agreeable date
- Data were collected from April - June, 2007
- DCs administered MSELS, and collected all copies of the MSELS and Scantron Forms, and all completed School, Program, Teacher, and Consent Forms
- DCs submitted all completed Forms to Dr. Meyers, who then forward them on to Dr. Marcinkowski for entry, cleaning and analysis

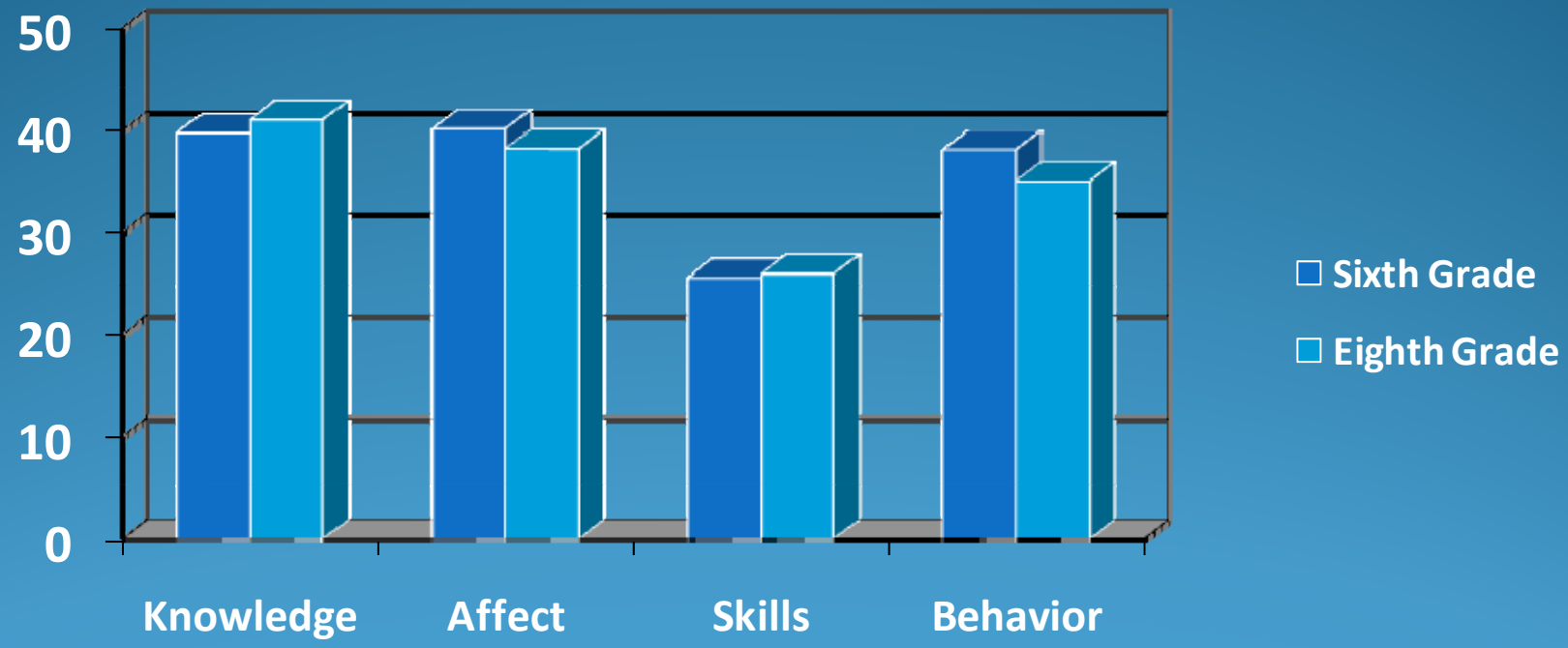
Descriptive Results for Grades 6 and 8, Phase One Sample

Variables	Grade	Sample Size	Possible Points	Mean	Std. Dev.
Ecological Knowledge	6	934	17	11.24	3.26
	8	921		11.62	3.32
Verbal Commitment	6	1000	60	43.89	8.88
	8	936		41.10	9.25
Environmental Sensitivity	6	978	55	32.54	7.47
	8	913		30.11	7.48
Environmental Feeling	6	987	10	8.14	2.00
	8	930		7.82	2.06
Issue Identification	6	902	3	1.31	.93
	8	885		1.29	.95
Issue Analysis	6	905	6	2.75	1.89
	8	869		2.86	2.00
Action Planning	6	874	20	7.25	5.44
	8	820		7.86	5.64
Environmental Behavior	6	974	60	38.44	9.15
	8	921		35.14	9.39

Adjusted Environmental Literacy Component and Composite Score for Phase One

Variables	Components of Environmental Literacy	Grade	Combined Component Mean	Environmental Literacy Composite Scores	
				6th	8th
Ecological Knowledge	Ecological Knowledge	6th	39.77	143.65	140.32
		8th	41.08		
Verbal Commitment	Environmental Affect	6th	40.18		
Environmental Sensitivity					
Environmental Feeling		8th	38.25		
Issue Identification	Cognitive Skills	6th	25.53		
Issue Analysis					
Action Planning		8th	25.93		
Environmental Behavior	Behavior	6th	38.17		
		8th	35.05		

Sixth and Eighth Grade Means for Literacy Components: Phase One



Discussion

- As the first study of its kind in the U.S., this study provides baseline data on the status of Environmental Literacy among 6^{th} & 8^{th} graders

- These data can be used as comparative measures to findings from other studies; no inferences can be made from this study about the effects of EE on middle grades students in the US

National Environmental Literacy Assessment Project (U.S.)

Methods & Results from

The Phase II Comparative Study

2008 - 2010

Research Team, Funders & Support

- **Research Team Members:**
  - **-Dr. William McBeth**
  - **-Dr. Tom Marcinkowski**
  - **-Ms. Karen Cifranick**
  - **-Dr. Harold Hungerford**
  - **-Dr. Trudi Volk**
  - **-Dr. Ron Meyers**
- **Funder:**
  - **-National Oceanic and Atmospheric Administration**
- **Support:**
  - **-U.S. Environmental Protection Agency**
  - **-North American Association for Environmental Education**

Purposes of Research for NELA Phase Two

- To identify environmental literacy levels of middle school students involved in on-going school-based environmental programs;
- To compare environmental literacy levels of middle school students involved in on-going school-based environmental education programs to those of the NELA Phase One Baseline sample;
- To identify middle schools where students exhibit high levels of environmental literacy for further study.

Research Questions for NELA; Phase Two

1) What is the level of environmental literacy of sixth, seventh and eighth grade students in the U.S., who are participating in established school-based environmental programming, on each of the following variables:

a. ecological knowledge;
b. verbal commitment [intention to act];
c. environmental sensitivity;
d. general environmental feelings [environmental attitudes];
e. environmental issue and action skills;
f. actual commitment [environmentally responsible behavior];?

2) How does the level of environmental literacy of students in these selected schools compare with the baseline level of environmental literacy among sixth and eighth grade students?

Selection of the Purposeful Sample

- The Research Team solicited school nominations through NAAEE website and communications, flyers included in 2008 NAAEE conference packets, face-to-face meetings, telephone and email.
- We actively recruited/invited EE programs, networks, and approaches to nominate schools at the 2007 and 2008 NAAEE Conferences.
- Through internet searches and other contacts we attempted to identify additional schools with established environmental programming: magnet and charted schools, schools with an environmental mission, and independent schools.

- 105 schools nominated
- All nominees were invited to complete a Screening Survey that would determine if their programs met the parameters of the study (program in place at grades 6th, 7th, and/or 8th grade level, for two or more years and in a minimum of two classes)
- 70 schools were invited to participate in the study
- Valid data sets were collected from 64 schools

Categories	Program Type	Program	n
1. Programs (n=28)	Federal Agencies	NOAA: BWET	1
		USFS: Natural Inquirer	4
		USFS: Residential Camp	3
	National Programs	PLT	2
		WILD	1
		PLT/WILD	2
		WET	4
		IEEIA	2
	Regional Programs	WI KEEP	2
		Eii	3
		North Bay	4
2. Approaches (n=8)		EIC	5
		Place-Based	2
		GIS	1
3. Networks (n=12)		Earth Day	2
		Earth Force	2
		Earth Partnership	2
		MAEOE Green Schools	4
		EKU-EE Endorsement	2
4. Magnet/Charter (n=7)	Environmental Magnet		2
	Green Charter		5
5. Independent (n=9)			9

Overview of the Sample

- Schools were located in 27 states
- School sample included: public (57), private independent (5), and private religious (2) schools, for a total sample of 64 schools.
- Student sample included: 3,134 6th, 2,693 7th, and 2,138 8th graders, for a total sample of 7,965 students

Data Collection Procedures were Similar to Phase One

- Karen Cifranick oversaw the recruiting, contracting, assigning, and orienting of Data Collectors (DC).
- Ron Meyers was responsible for recruiting and organizing the DCs
- DCs organized with Principals and Teachers to schedule data collection on a mutually agreeable date.
- Data were collected from April - June, 2009.
- DCs administered MSELS and collected all copies of the MSELS and Scantron Forms, and all completed School, Program, Teacher, and Consent Forms .
- DCs submitted all completed Forms to Ms. Cifranick, who then forward them on to Dr. Marcinkowski for entry, cleaning and analysis.

Reporting of the Results

- Each participating school received a report that was both:
  - Descriptive, and
  - Comparative to the Phase One sample.

- When there were two or more nominated schools, the nominator received a results report (schools were identified by number not name). In each case where there was only one nominated school, it was left to the school to contact the nominator.

Results for Research Question One

1) What is the level of environmental literacy of sixth, seventh and eighth grade students in the U.S., who are participating in established school-based environmental programming, on each of the following variables:

a. ecological knowledge;
b. verbal commitment [intention to act];
c. environmental sensitivity;
d. general environmental feelings [environmental attitudes];
e. environmental issue and action skills;
f. actual commitment [environmentally responsible behavior];?

Descriptive Results for 6th, 7th, and 8th Grade Samples on Environmental Literacy Scales for All Schools

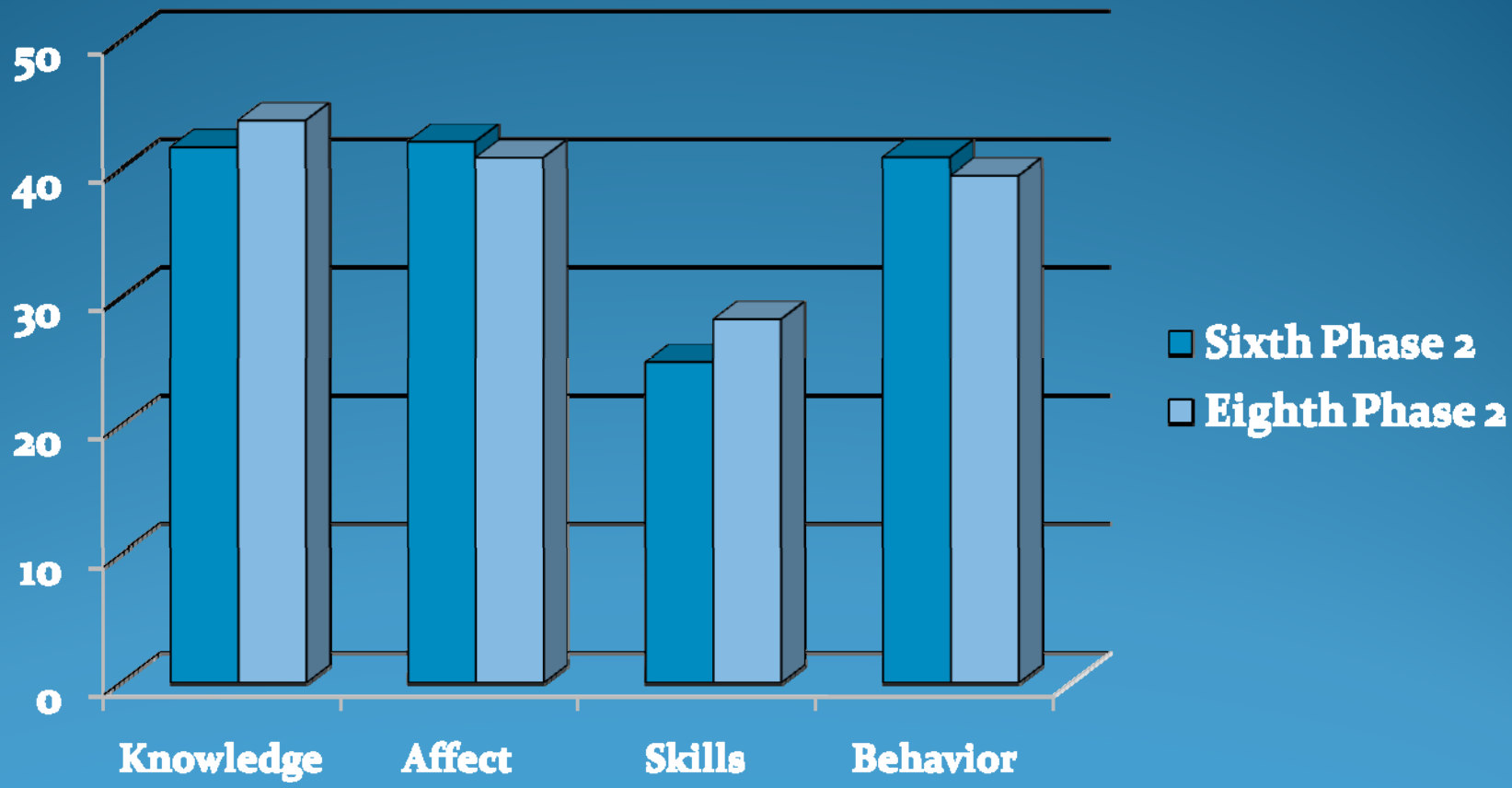
Table 1 *Summary of Descriptive Results for all Phase Two Sixth, Seventh, and Eighth Grade Students on Parts of the MSELS*

Parts of the MSELS (variables measured)	No. of Items	Range	Grade	Sample Size	Mean	Std. Dev.	% of Possible Points
				n			
II. Ecological Foundations (ecological knowledge)	17 Items (5 - 21)	0 - 17	6 7 8	3058 2654 2094	11.41 11.89 12.18	3.42 3.50 3.65	67% 70% 72%
III. How You Think About the Environment (verbal commitment)	12 Items (22 - 33)	12 - 60	6 7 8	3064 2644 2051	45.27 43.34 42.83	8.67 9.32 9.14	75% 72% 71%
V. You and Environmental Sensitivity (environmental sensitivity)	11 Items (46 – 56)	11 - 55	6 7 8	3015 2601 1999	33.00 31.88 31.03	7.37 7.32 7.55	60% 57% 56%
VI. How You Feel About the Environmental (environmental feelings)	2 Items (57 – 58)	2 - 10	6 7 8	2840 2443 1876	8.60 8.41 8.30	1.98 2.02 2.09	86% 84% 83%
VII.A. Issue Identification (issue identification)	3 Items (59, 60, 67)	0 - 3	6 7 8	2809 2431 1789	1.08 1.07 1.17	0.95 0.98 0.97	36% 36% 39%
VII.B. Issue Analysis (issue analysis)	6 Items (61 – 66)	0 - 6	6 7 8	2793 2439 1816	2.75 2.83 2.97	1.97 2.01 2.09	46% 47% 48%
VII.C. Action Planning (action planning)	8 Items (68 – 75)	0 - 20	6 7 8	2667 2315 1684	7.47 7.49 7.89	5.36 5.33 5.53	37% 37% 39%
IV. What You Do About the Environment (actual commitment)	12 Items (34 - 45)	12 - 60	6 7 8	3041 2618 2024	40.85 38.52 38.30	9.13 9.14 9.24	68% 64% 64%

Adjusted Environmental Literacy Component and Composite Scores; Phase Two Sample

Variables	Components of Environmental Literacy	Grade	Combined Component Mean	Environmental Literacy Composite Scores	
				6th	8th
Ecological Knowledge	Ecological Knowledge Range = 0-60	6th	41.68	149.64	152.35
		8th	43.77		
Verbal Commitment Environmental Sensitivity Environmental Feeling	Environmental Affect Range = 12-60	6th	42.11		
		8th	40.86		
Issue Identification Issue Analysis Action Planning	Cognitive Skills Range = 0-60	6th	24.94		
		8th	28.27		
Environmental Behavior	Behavior Range = 12-60	6th	40.90		
		8th	39.46		

Sixth and Eighth Grade Means for Literacy Components: Phase Two



Results for Research Question Two

How does the level of environmental literacy of students in these selected schools compare with the baseline level of environmental literacy among sixth and eighth grade students?

Z-Test Comparisons of Phase 1 and Phase 2 Mean Scores for 6th Grade Student Samples

Variable	Sample	Sample Size	Mean	SD	SE of Mean	Z-Score	Probability	Effect Size** (% of Phase 1 SD)
Ecological Knowledge	Phase 1 Phase 2	934 3058	11.24 11.41	3.26 3.42	.05895	2.88	.0002*	+5.2%
Verbal Commitment	Phase 1 Phase 2	1000 3064	43.89 45.27	8.88 8.67	.16042	8.60	.0000*	+15.5%
Environmental Sensitivity	Phase 1 Phase 2	974 3015	32.54 33.00	7.47 7.37	.13604	3.38	.0003*	+6.2%
Environmental Feelings	Phase 1 Phase 2	987 2840	8.14 8.60	2.00 1.98	.03753	12.26	.0000*	+23.0%
Issue Identification	Phase 1 Phase 2	902 2809	1.31 1.08	0.93 0.95	.01755	-13.10	.0000*	- 24.7%
Issue Analysis	Phase 1 Phase 2	905 2793	2.75 2.75	1.89 1.97	.03576	0.00	.5000	- - - - -
Action Planning	Phase 1 Phase 2	874 2667	7.25 7.47	5.44 5.36	.10534	2.09	.0183	+4.0%
Environmental Behavior	Phase 1 Phase 2	974 3041	38.44 40.85	9.15 9.13	.16593	14.52	.0000*	+26.3%

*Significant at $p \leq .006125$ — determined using the Bonferroni method (Cohen, 1988) of dividing the pre-set alpha level ($p < .05$) by the number of z-tests run (8).

**Effect Size was estimated as Phase 2 mean - Phase 1 / Phase 1 SD; reported as a percentage of the Phase 1 SD (e.g., 100% = +1 SD).

Z-Test Comparisons of Phase 1 and Phase 2 Mean Scores for 8th Grade Student Samples

Variable	Sample	Sample Size	Mean	SD	SE of Mean	Z-Score	Probability	Effect Size** (% of Phase 1 SD)
Ecological Knowledge	Phase 1 Phase 2	921 2094	11.62 12.18	3.32 3.65	.07255	7.72	.0000 *	+16.9%
Verbal Commitment	Phase 1 Phase 2	936 2051	41.10 42.83	9.20 9.14	.20314	8.52	0000 *	+18.8%
Environmental Sensitivity	Phase 1 Phase 2	913 1999	30.11 31.03	7.48 7.55	.16730	5.50	.0000 *	+12.3%
Environmental Feelings	Phase 1 Phase 2	930 1876	7.82 8.30	2.06 2.09	.04756	10.09	.0000 *	+23.3%
Issue Identification	Phase 1 Phase 2	885 1789	1.29 1.17	0.95 0.97	.02246	-5.34	.0000 *	- 12.6%
Issue Analysis	Phase 1 Phase 2	869 1816	2.86 2.97	2.00 2.09	.04693	2.34	.0097 *	+5.5%
Action Planning	Phase 1 Phase 2	820 1684	7.86 7.89	5.64 5.53	.13744	0.22	.4051	+0.5%
Environmental Behavior	Phase 1 Phase 2	921 2024	35.14 38.30	9.39 9.24	.20872	15.14	.0000 *	+33.7%

*Significant at $p \leq .006125$ — determined using the Bonferroni method (Cohen, 1988) of dividing the pre-set alpha level ($p < .05$) by the number of z-tests run (8).

**Effect Size was estimated as Phase 2 mean - Phase 1 / Phase 1 SD; reported as a percentage of the Phase 1 SD (e.g., 100% = +1 SD).

T-test Comparisons of Phase One and Phase Two Mean Scores for 6th Grade School Samples

Environmental Literacy Components	Sample	*n*	Mean	SD	*df*	*t*-score	Probability
Knowledge	Phase 1	48	39.77	6.41	89	1.601	.057
	Phase 2	43	41.68	4.78			
Affect	Phase 1	48	40.18	4.03	89	2.784	.004*
	Phase 2	43	42.11	2.21			
Skills	Phase 1	48	25.53	6.79	89	0.448	.328
	Phase 2	43	24.94	5.74			
Behavior	Phase 1	48	38.17	3.43	89	3.931	.000*
	Phase 2	33	40.90	3.18			
Composite Score	Phase 1	48	143.65	15.79	89	1.937	.028
	Phase 2	43	149.64	13.44			

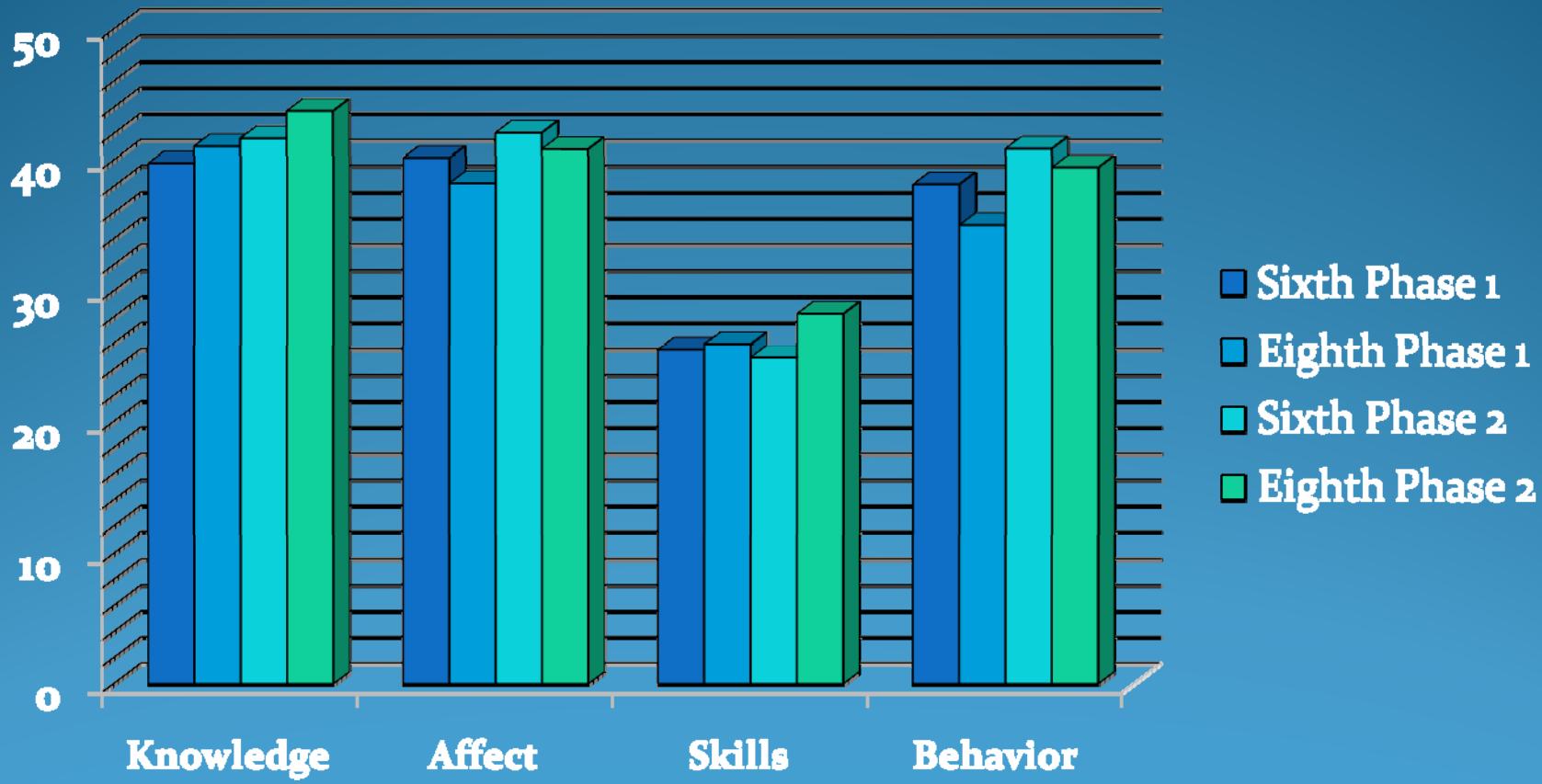
*= significant at .01 level; determined using the Bonferroni method (Cohen, 1988) by dividing the pre-set alpha level ($p \leq .05$) by the number of t-tests run (5) for each grade level.

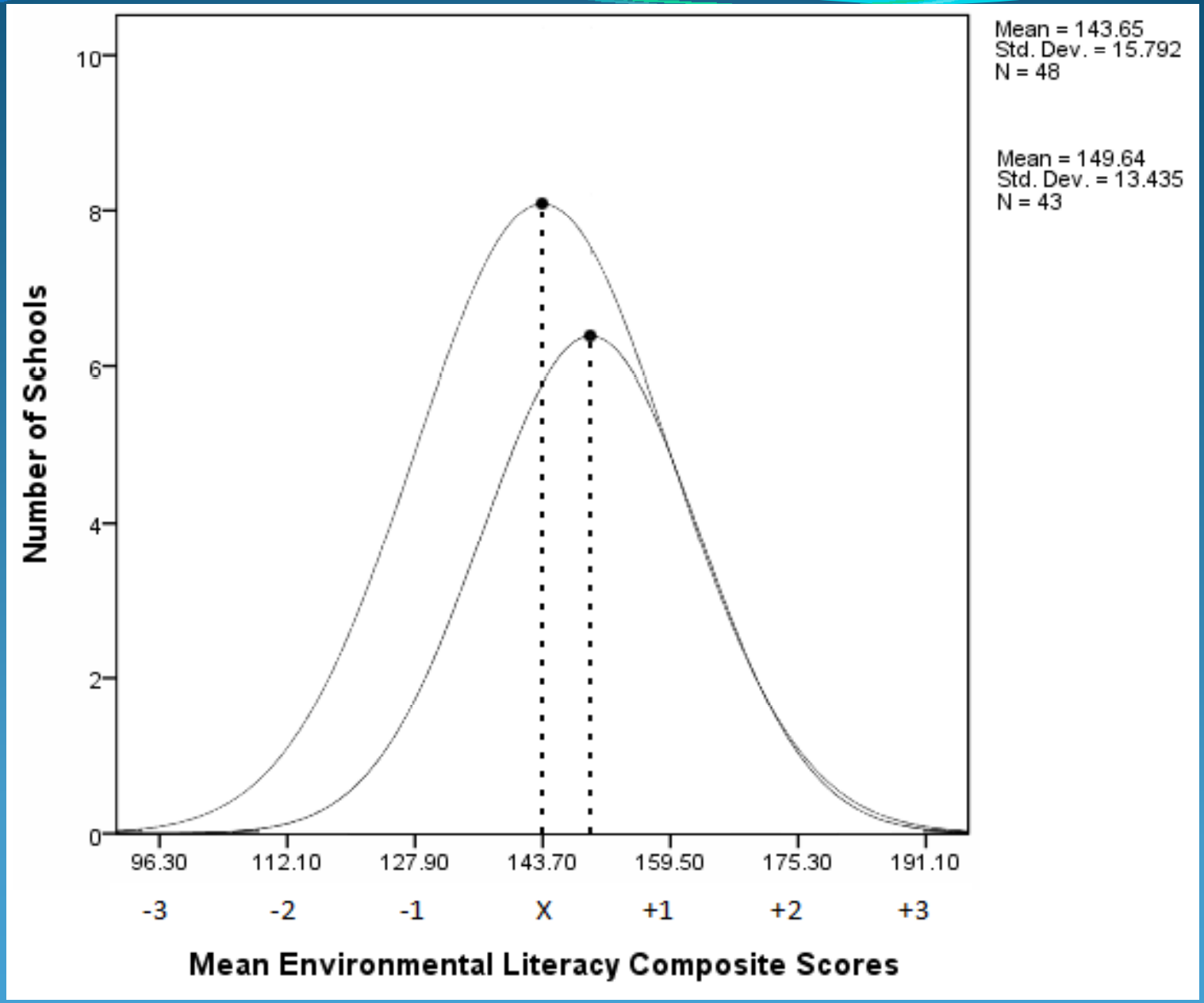
T-test Comparisons of Phase One and Phase Two Mean Scores for 8th Grade School Samples

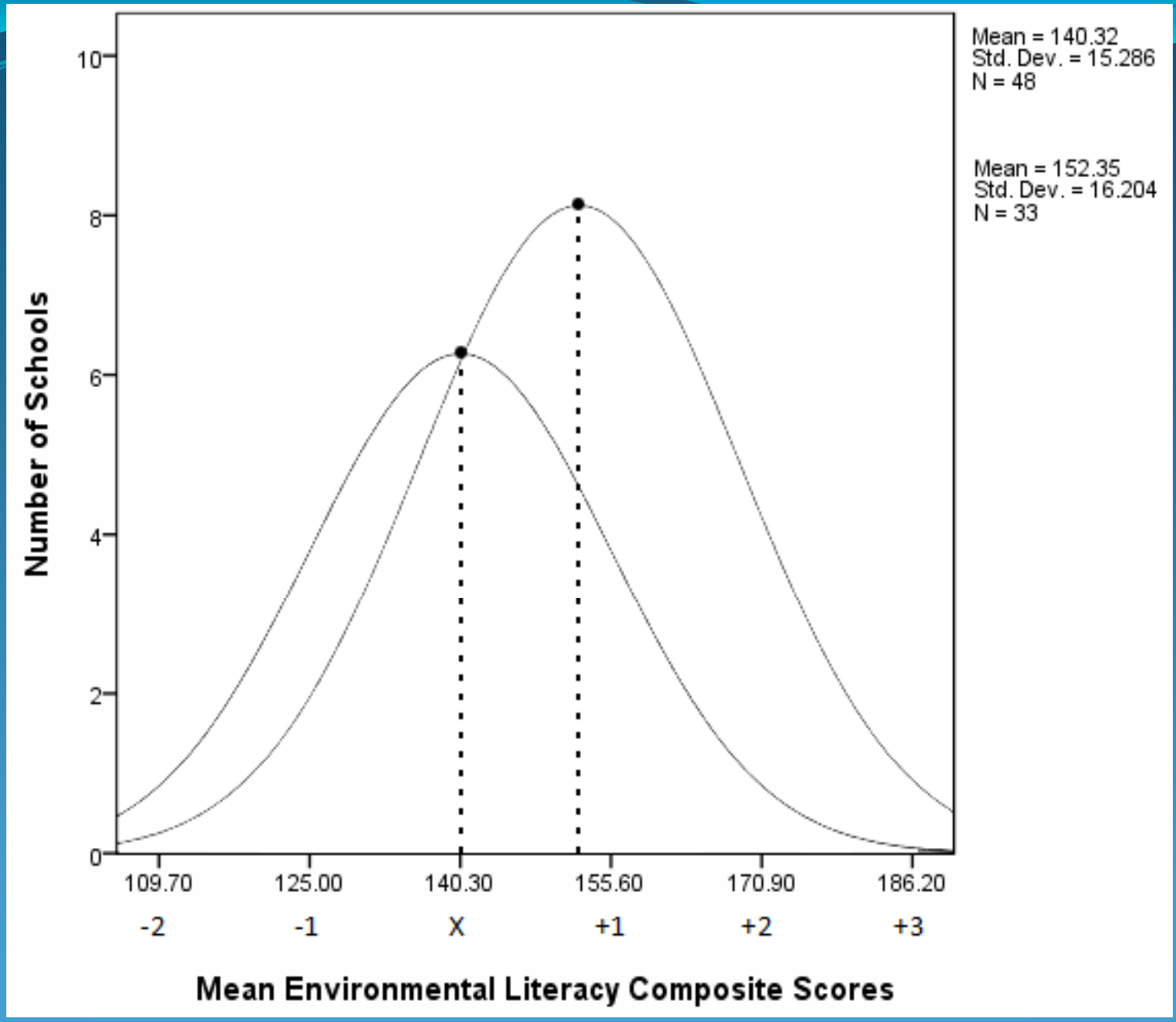
Environmental Literacy Components	Sample	*n*	Mean	SD	*df*	*t*-score	Probability
Knowledge	Phase 1	48	41.08	5.22	79	2.214	.015
	Phase 2	33	43.77	5.58			
Affect	Phase 1	48	38.25	2.58	79	4.140	.000*
	Phase 2	33	40.86	3.05			
Skills	Phase 1	48	25.93	6.82	79	1.509	.069
	Phase 2	33	28.27	6.91			
Behavior	Phase 1	48	35.05	3.47	79	5.554	.000*
	Phase 2	33	39.46	3.56			
Composite Score	Phase 1	48	140.32	15.29	79	3.398	.001*
	Phase 2	33	152.35	16.20			

* = significant at .01 level; determined using the Bonferroni method (Cohen, 1988) by dividing the pre-set alpha level ($p \leq .05$) by the number of t-tests run (5) for each grade level.

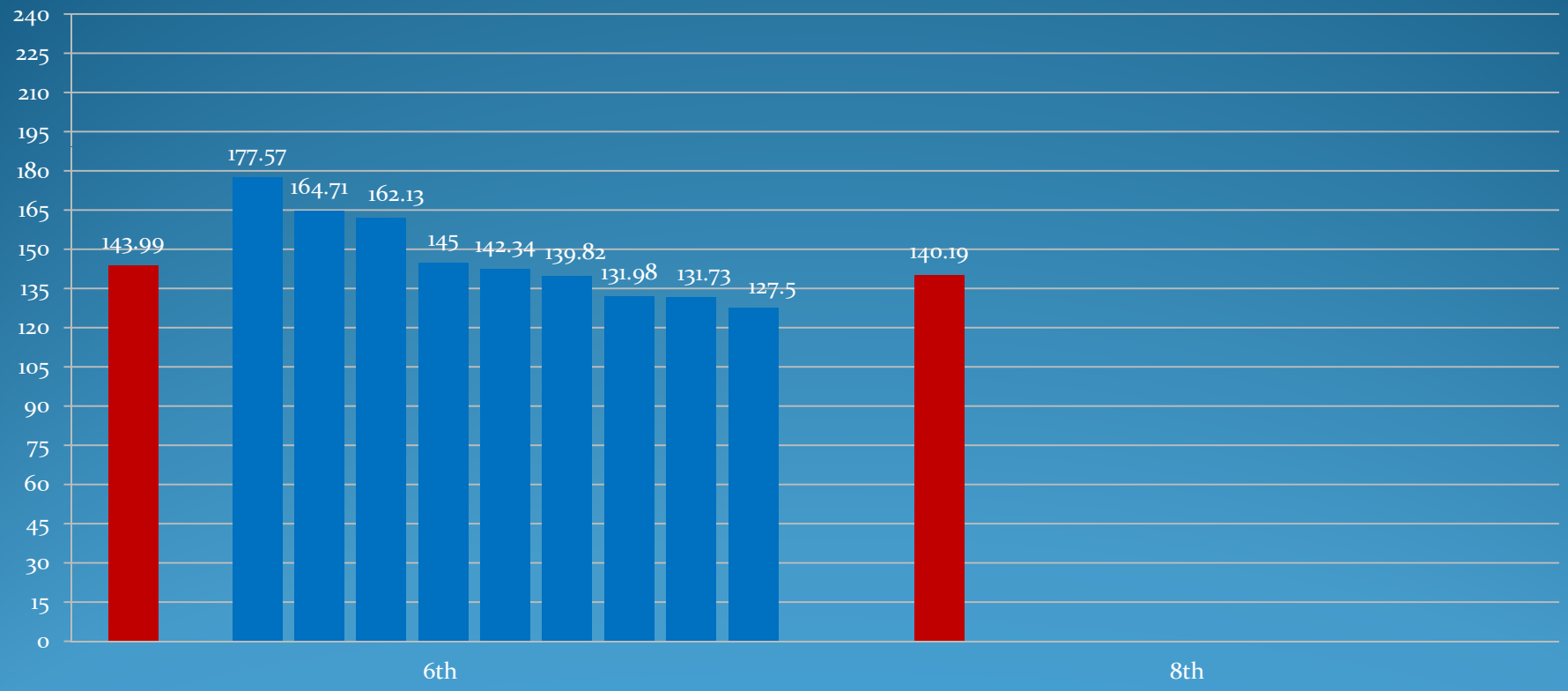
A Comparison of Sixth and Eighth Grade School Means for Literacy Components: Phases One and Two



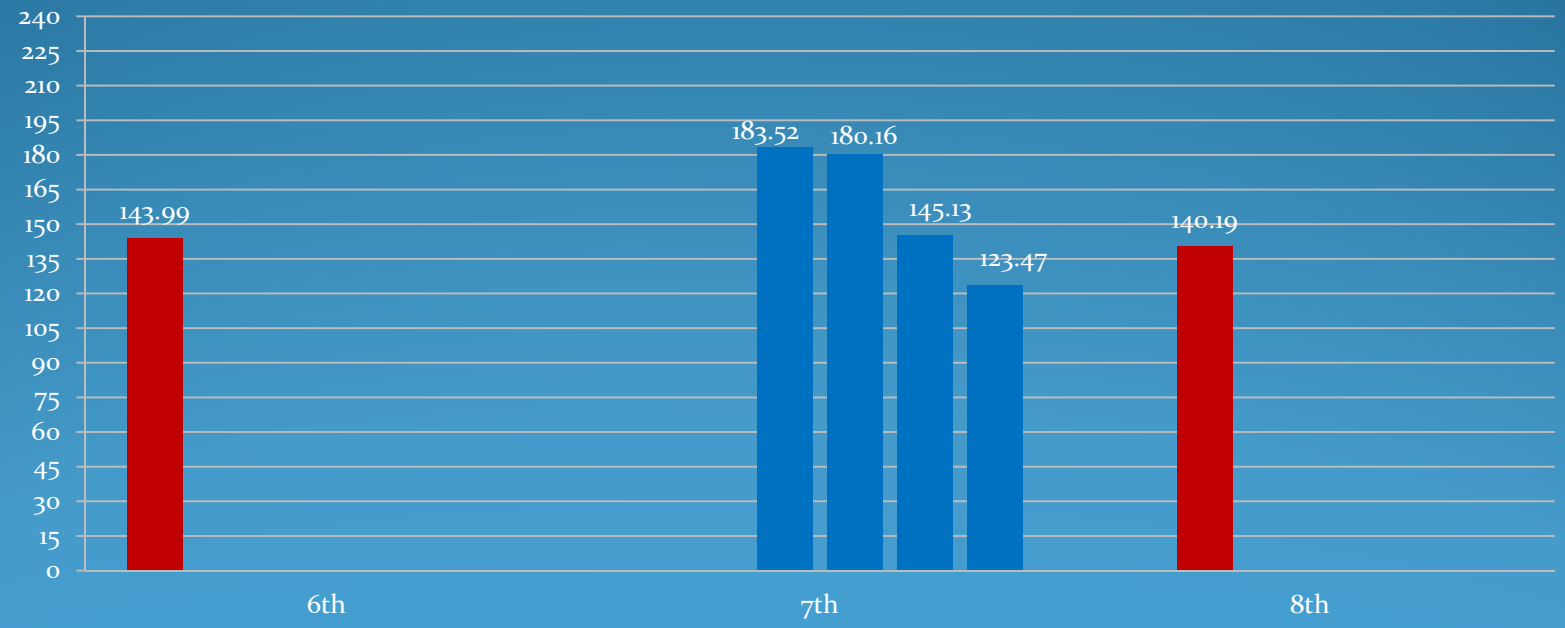

Mean = 143.65
Std. Dev. = 15.792
N = 48
Mean = 149.64
Std. Dev. = 13.435
N = 43
Number of Schools
0
2
4
6
8
10
96.30
112.10
127.90
143.70
159.50
175.30
191.10
-3
-2
-1
X
+1
+2
+3
Mean Environmental Literacy Composite Scores


Mean = 140.32
Std. Dev. = 15.286
N = 48
Mean = 152.35
Std. Dev. = 16.204
N = 33
Number of Schools
0
2
4
6
8
10
109.70
125.00
140.30
155.60
170.90
186.20
-2
-1
X
+1
+2
+3
Mean Environmental Literacy Composite Scores

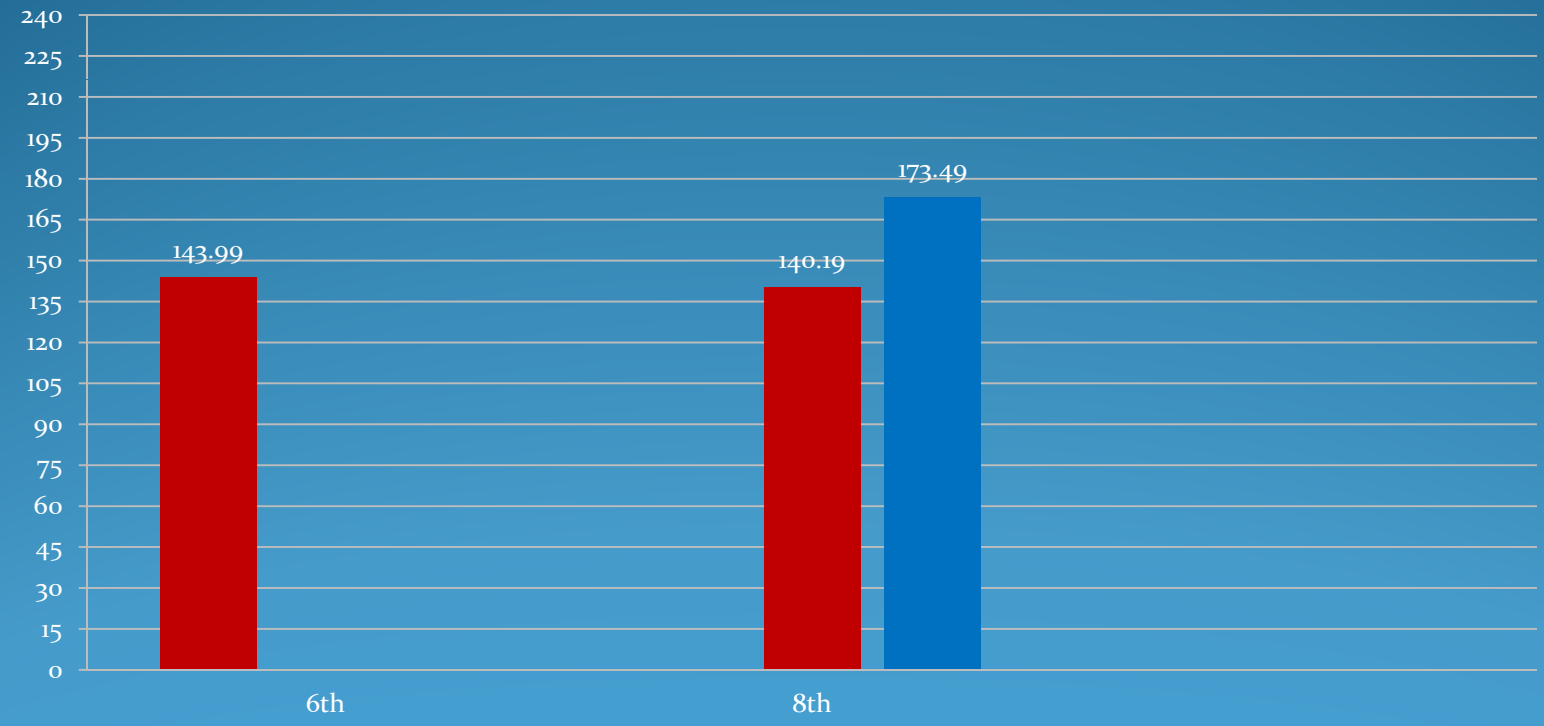
Maryland Schools
Grade 6 Environmental Literacy Composite Scores (in Blue) Compared to Grade 6 and 8 Phase I Results (in Red)



Maryland Grade 7 Environmental Literacy Composite Scores (in Blue) Compared to Phase I Results (in Red)



Maryland Grade 8
Environmental Literacy Composite Scores
(in Blue)
Compared to Phase I Results
(in Red)



Results

- In the Phase II purposeful sample, more classrooms and schools scored above the Phase I mean than below.
- Schools nominated in Phase II, with environmental education programming, indicate significantly higher levels of environmental literacy on the variables of ecological knowledge, verbal commitment, environmental sensitivity, and actual commitment (behaviors), than their counterparts from the random sample.

Results

- Older students out-scored younger students on variables focused on ecological knowledge and skills, as might be expected due to developmental differences.
- Younger students achieved higher scores than older students on variables associated with verbal commitment, environmental sensitivity, feelings and behavior.

Results

- In comparing Phase I to Phase II, the weakest dimension of environmental literacy is related to the cognitive skills component (issue identification, issue analysis and action-planning). It appears critical for EE programs to place more emphasis on cognitive skills.

- The environmental behavior component exhibited the largest effect sizes for both 6th and 8th grade cohorts. This growth in Phase II is substantial and encouraging.

Phase One and Two Reports

- The NELA Phase 1 Report URL is: http://www.oesd.noaa.gov/pubs_reports/Final_NELA%20minus%20MSELS_8-12-08.pdf
- The NELA Phase 2 Report URL is: http://www.oesd.noaa.gov/pubs_reports/NELA_Phase_Two_Report_020711.pdf

Phase Three

The goal of Phase Three is to identify and understand the interaction of the school-related variables that lead to and favor the development of environmentally literate young adolescents (school children between the ages of 12-14).

- Further analysis of the relationship of MSELS data gathered during Phase I and Phase II to data from:
  - School Information Form
  - Program Information Form
  - Teacher Information Form

Phase Four

As an extension of results, case study research will be undertaken in selected schools to identify and explore factors that appear to be successful in promoting environmental literacy.

An in-depth and exploratory study of high performing schools identified in the two initial phases of NELA is being planned.

Questions and Discussion

- Bill McBeth mcbeth@uwplatt.edu

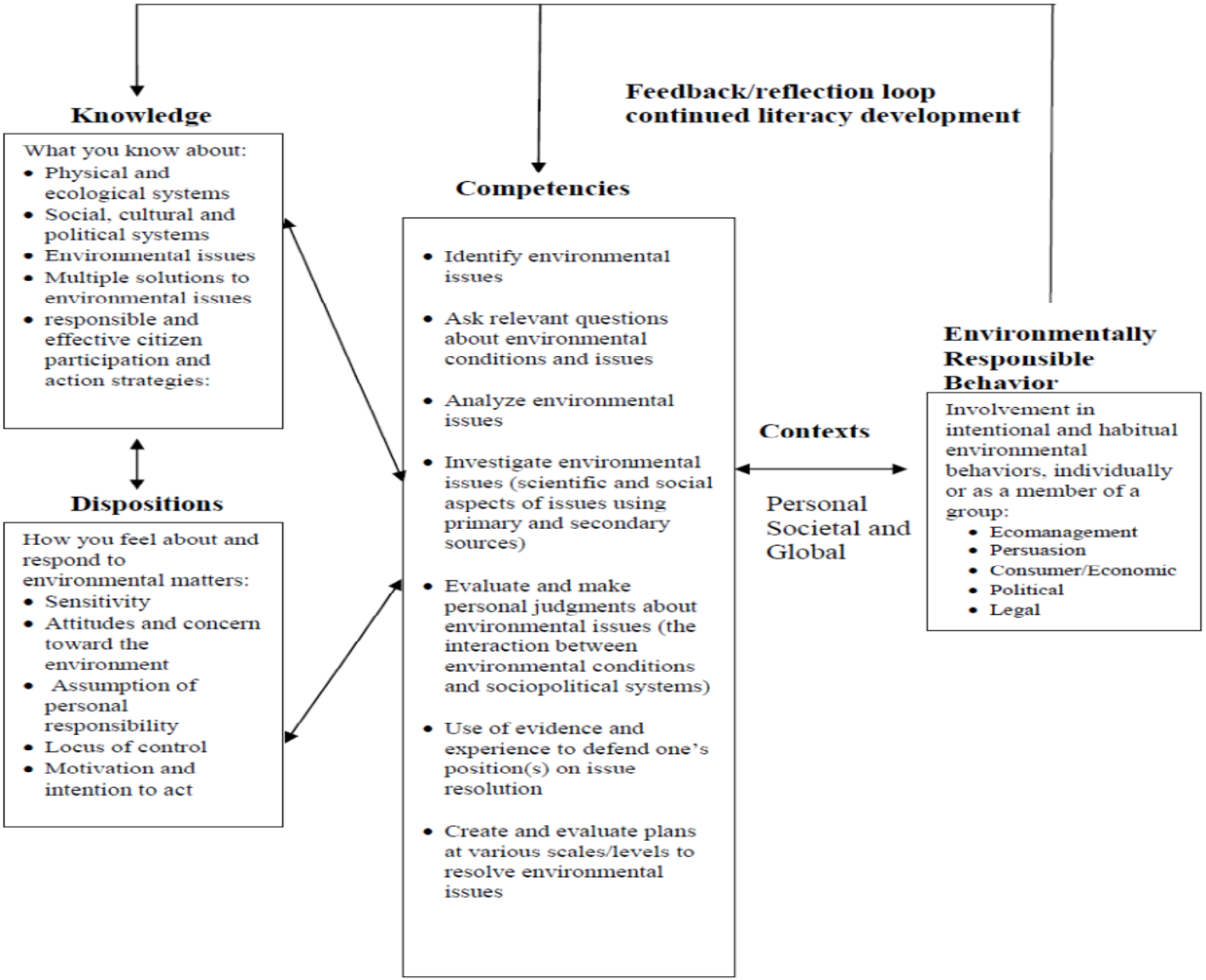


Figure 1. A Proposed Framework for the Domain of Environmental Literacy

Environmental Literacy Framework release:

Thursday, December 1, 2011, 1:00 - 2:00 p.m. Eastern Time

To register for this important event, visit: www.naaee.net/framework