The WEB Project, 2000

Evaluation: Impact on Student Performance

Prepared by:

Lorraine Sherry
RMC Research Corporation
1512 Larimer Street, Suite 540
Denver, Colorado 80202

Survey Results Showing Impact on Students

This section provides results of student surveys that measured students' perceptions of their own learning. It also presents teacher perceptions of student behaviors, as reported in the online survey over the past thee years. These data were triangulated with classroom observations, teacher interviews, student interviews, and focus groups that were conducted during the spring 2000 site visits to the participating schools. Data are consistent and show positive trends.

Respondent Characteristics

In January 2000, the student survey was administered to 165 students in nine schools that were participating in The WEB Project. One hundred thirty-seven of these surveys were from students who had not yet been exposed to the intervention, and whose responses could therefore be used as a pre-test. Thirteen teachers participated in the survey; two of these teachers co-taught a single class.

In May 2000, at the end of the spring term, the survey was re-administered as a post-test to the same sample of students. One hundred sixty-nine completed post-test surveys were returned by all nine schools by August 2000. The distribution of post-test respondents is presented in Exhibit III-15.

Exhibit III-15
NUMBER OF POST-TEST RESPONDENTS PER SCHOOL
N = 169

School	Number of Students Reporting
Brattleboro (BUHS)	29
Cabot	41
Edmunds	16
Lamoille	11
Montpelier	13
North Country High School (NCUHS)	22
Proctor	16
Walden	9
Whitingham	12

Exhibit III-16 shows the distribution of grade level, as reported by students, by school. Gender was about equally distributed within the sample. Of the 160 students who reported their gender, 86 (54%) were males and 74 (46%) were females. There were 127 students (75%) in high school (grades 9-12) and 42 students (25%) in middle school (grades 5-8).

Exhibit III-16
GRADE LEVEL DISTRIBUTION OF RESPONSES
N = 159

School	**Grade Levels**						
	5-6	7	8	9	10	11	12
Brattleboro (BUHS)				3	9	10	4
Cabot			17		18	5	1
Edmunds		8	7				
Lamoille					1	9	
Montpelier				2	4	1	3
North Country High School (NCUHS)				5	1	8	8
Proctor					4	11	1
Walden	9						
Whitingham				1	2	3	4
Totals	9	8	24	11	39	47	21

Attitudes Toward School

Using a 5-point combined Likert and semantic differential scale, students were asked six questions relating to their attitudes toward school. The results, reported in Exhibit III-17, indicate that students generally felt somewhat positively about school at the end of the 1999-2000 academic year.

Exhibit III-17
ATTITUDES TOWARD SCHOOL
AVERAGE SCORE ON A FIVE POINT SEMANTIC DIFFERENTIAL SCALE

Attitude	**Mean Value***	**S. D.**
Very interesting vs. not interesting at all (N=168)	3.43	.98
Fun vs. not fun at all (N=167)	3.40	1.09
Stimulating vs. not stimulating at all (N=166)	3.33	1.02
Easy vs. hard (N=166)	3.33	.89
Worthwhile vs. not worthwhile at all (N=167)	3.81	1.09
Something I like vs. something I do not like at all (N=167)	3.47	1.07

* Higher scores are indicative of more positive attitudes toward school.

Progress Toward Meeting TICG Goals

In keeping with the intent of the Technology Innovation Challenge Grants, The WEB Project's activities focused on attaining three important results:

- Increasing equitable access to technology throughout its dispersed, primarily rural, cooperating schools;

- Infusing technology into the academic content areas to support standards-based instruction, rather than simply acquiring proficiency with computer applications or building basic skills; and
- Increasing student achievement.

TICG Goal 1: Increased and Equitable Technology Access and Use

Students were asked a number of questions about access to computers and the Internet. Exhibit III-18 shows the percentages of students who have access to e-mail at home, at school, or elsewhere such as libraries or homes of relatives and friends. About three-quarters of the students have access from home and school. This is higher than the national average of 30.3% for rural homes with two parents (US Department of Commerce, 1999). *This Exhibit also shows that The WEB Project is promoting opportunities for students to learn by giving nearly 4% of the students access at school that they would not have at home.*

Exhibit III-18 also shows the percentages of students who have access to the Internet at home, at school, or elsewhere such as libraries or homes of relatives and friends. Nearly three-quarters of the students have home access, and nearly all have access from school. This percentage is about three times the national average of 23.9% for rural homes with two parents (US Department of Commerce, 1999). *This also shows that The WEB Project is promoting more opportunity for students to participate in Internet-based activities by giving nearly 20% of the students access at school that they would not have at home.*

Exhibit III-18
STUDENT ACCESS TO E-MAIL AND THE INTERNET

Place of Access	N	Percentage of Students with E-mail Access	N	Percentage of Students with Internet Access
Home	164	72.6%	160	73.8%
School	160	76.3%	161	91.9%
Elsewhere	144	50.7%	135	58.5%

Students were asked how often they used e-mail and the Internet. Exhibit III-19 shows that more than half of the students (59.7%) used e-mail daily or weekly. Exhibit III-19 also shows that over three-quarters of the students used the Internet daily or weekly, and about 95% of students used the Internet at least once per month.

Exhibit III-19
FREQUENCY OF STUDENT E-MAIL USE

Frequency of Use	E-Mail Use: Percentage of Students (N=161)	Internet Use: Percentage of Students (N=164)
Daily	40.4%	49.4%
Weekly	19.3%	28.0%
Monthly	23.0%	17.7%
Less than that	17.4%	4.9%

Access to technology does not necessarily equate with availability. For example, there may be a computer with Internet access in the school library, but it may be difficult for language arts students to use it to post/retrieve messages from *Taking A Stand* if that computer is used primarily for research by other students. Ninety-eight percent of the students who responded to the survey reported that it was relatively easy to access the Internet, with 79.4% of the students reporting that it was "easy" to get on, or that they only had to wait a short time to get on (19.4%).

Prior Experience with Technology

It was important to assess participating students' prior experience with multimedia and online discussions because students who were taking the pre-test survey prior to the intervention (i.e., WEB Project-related activities infused into an academic subject area during the spring 2000 term) might not necessarily be starting out with no technology knowledge and skills.

About half of the 165 students (52.1%) who answered the question about prior experience with multimedia or about online discussions indicated that they had used multimedia for at least one year. The distribution of prior experience is shown in Exhibit III-20. This is not surprising, since students in the cooperating schools have been participating in The WEB Project-related activities for two to five years.

Exhibit III-20
PRIOR EXPERIENCE WITH MULTIMEDIA OR ONLINE DISCUSSIONS
N = 81

Prior Experience with Multimedia or Online Discussions	Valid Percentage of Responses
One year	39.5%
Two years	25.9%
More than two years	34.6%

These data, taken together, support the conclusion that The WEB Project is providing e-mail and Internet access to students who would not ordinarily have it at home.

TICG Goal 2: Academic Uses of The WEB Project Computers

The use of technology within The WEB Project activities was dispersed fairly evenly throughout six academic content areas, as shown in Exhibit III-21.

Exhibit 21
ACADEMIC CONTENT AREAS
N = 156

Class Area	Valid Percentage of Responses
Integrated Curriculum (Interdisciplinary)	16.7%
Art	20.5%
Music	16.7%
Technology	18.6%
English/Language Arts	17.3%
History/Social Studies	10.3%

Students were asked when they created art, music, or multimedia products for their classes, whether they tended to work on them as individual or group projects. Most of the respondents reported that they worked on individual projects (68%) rather than in group projects (27%). *These data, along with those collected for qualitative analyses, show that The WEB Project infused technology into the academic content areas to support standards based reform.*

TICG Goal 3: Improvement in Student Achievement

The overarching goal of The WEB Project is to improve student performance. To document improvement in student performance over time, specifically regarding skills that are honed by participating in The WEB Project activities, three analyses are presented:

- Results from the student surveys;
- Teacher perceptions reported in the online survey; and
- Results of the scoring of the Student Learning Process Assessment and the Student Product Assessment.

The correlations between motivation, metacognitive skills, learning processes, and student performance using an expanded version of Sternberg's (1998) *Developing Expertise* model are also presented as a way to explain some of the patterns found in the data.

Improvement Over Time

Students were asked to identify their skill level along ten dimensions before and after participation on a five point Likert-type scale (1 = "could not do it;" 5 = "expert, the best!"). A multivariate analysis of variance (MANOVA) was performed, along with follow-up F-tests to determine significance levels. Exhibit III-22 presents the students' perceived skill improvement over time. Higher mean scores indicate student perception of higher skill level. There were statistically significant differences ($p < .05$) between the before and after skill levels for all skill items.

Exhibit III-22
PERCEIVED SKILL IMPROVEMENT OVER TIME
N = 169

Skill	Before	Now	F*	df	p**	Eta***
a. Create a multimedia project	2.76	3.60	108.6	1,138	.000	.663
b. Use a video camera	3.25	3.79	44.44	1,140	.000	.491
c. Send and receive e-mail	3.79	4.09	15.50	1,147	.000	.308
d. Search for info on the WWW	3.89	4.17	12.72	1,150	.000	.279
e. Create or edit a WWW site	2.16	3.21	64.98	1,129	.000	.579
f. Send and receive files over the Internet	2.94	3.52	38.75	1,144	.000	.460
g. Compose music electronically	2.36	3.23	46.79	1,134	.000	.508
h. Create or edit digital art	2.50	3.53	93.15	1,134	.000	.640
i. Scan materials	2.79	3.85	92.09	1,137	.000	.634
j. Participate in online discussions	2.98	3.61	53.59	1,122	.000	.552

* Test for statistical significance
** Statistical significance level
*** Correlation coefficient-based effect size
Note: Cohen (1988) considers an effect size of 0.1 to be small, 0.3 to be moderate, and 0.5 to be large.

Clearly, The WEB Project resulted in students acquiring a range of specific technology skills. The smallest differences were in students' capabilities in using the World Wide Web. Many students already had this skill. The largest differences were in creating multimedia projects, in creating or editing digital art, and in scanning materials.

Use of Telecommunications and The WEB Exchange

The WEB Exchange is an online resource where art and music students can post works in progress; receive constructive feedback from teachers, experts, and mentors; and revise their work accordingly. Additionally, the Vermont Center for the Book supports student telecommunications that address literacy, focusing on the *Taking A Stand* discussions.

Students were asked how often they used e-mail or The WEB Exchange for three types of activities:

- Communicating with experts;
- Asking for feedback on assignments; and
- Receiving feedback on assignments.

Exhibit III-23 shows that about half of the students (48%) who completed the surveys participated in online communications.

Exhibit III-23
FREQUENCY OF USE OF E-MAIL AND/OR THE WEB EXCHANGE

Activity	Daily	2-3 times a week	A few times a month	Less than that
Communicate with experts outside of your school (N=81)	4.9%	12.3%	37.0%	45.7%
Ask for feedback on your assignments from experts, teachers, or other students (N=80)	7.5%	8.8%	41.3%	42.5%
Receive feedback on your assignments from others (N=80)	3.8%	13.8%	37.5%	45.0%

Revision of Student Products

Exhibit III-24 presents the frequency of revisions for the 144 students who reported revising and refining their final products. About 95% of the students posted products and revised them at least once. Most students posted multiple times. However, based on the messages in The WEB Exchange threads, it is clear that many of the revised products were never posted.

Exhibit III-24
FREQUENCY OF STUDENT PRODUCT REVISION
N = 144

Frequency of Revisions	Percentage of Students Who Posted Products
Never	4.9%
Once	18.1%
Twice	32.6%
More than twice	42.4%

Student Perception of "Fun"

Students were asked how much fun they had in their WEB Project-related class. There were three levels: "super," "OK," and "not much." More than half of the 155 students who answered the question reported that it was "super." Less than 5% said "not much." The student responses are presented in Exhibit III-25. These findings demonstrate that students were enjoying the class. This implies that using technology in the creative endeavors fostered by The WEB Project was motivating for the students.

Exhibit III-25
STUDENT PERCEPTION OF "FUN"
N = 155

Overall, how much fun did you have in this class?	Valid Percentage of Responses
Super!	52.3%
O.K.	43.2%
Not much	4.5%

Learning New Skills

Using a Likert scale, students were asked the degree to which they believed they acquired new skills as a result of participation in The WEB Project-related activities. Exhibit III-26 presents the relative percentages of student responses to these questions. In each case, more than three-quarters of the students either agreed or strongly agreed that they were learning new skills, were given more approaches to be creative, were better able to communicate, and were better able to visualize ideas.

Exhibit III-26
STUDENTS' PERCEPTIONS OF DEGREE OF LEARNING NEW SKILLS

New Skill	Strongly Agree	Agree	Disagree	Strongly Disagree
I am learning skills that will be useful in the future. (N=163)	47.2%	44.8%	4.9%	3.1%
I am learning skills that I can use for other creative activities. (N=161)	38.5%	55.3%	4.3%	1.9%
I have more opportunities to be creative. (N=162)	36.4%	51.2%	9.9%	2.5%
I am better able to communicate my ideas to others. (N=156)	22.4%	69.9%	6.4%	1.3%
I am better able to picture in my mind ideas and concepts taught in this class. (N=158)	20.9%	62.7%	13.9%	2.5%

Transfer of Skills

Students were asked whether they were able to use what they learned with technology either in another class or outside of school. Most of the 144 students who answered this question (82.3%) reported that they used their newly acquired skills outside of class. This was affirmed in the interviews and focus groups in which students reported that they produced multimedia reports or reports with digital graphics for other core courses, were members of multimedia clubs, participated in multimedia festivals, and/or used their skills for job-related activities or portfolios for entrance to college.

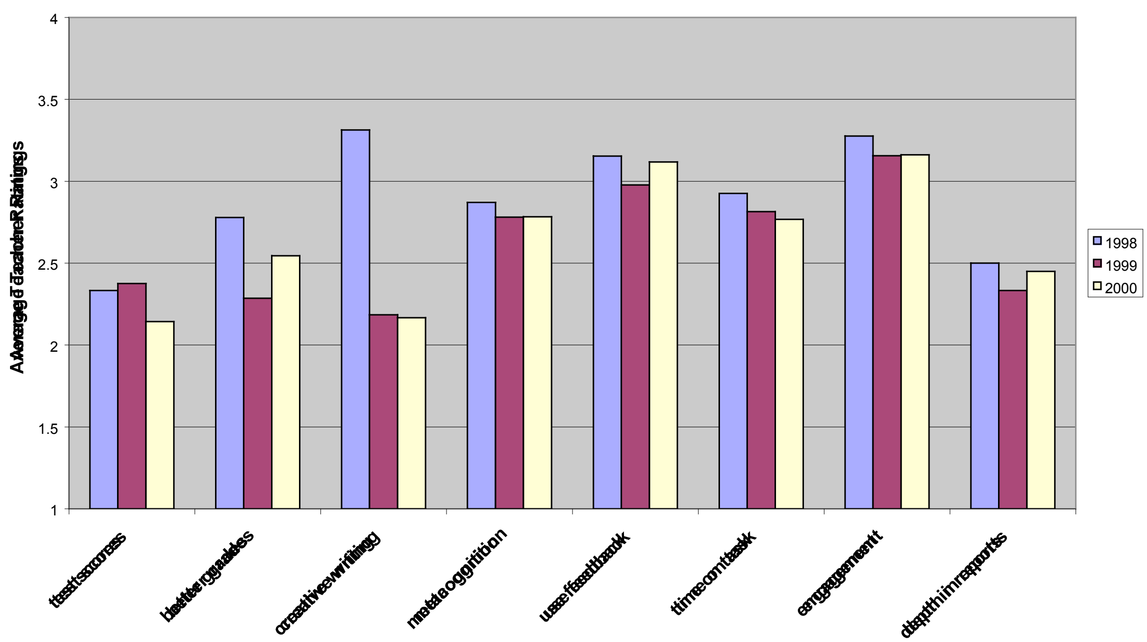
Teacher and Administrator Perceptions of Student Behaviors

Online Survey Results

In the online surveys that were administered in the spring of 1998, 1999, and 2000, teachers, administrators, and mentors were queried about the impact of The WEB Project as a whole on student performance. Eight indicators of student performance were listed, and their degree of influence was measured using a four-point scale ("1" = not at all; "2" = slight; "3" = moderate; and "4" = a lot).

Teachers responded to the questions about the eight indicators via online survey. Useable response rates ranged from 6 to 29 in 1998, from 8 to 43 in 1999, and from 7 to 49 in 2000, depending on the question asked. In all three years, the preponderance of responses came from teachers at the participating schools. The results of the analysis of the four-point scale described are displayed in Exhibit III-27.

Exhibit III-27
TEACHER PERCEPTIONS OF STUDENT BEHAVIORS



The survey shows that teachers thought that the greatest impact was on creative writing in the first year, followed by student engagement, use of feedback, time on task, and metacognition across years. For these indicators, teachers said that The WEB Project had a moderate to slight impact on student behaviors.

The pattern of results for three of the eight subscales over the three-year period during which teachers observed and reported these effects indicated that the effect was higher at first, then lower, and then tended to rise again. Often, when new technology is introduced, there is a learning curve that lowers performance before the desired student skills begin to increase again. In essence, respondents feel confident, in their knowledge and skills, then discover what they do not know and feel less confident, then learn the skills, feeling competent again. Moreover, in The WEB Project, teachers and students are co-learners; in other words, teachers need to learn what behaviors to identify and observe and often need to learn along with their students..

From an analysis of the online survey responses over the three-year period, it also became apparent that teachers were seeing improvements in student behaviors in a time sequence. They tended to observe increases in *student engagement* and *time on task* early in this sequence. These behaviors may be interpreted as indications of student motivation. Teachers observed *use of constructive feedback* and increased *metacognitive skills* early in the time sequence. These behaviors may be interpreted as strategic thinking skills. *Depth in reports* emerged still later in the time sequence. This is an outcome of higher order thinking skills. Finally, most teachers thought it was "too early to tell" about improvements in *student grades* and *test scores*. These are traditional learning results that are more easily measured, but that do not necessarily capture the value that technology adds to the learning process.

Based on these responses to the online survey, a connection between student motivation, metacognition, and learning processes that was reminiscent of Sternberg's (1998) *Developing Expertise* model was discovered. This framework became an interpretative guide for additional exploratory analyses of teacher and student reported data.

Relationship Between Processes and Student Outcomes

Motivation

According to Sternberg (1998), motivation drives metacognition, which, in turn, stimulates the development of thinking and learning skills. Thinking and learning skill development further stimulates metacognition, resulting in the development of expertise. Thus, it was important to measure students' self-reported levels of motivation, both in their WEB Project-related class and in school in general, in order to carry out structural equation modeling later on, using the Sternberg model as a theoretical framework.

Ten items related to student motivation "in this class" and "in school in general" were identified. Students were asked to rate how they felt about their WEB Project-related class on a five point Likert-type scale (1 = "strongly disagree;" 5 = "strongly agree"). A factor analysis was performed on the ten pre-test items, which resulted in two distinct factors. The seven items in the first factor were used as a scale for further analysis, and the remaining three items were dropped. Internal consistency reliability for all seven items in the motivation scale was high (see Exhibit III-28). The post-test results are presented in Exhibits III-29 and III-30.

Exhibit III-28
PRE-TEST/POST-TEST INTERNAL CONSISTENCY RELIABILITY FOR SCALES USED IN EXPLORATORY ANALYSES (COEFFICIENT ALPHA)

Scale	Pre-Test		Post-Test	
	N	Alpha	N	Alpha
Motivation "in school in general"	103	.8339	158	.8594
Motivation "in this class"	97	.8177	157	.8095
Metacognition	103	.8725	157	.8934
Inquiry Learning	102	.8006	165	.7480
Application of Skills	100	.6962	162	.6147

Exhibit III-29
STUDENT MOTIVATION "IN THIS CLASS"

Motivation Item	Mean Value*	Stdev
I have initiative. (N=155)	3.67	.83
When I take on new responsibilities, I follow through and complete them. (N=158)	3.72	.73
I believe I am intelligent. (N=158)	3.84	.87
I try to do my best. (N=159)	3.96	.78
I work hard. (N=157)	3.89	.81
I have confidence in myself. (N=159)	3.84	.75
I am satisfied with who I am. (N=158)	4.06	.85

* Average scores are on a five-point scale. Higher values indicate greater motivation.

Exhibit III-30
STUDENT MOTIVATION "IN SCHOOL IN GENERAL"

Motivation Item	Mean Value*	Stdev
I have initiative. (N=155)	3.40	.85
When I take on new responsibilities, I follow through and complete them. (N=158)	3.56	.77
I believe I am intelligent. (N=158)	3.77	.84
I try to do my best. (N=159)	3.77	.84
I work hard. (N=157)	3.73	.92
I have confidence in myself. (N=159)	3.81	.78
I am satisfied with who I am. (N=158)	4.00	.84

* Average scores are on a five-point scale. Higher values indicate greater motivation.

The results for the classroom and school were compared. A paired-samples t-tests were conducted on the seven-item motivation scales. The pre-test and post-test mean values for items addressing initiative, responsibility, effort, and hard work were significantly different. This indicates that students tend to be more engaged in The WEB Project classes than they are in other school activities. Results of the paired-samples t-test are presented in Exhibit III-31.

Exhibit III-31
RESULTS OF PAIRED SAMPLES t-TEST FOR MOTIVATION SCALES

Subscale	t-Value	df	2-tailed Significance*
I have initiative.	4.054	154	.000
When I take on new responsibilities, I follow through and complete them.	2.867	157	.005
I believe I am intelligent.	1.294	157	.198
I try to do my best.	2.961	158	.004
I work hard.	2.211	156	.028
I have confidence in myself.	.610	158	.543
I am satisfied with who I am.	1.039	157	.300

*Statistical significance level ($p<.05$)

Metacognition

Reviewing the research literature, eight metacognitive skills were identified as being relevant for students who used technology in their work with art, music, multimedia, or online discussions. These are listed in Exhibit III-32. Students were asked how often they used metacognitive skills, as measured by the subscale, as they used technology to support their activities in art, music, multimedia, and online in their WEB Project-related activities. There were four levels: "1" = never; "2" = seldom; "3" = often; and "4" = a lot. Internal consistency reliability for all eight items was high (see Exhibit III-28).

Exhibit III-32
METACOGNITIVE SKILLS RELATED TO THE WEB PROJECT

Metacognitive Skill	Mean Value*	Stdev
Get information from places I can count on (N=169)	2.75	.83
Try different ways to solve a problem (N=167)	2.25	.96
Get reasons for my answers (N=158)	2.31	.94
Make sure my answers are right (N=167)	2.33	.93
Find Patterns (N=165)	2.05	.90
Make Connections (N=166)	2.37	.94
Make a sketch or picture to show a problem or idea (N=167)	2.19	1.05
Change or improve my idea or product (N=167)	2.65	.95

* Average scores are on a four-point scale. Higher values indicate greater use of Metacognitive Skills.

Three other scales were also derived from the student survey data. Metacognition was measured using eight items. Learning processes consisted of two distinct factors – inquiry learning (4 items) and application of skills (6 items). These two scales were derived from the ten items in survey question 7. Internal consistency reliability for all of these scales was fairly high and remained relatively stable between the pre-test and the post-test.

Learning Processes

These data show that students recognize that they engage in some metacognitive skills, particularly changing/improving ideas and products and retrieving information. The large range in responses is related to the type of WEB Project activity in which the students engaged. For example, students in the arts and music programs were expected to post products, receive feedback, and revise. This was an occasional occurrence as product creation warranted, so the responses most likely reflect the reality of The WEB Project experience.

Students were asked how often they used technology for a list of 10 common technology – related activities, using a 4 point scale with "1" =never; "2" =seldom; "3" = often; and "4" = a lot. These activities were grouped into two factors that were named *application of skills* and *inquiry learning*. Internal consistency reliabilities were fairly high for both scales (see Exhibit III-28). The items that make up these two subscales are shown in Exhibits III-33 and III-34. They are indicative of learning processes.

Exhibit III-33
APPLICATION OF SKILLS RELATED TO THE WEB PROJECT

Application of Skills	Mean Value*	Stdev
Design graphics (N=167)	2.53	1.18
Communicate with others (N=168)	2.91	.95
Take part in simulations (N=166)	1.84	.91
Make models (N=165)	1.77	.97
Build websites (N=167)	1.82	1.05

* Average scores are on a four-point scale. Higher values indicate greater Application of Skills.

Exhibit III-34
INQUIRY LEARNING RELATED TO THE WEB PROJECT

Inquiry Learning	Mean Value*	Stdev
Do research (N=168)	2.79	1.01
Get ideas (N=166)	2.63	.85
Show ideas (N=166)	2.83	.91
Solve problems (N=168)	2.20	.93

* Average scores are on a four-point scale. Higher values indicate greater Inquiry Learning.

These Exhibits show that students most often engage in design and communication functions and in a range of inquiry-based activities. Again, this was related to the nature of The WEB Project activities in which students participated. Fostering online communication was one of the overarching aims of The WEB Project. Conducting research was highly encouraged by interviewed teachers and was an integral part of their curriculum.

"Show ideas" refers to demonstrating student learning. Several teachers in core curriculum areas reported that they gave their students the option of using technology-supported presentations for their final projects, rather than the usual oral or written report. They also mentioned that students who created multimedia final projects generally received higher grades than those who demonstrated their learning by more traditional venues.

Learning Results

Student Product Assessment scores were discussed and juried at the Basin Harbor Retreat by experts in the discipline area who developed rubrics through the establishment of anchor products. Products were scored by three raters. Scores that were not deemed reliable were not used in this analysis. Since the rubrics for the individual content areas had different ranges, the raw scores were translated across academic content domains to a scale of "0" (no evidence), "1" (approaches standards), "2" (meets standards), "3" (exceeds standards). One hundred forty-one student products were scored. Exhibit III-35 presents the distribution of Student Product Assessment scores.

Exhibit III-35
DISTRIBUTION OF STUDENT PRODUCT ASSESSMENT SCORES
FOR ALL PARTICIPATING STUDENTS
N = 141

Score on Student Product Assessment Rubric	Percentage of Students
0: No Evidence	0%
1: Approaches standards	29%
2: Meets standards	40%
3: Exceeds standards	31%

Student Learning Process Assessment scores were reported by 143 of the participating teachers. The rubric has a range of 1 (little revision) to 4 (very detailed and important revisions). Results are reported across the project in Exhibit III-36.

Exhibit III-36
DISTRIBUTION OF STUDENT LEARNING PROCESS ASSESSMENT SCORES
FOR ALL PARTICIPATING STUDENTS
N = 143

Score on Student Learning Process Assessment Rubric	Percentage of Students
1: Makes few, if any, attempts at revision	6%
2: Revises, but addresses only the most obvious difficulties	28%
3: Revises in ways that serve the purpose of the product	28%
4: Revisions are likely to produce a high quality product	38%

Exhibit III-37 presents the mean values and standard deviations for the scores for those students who had not been exposed to the intervention as of January 2000, and which were used in the exploratory analysis.

Exhibit III-37
TEACHER-REPORTED SCORES OF STUDENT ACHIEVEMENT

Measure	Mean Value	Stdev
Student Product Assessment (N=91)	1.978	.760
Student Learning Process Assessment (N=107)	2.785	.906

Across the project, students nearly met the standards for the Student Product Assessment. Students also nearly met level 3 of the Student Learning Process Assessment, namely, "Revises the process or product in ways that serve the purpose of the process or product."

To see whether improvement occurred and was sustained over time, 76 valid data sets were matched, and a true repeated measures paired sample t-test methodology (pre-test vs. post-test) was conducted. A 2-tailed t-test was used because it was predicted that the mean value of all of these subscales would increase from the pre-test to the post-test. Data were filtered on "midpoint," i.e., only classes that started in January 2000 (no prior intervention) were analyzed.

The results are displayed in Exhibit III-38 for the key subscales of interest. *The only subscale that showed significant improvement over the spring term was application of skills.* Class motivation declined slightly, but this may have been affected by the timing of survey administration since many students are generally less motivated at the end of the school year.

Exhibit III-38
RESULTS OF PAIRED SAMPLES t-TEST FOR PRE/POST TEST SUBSCALES

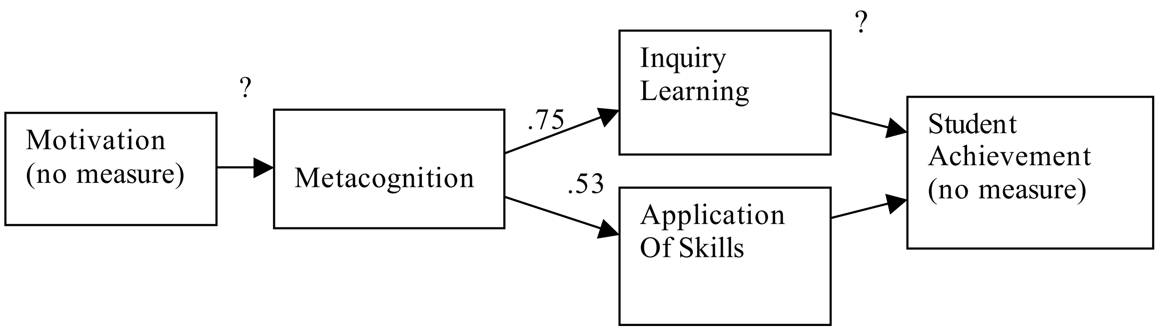
Subscale	Pre-Test Mean Value	Post-Test Mean Value	t-Value	df	2-tailed Significance*
School Motivation	3.783	3.771	.141	66	.444
Class Motivation	4.05	3.925	-1.468	61	-.0735
Metacognition	2.219	2.268	.812	73	.210
Inquiry Learning	2.409	2.463	.791	74	.216
Application of Skills	1.767	1.898	2.172	74	.0165 *

*Statistical significance level (p<.05)

Exploratory Analyses

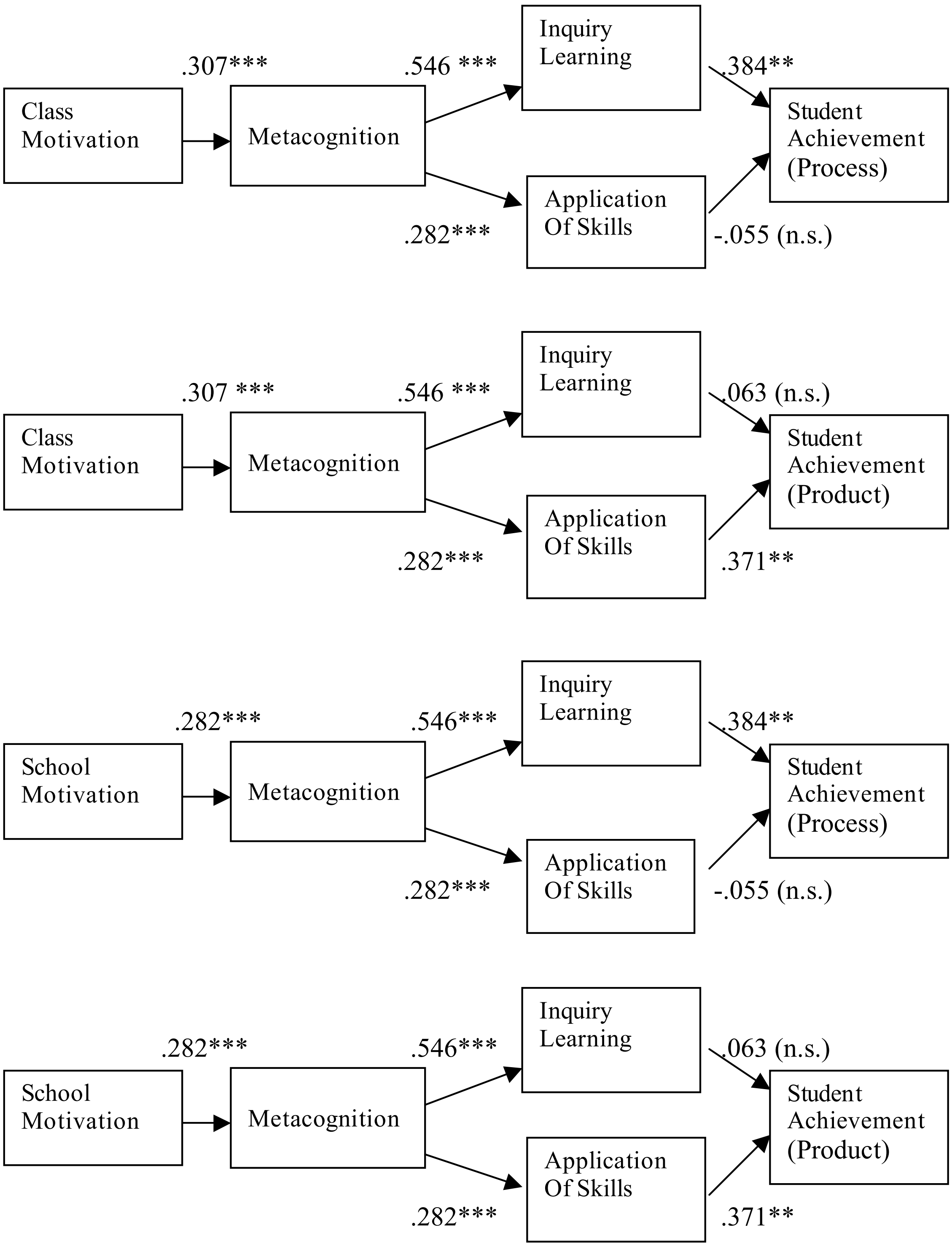
Last year, an initial path analysis of WEB Project data yielded a promising set of hypotheses to explain influences on student outcomes. Exhibit III-39 depicts the model that was used for the path analysis. The values for the arrows connecting metacognition and inquiry learning, and metacognition and application of skills, represent partial correlations. The 1999 results indicated that metacognition had a moderate to strong ability to predict learning processes (inquiry learning and application of skills). However, at that time there were no measures of motivation on achievement.

Exhibit III-39
INITIAL PATH ANALYSIS RESULTS (MAY 1999)



With the inclusion of the student motivation measures, the Student Learning Process Assessment, and the Student Product Assessment, a more sophisticated model could be derived and tested. Structural equation modeling was used to find the partial correlations between motivation, metacognition, inquiry learning, application of skills, the Student Learning Process Assessment, and the Student Product Assessment. The results are presented in Exhibit III-40.

Exhibit III-40
SIMPLIFIED PATH ANALYSIS SHOWING INFLUENCES ON STUDENT ACHIEVEMENT



*<.05
**<.01
***<.001

(n.s.) not significant

The results of the intermediate analyses that produced the correlations presented in Exhibit III-40 [the previous exhibit] are presented in Exhibits III-41 through III-43.

Exhibit III-41
REGRESSION ANALYSIS: MOTIVATION -> METACOGNITION

Dependent Variable	R	F	df	2-tailed Significance*
Motivation in this class	.307	16.539	1,159	.000
Motivation in school in general	.282	13,698	1,157	.000

* Statistical significance level (p<.05)

Exhibit III-42
ANOVA: METACOGNITION -> LEARNING PROCESSES

Dependent Variable	Beta*	t-value	2-tailed Significance**
Inquiry Learning	.546	8.362	.000
Application of Skills	.282	4.313	.000

* Standardized correlation coefficient
** Statistical significance level (p<.05)

Exhibit III-43
REGRESSION ANALYSIS: LEARNING PROCESSES -> LEARNING OUTCOMES

Independent Variable	Dependent Variable	Beta*	t-value	2-tailed Significance**
Inquiry Learning	Process Assessment	.384	3.295	.001
Application of Skills	Process Assessment	-.055	-.473	.637
Inquiry Learning	Product Assessment	.063	.504	.615
Application of Skills	Product Assessment	.371	2.986	.004

* Standardized correlation coefficient
** Statistical significance level (p<.05)

Four separate simplified path analysis models were tested. The first pair addressed progress and product outcomes for classroom motivation, and the second pair addressed school motivation. Motivation is related to metacognition. The relationship between class motivation and metacognition was slightly stronger than the relationship between school motivation and cognition.

The relationship between metacognition and inquiry learning was stronger than the relationship between metacognition and application of skills. Also, the relationship between inquiry learning and the student achievement process outcome was stronger than the relationship between application of skills and the student achievement process outcome. Finally, the relationship between application of skills and the student achievement product outcome was stronger than the relationship between inquiry learning and the student achievement product outcome.

Based on the significant correlations of the teacher measurements of student achievement with the student survey data, these data validated the *Developing Expertise* model, to explain increases in student performance as a result of engaging in WEB Project-related activities.

Discussion

The *Secretary's Conference on Educational Technology 2000* focused on several important issues regarding student achievement. In particular, questions such as "What added value does technology bring to schools?" and "What assessment strategies and designs are currently being used to capture the added value that technology brings to schools?" The President's Committee of Advisors on Science and Technology (1997) listed three goals for student outcomes:

- Richer, deeper content, mastered earlier in the curriculum;
- Attainment of higher-order cognitive, affective, and psychosocial skills; and
- Success for all students.

Rockman (1998: 3) suggests that "A clear assessment strategy that goes beyond standardized tests enables school leaders, policy makers, and the community to understand the impact of technology on teaching and learning." Using a research-based framework such as the Sternberg model to organize and interpret the variety of student self-perceptions, teacher observations of student behaviors, and juried scoring of student products using teacher-created rubrics, captures the overlapping kinds of expertise that students are developing in their WEB Project-related activities.

These preliminary findings suggest that teachers should emphasize the use of metacognitive skills, application of skills, and inquiry learning as they infuse technology into their academic content areas. This is directly in line with the Vermont Reasoning and Problem Solving Standards.

The findings also indicate a lack of impact on traditional measures of student achievement. However, as Dede (1998: 4) stated, "To succeed in technology-based educational reform, state policy makers must prepare communities for the fact that test scores will not instantly rise and that other, complementary types of improvements in student outcomes less easy to report quantitatively are better short-range measures of success."

In the final three years of the project, the teacher responses regarding time on task and greater engagement signaled greater motivation among students, especially because students reported spending many hours learning and applying new skills. For the most part, student interviews and focus groups showed this was done willingly and not because of the demands of the instructor. The technology itself motivated them. Moderately high rankings for metacognitive skills such as “get information from places I can count on” and “change or improve my idea or product” indicate that students were evaluating the quality of the information they find on the Internet, The WEB Exchange, and other primary sources. They are also reformulating strategies to improve their work. *Moreover, the fact that nearly all students across the project met the standards for both the teacher-created product assessment and the learning process assessment indicates that, in general, the project did have a positive impact on student achievement.*