August 2005

VisTE Final Evaluation Report

Prepared for

VisTE Project
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*RTI International is a trade name of Research Triangle Institute.

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Introduction

VisTE is a National Science Foundation funded project that promotes technological literacy by attempting to link to the Standards for Technological Literacy (STL) through the study of visualization, science, and technology. Over a 3-year period, the VisTE project team has developed and piloted 12 units for technology education in grades 8 to 12. During the 2002–2003 school year, six VisTE teachers pilot tested the first four VisTE units. During the 2003–2004 school year, seven teachers were asked to pilot test the second four VisTE units and some teachers re-taught some of the first four VisTE units. During the 2004–2005 school year, the seven pilot teachers pilot tested all or a subset of the last four units. The purpose of this report is to provide a process and outcome evaluation for the last four VisTE units.

The data used in this report were drawn from several sources. Students' content knowledge and conceptual understanding were measured using multiple choice quizzes taken at the beginning and the end of each unit. Students' beliefs about their own abilities in learning technology, math, and science, and their attitudes toward technology in general and toward the specific type of technology taught in each unit were measured using surveys that students completed before and after each unit. Data were gathered from teachers through teacher logs. While teaching the VisTE units, teachers were asked to fill in a unit completion log for each unit they taught (see Appendix A for an example of the logs). Through the logs, teachers reported on several different topics, including their reaction to the unit, their students' reactions to the unit, aspects of the unit they liked, and aspects they did not like.[1] We collected data from the VisTE Advisory Board on the degree to which the VisTE units address each of the STL they were designed to address (the STL were created by the International Technology Education Association [ITEA]).

One caveat to this report is that this is a quasi-experimental design. Our quantitative analyses are based on a "pre-post" test design (i.e., data collected before and after an intervention). Because we do not have a group of students who were randomly assigned to a control group, we have to acknowledge the possibility that any change or lack of change in the data may have been caused by some unknown, unmeasured factor.

Section 2 contains demographic data on the participating students. ***Section 3*** addresses changes in students' knowledge of technology while participating in VisTE. ***Section 4*** discusses students' attitudes toward technology. ***Section 5*** discusses the impact of participation of VisTE on teachers and teachers' views on the VisTE units. ***Section 6*** discusses whether the process of developing and pilot testing the VisTE units is effective and efficient.

[1]Due to the fact that logs for some units were only completed by one or two teachers, where appropriate, responses to questions on the teacher logs were collapsed across the units.

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Demographic Data

We collected surveys from 271 students. After excluding students who did not have pre- and post-unit data for at least one unit, 199 students remained in the data set. Of these students, 84 percent were male; 60 percent were White, 16 percent were Black, 5 percent were Native American, 6 percent were Asian, 9 percent were Latino, and 5 percent were of multiple ethnicities. Students ranged from 6th to 12th grade; 18 percent were 6th graders, 1 percent were 7th graders, 19 percent were 8th graders, 12 percent were 9th graders, 15 percent were 10th graders, 18 percent were 11th graders, and 18 percent were 12th graders. Geographic locations of students were as follows: 11 percent lived in rural areas, 62 percent lived in suburban areas, and 27 percent lived in urban areas.[2]

Exhibit 2-1 shows student demographic data by unit. The number of students with data for each unit ranges from 28 to 87 students.

[2]The rural, suburban, and urban area classifications were determined for each school by the VisTE project director.

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Exhibit 2-1. Student Demographics by Unit

Unit Name	Number of Students With Pre- and Post-Unit Surveys	Grade	Gender	Race/Ethnicity	Teacher	Geography
Unit 9. Weather	28	9th graders – 6 10th graders – 7 11th graders – 13 12th graders – 2	Girls – 3 Boys – 25	White – 19 Other – 9	Teacher A = 11 Teacher D = 17	Suburban – 17 Urban – 11
Unit 10. Nanotechnology	80	8th graders – 19 9th graders – 9 10th graders – 10 11th graders – 19 12th graders – 23	Girls – 8 Boys – 72	White – 44 Other – 36	Teacher A = 22 Teacher B = 13 Teacher C = 8 Teacher D = 17 Teacher G = 20	Rural – 13 Suburban – 37 Urban – 30
Unit 11. Biometrics	45	7th graders – 1 8th graders – 18 10th graders – 4 11th graders – 7 12th graders – 15	Girls – 8 Boys – 37	White – 25 Other – 20	Teacher A = 9 Teacher B = 9 Teacher C = 8 Teacher G = 19	Rural – 9 Suburban – 19 Urban – 17
Unit 12. Careers & Technology	87	6th graders – 36 9th graders – 13 10th graders – 15 11th graders – 14 12th graders – 9	Girls – 20 Boys – 67	White – 49 Other – 38	Teacher A = 16 Teacher C = 8 Teacher D = 27 Teacher G = 36	Suburban – 63 Urban – 24

Note: Teachers were assigned letters at the beginning of the study. Thus, teachers who taught previous units but did not return surveys or logs for these four units are not shown here.

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Student Content Knowledge and Conceptual Understanding of Technology

The first evaluation question is whether participation in the VisTE program improves students' content knowledge and conceptual understanding of technology, thus improving the likelihood of their meeting the standards in the field. To make this determination, we examined students' test scores and data from the teachers' logs.

3.1 Student Multiple Choice Test Data

We used multiple choice tests that students took before and after each unit to measure their knowledge of the subject area (Weather was tested using 10 items, Nanotechnology was tested using 20 items, Biometrics was tested using 20 items, and Careers & Technology was tested using 16 items). The results show that teaching the VisTE units improved students' knowledge of technology in three of the areas covered by the units: Nanotechnology, Biometrics, and Careers & Technology. There was no change in students' knowledge of the material presented in the Weather unit (see ***Exhibit 3-1***). On the three units where students improved, they increased their scores by 3.1 points in Nanotechnology, 3.2 points in Biometrics, and 2.1 points in Careers & Technology. However, for all three of these units, students' pre- and post-unit test scores were somewhat low, indicating that there is still room for improvement (i.e., on the post-unit test in all three units students answered just under 60 percent of the questions correctly).

Exhibit 3-1. Students' Test Scores on Knowledge of Technology

Unit	Pre-Unit Average Score	Post-Unit Average Score	Paired *t* test	n	Average Test Score Change (Range)
Unit 9. Weather	3.1 (out of 10)	3.3	0.6	28	0.21 (–4 to 4)
Unit 10. Nanotechnology	7.6 (out of 20)	10.7	6.3***	69	3.1 (–7 to 12)
Unit 11. Biometrics	8.6 (out of 20)	11.8	5.3***	42	3.2 (–3 to 17)
Unit 12. Careers & Technology	6.8 (out of 16)	8.9	5.0***	57	2.1 (–5 to 9)

***$p \leq 0.001$.

Where group sample sizes allowed, we conducted analysis of covariance to test for differences in the change scores based on race/ethnicity, gender, and geographic location (rural, suburban, urban) and interactions between these variables. We did not test group differences where any subgroup had fewer than 20 students. The only significant differences were by geographic location. For Nanotechnology, the results showed that suburban and rural students showed a larger increase in scores (average change = 4.4) compared to rural students (average change = .9) (see ***Appendix B***). For Careers & Technology, the results showed that suburban students (average = 2.8) had a higher increase in scores than urban students (average = .8) (see ***Appendix B***). It is important to note that because of the small size of the subgroups and possible confounding factors not included in the model, such as teacher, students' socioeconomic status, and various school level variables, we should be very cautious when interpreting the findings on group differences. For example, because geography is highly confounded with the teacher the student had and the school the student attends, caution must be taken when interpreting these scores as being geography-based rather than influenced by teacher or school characteristics.

3.2 Teacher Log Data

Using logs that the teachers completed after teaching each unit, we asked the teachers how effective using the VisTE units was in enhancing students' understanding of the intended learning goals and objectives. Their response options were "not at all effective," "somewhat effective," and "very effective." All teachers rated the units as somewhat or very effective (see ***Exhibit 3-2***).

Exhibit 3-2. Teachers' Ratings of Effectiveness of VisTE Regarding Enhancing Students' Understanding of Intended Learning Goals

Unit	Number of Teachers Who Taught Unit	Number of Teachers Returning Logs for Unit	Ratings (# of teachers)	Comments
Unit 9: Weather	2	2	Somewhat effective (1) Very effective (1)	
Unit 10: Nanotechnology	5	4	Somewhat effective (1) Very effective (3)	Lack of interest for some students; The students learned a lot; It was easy to teach.
Unit 11: Biometrics	4	3	Somewhat effective (1) Very effective (2)	Not enough student interest; A cool unit.
Unit 12: Careers & Technology	4	4	Very effective (1) (3 teachers had missing data)	I've never done a "career history" approach.

Does Participation in VisTE Improve Students' Attitudes Toward Technology?

4.1 Students' Self-Concept of Ability in Technology, Mathematics, and Science

This section examines the relationship between participation with the VisTE units and students' attitudes. First we looked at whether the VisTE units had any influence on students' self-concept of ability in technology, math, or science; we hypothesized that if students learned technology using a curriculum that presented the material in a logical and applied manner, and were successful with this curriculum, their self-concept of ability might change in technology and related areas. ***Exhibit 4-1*** shows that participation in VisTE was related to a slight increase in students' self-concepts of math ability, but was not related to change students' self-concepts of abilities in technology and science. One possible explanation for lack of a bigger effect is that students' academic self-concepts of ability are formed starting at a young age, and participating in one or more VisTE units is not enough time to allow for a change in one's self-concept. The majority of students (53 percent for technology, 56 percent for math, and 55 percent for science) reported no change in self-concept of ability.

Where there was a significant difference over time in self-concept of one ability (math), we conducted analysis-of-covariance to test for differences in the change scores based on race/ethnicity, gender, and geographic location and the interactions of these variables. There were no significant differences in the amount of change in self-concept of math ability based on these covariates or on any interactions between them, which indicates that participating in VisTE did not differentially influence students' self-concept of ability in math based on gender, race/ethnicity, or geographic location.[3]

Exhibit 4-1. Students' Self-Concept of Ability in Technology, Math, and Science

Attitude toward Unit	Pre-Unit Attitude	Post-Unit Attitude	Paired *t* test	n	Average Test Score Change (Range)
How hard or easy is it for you to learn technology?	3.6	3.5	–0.70	183	0.0 (–3 to 4)
How hard or easy is it for you to learn math?	3.3	3.5	2.39**	181	0.2 (–2 to 4)
How hard or easy is it for you to learn science?	3.5	3.6	1.32	180	0.1 (–3 to 4)

NOTE: Students answered these questions on a scale where 1 = very hard, 2 = hard, 3 = neither hard nor easy, 4 = easy, and 5 = very easy. $^{**}p \leq 0.01$.

[3]The subgroups for these analyses were much larger than the subgroups for any analyses we conducted specific to a certain unit, because these attitude questions appeared on the survey for every unit.

4.2 Students' Attitudes Toward General Technology

In addition to examining self-concept of ability, we also explored the relationship between participation in VisTE and students' attitudes toward general technology (as opposed to toward the specific topics in technology that the VisTE units cover). For these attitudes, ***Exhibit 4-2*** shows either no change in students' attitudes toward general technology or slightly more negative attitudes toward technology after participation in VisTE. For example, after participating in VisTE, students were less likely to want to know more about technology and were less positive about the consequences of technology. One interpretation is that any change in student attitudes, positive or negative, represents an effective result. Attitude change in either direction might show that students were engaged in the material and were considering both the positive and negative effects of technology. However, these differences were very small (–0.2 and –0.3), and while statistically significant may not be meaningful.

For the two attitudes toward technology where there was a significant difference over time, we conducted analysis-of-covariance to test for differences in the change scores based on race/ethnicity, gender, and geographic location and the interactions of these variables. There were no significant differences in the amount of change based on these covariates or on any interactions between them, which indicates that participating in VisTE did not differentially influence students' attitudes toward general technology based on their gender, race/ethnicity, or geographic location.

Exhibit 4-2. Students' Attitudes Toward General Technology

Attitude toward Unit	Pre-Unit Attitude	Post-Unit Attitude	Paired *t* test	n	Average Test Score Change (Range)
I have a good understanding of the ways that technology can be used in the real world.	4.0	3.9	–1.4	182	–0.1 (–3 to 4)
I will probably choose a job in technology.	3.3	3.2	–0.5	180	0.0 (–3 to 4)
You have to be smart to study technology.	2.9	2.9	–0.6	180	0.1 (–4 to 4)
I would like to know more about technology.	4.0	3.8	–2.7**	182	–0.2 (–4 to 4)
Consequences of technology[1]	3.9	3.6	–4.7***	122	–0.3 (–2.8 to 0.8)

**$p \leq 0.01$, ***$p \leq 0.001$.

[1] This scale is from the E.A. Bame and W.E. Dugger, Jr. (October 25, 1989). "Pupils' Attitude Toward Technology PATT-USA, A First Report of Findings." This data set has a standardized alpha of 0.83. It measures the degree to which students believe technology has good consequences (higher score indicates positive consequences). It includes the following items:

- Technology is good for the future of the country.
- Technology makes everything work better.
- Technology is very important in life.
- Everyone needs technology.
- Technology has brought more good things than bad.

NOTE: Students answered these questions on a scale where 1 = disagree, 2 = tend to disagree, 3 = neutral, 4 = tend to agree, and 5 = agree.

4.3 Students' Attitudes Toward the Specific Types of Technology Taught in the VisTE Units

The exhibits in ***Appendix C*** show the examination for attitude changes toward the specific types of technology taught in each VisTE unit. Overall, there was a minimal amount of attitude change between before and after participation in the VisTE units. The statistically significant attitude changes were as follows:

- **Unit 10. Nanotechnology:** There was a statistically significant change, such that students were more likely to agree with the following statement after participating in this unit, "I have a good understanding of the ways in which nanotechnology can be used in the future" (average change = 0.8). There was a statistically significant, but small (average change = .3), change whereby after participating in the unit students were more likely to agree that nanotechnology is good for the future of the county. There was a statistically significant, but small, decrease whereby students were less likely to be interested in learning more about nanotechnology after participating in the unit (average change = –.4).

- **Unit 11. Biometrics:** There was a statistically significant change, such that students were more likely to agree with the following statement after participating in this unit, "I have a good understanding of the ways in which people use biometrics technology" (average change = 1.8). There was a statistically significant, but small, change such that after participating in this VisTE unit, students were more likely to agree that "Biometrics technology is good for the future of the country" (average change = 0.4).

4.4 Understanding of the Role of Technology in the Workplace and Other Real-World Contexts

Another evaluation question was "Does VisTE improve understanding of the role of technology in the workplace and other real-world contexts?" Some change was found using data from the student surveys. For general technology, students' ratings of their understanding of how technology can be used in the real world did not change. However, for two of the units, Nanotechnology and Biometrics, students were significantly more likely to agree by a meaningful amount (average change = .8 for Nanotechnology and average change = 1.8 for Biometrics) that they have a good understanding of the ways in which nanotechnology (or biometrics technology) can be used in the future.

We also asked the teachers whether they thought that participation in VisTE was helpful for increasing their students' understanding of the role of technology, science, and/or mathematics in real-world contexts (with the response options of "not at all helpful," "somewhat helpful," and "very helpful"). All teachers responded that the units were somewhat or very helpful in this regard, and they gave a variety of examples of how the units were helpful in this way (see ***Exhibit 4-4***). It seems that for Nanotechnology and Biometrics, both students and teachers perceived that students increased their understanding of the use of technology in the real world, and that for Weather and Careers & Technology, only teachers perceived that students' understanding of the use of technology in the real world increased.

Exhibit 4-3. Teachers' Ratings of Effectiveness of VisTE Regarding Enhancing Students' Understanding Real-World Applications of Technology

Unit	Number of Teachers Who Taught Unit	Number of Teachers Responding	Ratings	Comments
Unit 9: Weather	2	2	Very helpful (2)	The students were exposed to higher level thinking and not so common technology; The weather channel.
Unit 10: Nano-technology	5	4	Somewhat helpful (1) Very helpful (3)	It is a new, real-world technology; Some students don't have many ideas on how things work, or how some things are made. Some don't want to know this information; Excellent cross-curricular activities.
Unit 11: Biometrics	4	3	Very helpful (3)	How software applications are used in real-world situations, suspects identified, identify theft is very real, very applicable; Their application of the eye scanner was interesting—used to open school locker; They understood how fingerprints are used in law enforcement.
Unit 12: Careers & Technology	4	4	Somewhat helpful (1) (3 teachers had missing data)	A new look at historical technology.

4.5 Participation in Technology for Females and Minority Students

When the subgroups were large enough, we tested for differences by gender and minority status. For the most part, we did not find differences in student test scores or in student attitudes. In addition, for the Careers & Technology and Weather units, all teachers agreed that the units were equally appealing to male and female students. For the Nanotechnology and Biometrics units, teachers did not agree regarding which gender found the units to be somewhat more appealing compared to the other gender. One teacher commented that Nanotechnology was applicable to students from all cultures.

5

Teachers' Impressions of VisTE

We collected data from the teachers' logs about their experience using VisTE and the impact of participating in VisTE on their students and themselves.

5.1 Teachers' Perceptions of Changes in Student: Engagement and Attitudes Toward Technology

Teachers rated their students' interest in the material taught in each unit. Their response options were "not at all interested," "somewhat interested," and "very interested." For the most part, teachers reported that students were somewhat or very interested. For the Weather unit, one teacher reported students as being very interested and one teacher reported students as somewhat interested. For the Nanotechnology unit, three of four teachers reported that students were somewhat interested and one reported that students were very interested. One teacher reported that students lost interest when they did not understand the material; other teachers reported that the projects were good and that the students were very interested and paid attention. For the Biometrics unit, two of three teachers reported that students were very interested and one teacher reported that students were not at all interested. For the Careers & Technology unit, one teacher reported that the students were somewhat interested and that most of the students showed a real interest in the unit.

In addition, teachers rated change in their students' attitudes towards the material covered. Their response options were "students' attitudes became more negative," "no attitude change," and "students' attitudes became more positive." For the Weather unit, one teachers reported students' attitudes became more negative (although this teacher reported that different students in the class responded differently), one teacher reported no attitude change (this teacher reported that the students already had a high interest in this topic before beginning the unit), and one teacher reported students' attitudes became more positive. For the Nanotechnology unit, all four teachers reported no attitude change in students. For the Biometrics unit, two of three teachers reported no attitude change in students (one reporting that the students were very motivated to begin with) and one teacher reported that the students' attitudes became more positive. For the Careers & Technology unit, one of four teachers reported no attitude change in students (this teacher mentioned that students disliked doing a careers report) and the remaining three teachers reported that students' attitudes became more positive (teachers reported that students were interested in the material and that students had ideas on some of the materials in the unit). So, overall, teachers felt that participation in the units led fairly equally to both no attitude change and positive attitude change.

5.2 Teacher Response to VisTE Units 9 to 12

The teachers reported that the last four units will be easier to teach for teachers who do not have computers or who have minimal computer equipment, compared with the first eight units, because the last four units can be taught without high-end technology. The teachers felt that the topics in the last four units were more advanced compared with the other units, but that they used less technology.

One teacher reported that teachers have to become familiar with the content and ideas in the last four units before they teach them, rather than just jumping into teaching them, because the material is cutting edge and they might not be familiar with it already. This teacher also commented that some of the new units are very abstract (especially the Nanotechnology unit) and can be used to teach students something in science that is not concrete, which is beneficial because students are not usually exposed to that concept. So, the unit could be used to teach about abstract concepts (e.g., that truth is relative, how ideas in science change) in addition to teaching about nanotechnology.

Unit 9. Weather

For Weather, two teachers returned teacher logs. For the most part teachers reported that the background materials in the unit were adequate to teach the unit. One teacher had problems getting the programs to run on the computers in the classroom due to the way the computers were set up. Teachers felt that the materials in the unit met or somewhat met the learning objectives for the unit and that the material was at the appropriate difficulty level for their students. Overall, teachers felt that the material was good and that they would or would probably teach this unit again.

Unit 10. Nanotechnology

For Nanotechnology, four teachers returned teacher logs. They reported that the background materials for the unit were adequate to teach the unit. The majority of the teachers felt that the materials for Project 1, History of Nanotechnology, addressed the learning objectives for the unit. The majority of the teachers felt that the materials for Project 2, Tools of Nanotechnology only somewhat addressed the learning objectives for the unit. One teacher reported that the second project was "deeper and very few students 'got' it." Teachers' suggestions included: providing more resources so that teachers would not need to spend time finding usable websites. However, all four teachers reported that the material was at the appropriate difficulty level for their students. Two of the teachers altered the instructional strategies presented in the unit, one by adding a 3D animation requirement and one by allowing the students to choose the media in which they presented their findings. Teachers' overall responses to the unit included:

> "Some parts of these units I thought was a little over high school students. Some information on these units was very good information for my students. On the other, this information will be used in some of my class for years to come. I will [say] this information on these units was good."

> "Need a PowerPoint made of the background materials to help get the students turned on and impart basic knowledge."

> "This unit desperately needs resources for the students to use. Real life applications are a necessity and there were none included! How is Nanotechnology used now? In products we purchase?"

Unit 11. Biometrics

For Biometrics, three teachers returned teacher logs. For the most part teachers reported that the background materials in the unit were adequate to teach the unit. One teacher reported that the software tutorial was "horrible" and that a more user-friendly package or tutorial would have been better. Also, a teacher felt that Project 4, Identity Theft and Privacy, needed more examples of actual cases and how identity theft works (suggestions included news articles and real-life situations). Teachers felt that the materials in the unit met or somewhat met the learning objectives for the unit, although they varied in their feelings about how effective the unit was in enhancing students' understanding of the intended learning goals, one teacher wrote "Cool unit," another wrote "Not enough student interest." Two of the teachers felt that the material in the unit was at the appropriate level, one teacher felt that the material in the unit was too hard. Two of the teachers altered the instructional strategies presented in the unit by adding 3D animation, pairing students, and changing the crime scene to a game by trying to match fingerprints on an object to a student in the class. Teachers' overall responses to the unit included:

> "More applicable situations of identify theft. New articles—real-life situations. Also, a better software tutorial for Image J."
>
> "I had problems with Image J."
>
> "Fingerprinting was very effective and fun. Applications of biometric devices was very intriguing. Need identity theft stories."
>
> "The lab on finger prints was hard—try using packing clear tape and crushed charcoal using a mort and pistol from chemistry—also use a makeup brush."
>
> "When the students were shown how simple it was to take their own finger prints. The least effective was when the students were asked to read some of the units on their own."

Unit 12. Careers & Technology

For Careers & Technology, four teachers returned the teacher logs. For the most part they reported that the background materials for the unit were adequate to teach the unit. The majority of the teachers felt that the materials addressed the learning objectives of the unit. One teacher reported that there was "…not enough time for historical overview, not enough trade and industrial/professional school examples." Three of the four teachers felt that the material was at the appropriate difficulty level for their students and one felt that the material was too difficult for their students. All four teachers felt that this unit gave them new ideas about different teaching strategies that they could use for teaching other materials, including incorporate timelines, new approach to careers, including information from this unit into the unit that they currently teach on Careers & Technology, and more in-depth research. Teachers' overall responses to the unit included:

> "The systems timeline was good to show students how technology changes jobs."
>
> "More examples of trade & professional training programs on certifications."
>
> "Best unit yet! Loved it—need to label the drawing with trees or mits."
>
> "All information in this unit will be used in the future, years to come. Time wise, these units were introduced too late in the school year, needed more time for these units."

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6

Is the Process of Developing and Pilot Testing the VisTE Modules Effective and Efficient?

6.1 How Effective Are the Training Workshops?

The training workshop seems to have prepared teachers well to teach the units. Teachers reported spending some, but not a lot of, extra time preparing to teach the units. Teachers reported that compared with the average amount of time spent preparing to teach new materials, they spent from 0 to 4 extra hours preparing to teach the VisTE units, with an average of 2 hours. Teachers reported using this extra time finding websites, setting up a crime scene, trying to work Image J, and printing a hardcopy and reading over each unit.

Teachers overwhelmingly responded that it was not hard for them to integrate the units into their curriculum. Teachers' responses across all units indicated that 79 percent of the time integrating the units into the curriculum was "not at all difficult" and that 21 percent of the time it was "somewhat difficult." The few difficulties the teachers mentioned indicated that student interest was the biggest problem; students asked "What can we do with this [Biometrics unit] today?" and younger students had difficulty understanding why they were studying how to get into college [Careers & Technology unit].

The teachers reported that they learned the four new units during the July 2004 workshop as well as brainstorming ideas for these new units and helping to write them. They reported that the VisTE team took their advice from last year and separated them from the new teachers at the workshop. They enjoyed having the opportunity to tell the VisTE team their reactions to the new units and felt that it was highly beneficial to have input on the last four units at an earlier stage of development than they did for the earlier units.

6.2 How Are Teachers Supported and is the Support Adequate?

Exhibit 6-1 shows the frequency of the teachers' contact with the VisTE staff. For each unit, the teachers had consistent contact with the VisTE staff through a variety of methods. The preferred methods of contacting the VisTE staff seem to be via e-mail, phone, and listserv. All four teachers who returned the teacher logs contacted the VisTE team at least once a month.

6.3 How Does the VisTE Proposed Curriculum Address the Current National Technology Standards?

As we did for the first eight units, we intended to use feedback from the VisTE advisory board members to determine whether the VisTE units addressed the Standards for Technological Literacy (STL) created by ITEA. The ITEA is a professional educational association and information clearinghouse devoted to enhancing technology education through experiences in our schools (K–12). In 2000, the ITEA published the *Standards for Technological Literacy: Content for the Study of Technology,* which outlines

Exhibit 6-1. Frequency of Teachers' Contact with VisTE Staff

	Phone Contact	E-mail Contact	Listserv Contact	In-Person Contact	Contact Through Materials VisTE Staff Posted on VisTE Website
Unit 9	Less than once a month = 1	About once a month = 1	About once a month = 1	Less than once a month = 1	
Unit 10	Less than once a month = 2 About once a month = 1	Less than once a month = 2 About once a month = 1 A few times a month = 1	Less than once a month = 2 About once a month = 1	About once a month = 1	Less than once a month = 1 About once a month = 2
Unit 11	About once a month = 2	About once a month =1 A few times a month = 2	About once a month =1 A few times a month = 2	Less than once a month = 1 About once a month = 1	About once a month = 1 A few times a month = 1
Unit 12	Less than once a month = 1 About once a month = 1 A few times a month = 1	Less than once a month = 1 About once a month = 2 A few times a month = 1	About once a month = 2	About once a month = 1	Less than once a month = 1 About once a month = 1

the content essential to ensuring that all students attain technological literacy. The standards are built around both a cognitive base as well as a doing/activity base and include knowledge, abilities, and the capacity to apply both knowledge and abilities to the real world.

We gave a subset of board members surveys that asked them to do two things. First, we asked them each to rate the projects for the units, indicating whether or not the project addressed the standards it was intended to address (see ***Appendix D*** for a sample evaluation form). Second, we asked the advisory board members to give examples of how the projects address the standards or to make suggestions for changes to ensure that projects do address the standards (see ***Exhibit 6-2*** for the ITEA standards).

However, due to an unusually low response rate from the board members, we did not receive enough data to measure how well each VisTE unit addressed the STL it was designed to address. As a result, we cannot present results summarizing whether the board members consider the units to meet the STL. We do present comments from the board members who did return surveys with examples of how the projects address the standards or to suggestions for changes to ensure that projects do address the standards.

We also received feedback from the board that the ITEA makes a distinction between standards-based and standards-reflected curriculum. Standards-reflected means that the curriculum developer starts with existing curriculum material and then "checks-off" the *STL* standards and benchmarks (ITEA, 2005). Using this method the STL become an afterthought and are not the central basis for developing the curriculum and the method can give the impression that practices are standards-based when they are not (ITEA, 2005). The ITEA defines standards-based curriculum as when the curriculum developer begins by selecting specific standards and benchmarks that will be covered in the curriculum and builds the curriculum based on those standards and benchmarks. Unfortunately the surveys we sent to the board members for all 12 of the unit did not make this distinction, so we cannot say whether the board members consider the units and projects to be standards-based versus standards-reflected. This is an important topic for a future evaluation.

Exhibit 6-2. ITEA Standards

Standard 1: Students will develop an understanding of the characteristics and scope of technology.
Standard 2: Students will develop an understanding of the core concepts of technology.
Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 5: Students will develop an understanding of the effects of technology on the environment.
Standard 6: Students will develop an understanding of the role of society in the development and use of technology.
Standard 7: Students will develop an understanding of the influence of technology on history.
Standard 8: Students will develop an understanding of the attributes of design.
Standard 9: Students will develop an understanding of engineering design.
Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Standard 11: Students will develop abilities to apply the design process.
Standard 12: Students will develop abilities to use and maintain technological products and systems.
Standard 13: Students will develop abilities to assess the impact of products and systems.
Standard 14: Students will develop an understanding of and be able to select and use medical technologies.
Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18: Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19: Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20: Students will develop an understanding of and be able to select and use construction technologies.

Exhibits 6-3 through ***6-6*** present the comments from the board members who did return surveys. The comments include examples of how the projects address the standards or suggestions for changes to ensure that projects do address the standards.

Exhibit 6-3. Board Member Feedback on the Weather Unit

Unit 9. Weather
Project 1. Weather Satellites and Remote Sensing Images • Standard 5: Include a short case where information from GOES is used to inform action so that habitats are protected. • Standard 4: If not predicted properly, this can have consequences with regards to natural disasters, crop predictions etc. thereby impacting local and global economies. • Standard 17: Standard 17 deals with information and communication. Discuss more of what is in the various benchmarks in the text and in the design brief.
Project 2. Manipulating Color Look-up Tables • Standard 17: The actual task of converting data from one form to another demonstrates the logistics of communicating technical information for the purposes of practical use. • Standards 8 and 11: Choosing appropriate colors to display cloud formation etc. is important for design.
Project 3. Image Resolution • Standard 3: Illustrated in the analogy of the digital camera for the GOES sensing. • Standards 8 and 11: (Based on Item 3 in the project) They need to create a visualization based on their materials, therefore addressing the importance of design.
Project 4. Measurement Calculations with Images • Standard 5: Could make more specific by adding a discussion portion. For this section could provide information on what actually happened to NC coastline and what may have happened if GOES information not available. Could also use Tsunamis. • Standard 11: Tie this project closer into Standard 11. Discuss the details of the benchmarks (of Standard 11) in the text and incorporate these benchmarks in the design brief.

Exhibit 6-4. Board Member Feedback on the Nanotechnology Unit

Unit 10. Nanotechnology
Project 1. Nanoscience to Nanotechnology • Standard 4: The project has students justifying the construction of a nanotech manufacturing facility in a small town. There are obvious and economic effects on the town and its people. These effects are implicit in the students' presentation. • Standard 3: Objective to describe the multidisciplinary nature of the field of nanotechnology in their presentation (scenario at a town meeting) • Standard 1: Discuss the differences between science and technology as presented in STL Standard 1 as well as what is in Chapter 1. Use the benchmarks of Standard 1 to help do this.

(continued)

Exhibit 6-4. Board Member Feedback on the Nanotechnology Unit (continued)

Project 2. Tools of Nanotechnology • Standard 2: I've added this [standard] as it seems to me that the study of STM and AFM involves learning about several scientific principles and technologies that are required to build these devices. It demonstrates how one technology is built from many preceding technologies. • Standard 11: In activity, the students will create designs to be mapped in the scanning simulation.
Project 3. Ethical and Societal Concerns Related to Nanotechnology • Standard 4: Exemplified in the research aspect of the project –students research the potential ethical, societal, economic, and political impacts/concerns of nanotechnology. • Standards 4 and 6: Incorporate the effects of Technology on Society (Standard 4) and the role of society in the development of technology (Standard 6) in the teacher background material as well as in the design brief.
Project 4. Nanoengineering and the Nanoscale • Standard 6: I excluded this [standard] because I saw no indication of it in the project. It might be reflected by the instructor in lectures, but it was not very clear to me. • Standard 1: The activity (diluting solutions) to illustrate scale addresses this standard.

Exhibit 6-5. Board Member Feedback on the Biometrics Unit

Unit 11. Biometrics
Project 1. Biometric Tools • Standard 7: Discuss in text the influence of technology on history (as related to Biometrics). Weave the benchmarks for Standard 7 into this. Show how these tools help solve human needs and wants.
Project 2. Collecting and Analyzing Fingerprints. No Comments.
Project 3. Processing Fingerprints. No Comments.
Project 4. Identity Theft and Privacy. No Comments. • Standard 10. Present the role of research and development in Problem Solving for Identity Theft and Privacy (go down to Standard 10's benchmark level to get some direction for this).

Exhibit 6-6. Board Member Feedback on the Careers and Technology Unit

Unit 12. Careers and Technology
Project 1. Technological Systems, Careers, and Change • Standard 14: I In the assignment to research a particular career. • Standard 3: Although it does not cover careers, Standard 3 could be a resource for careers across (among) technologies as well as in other fields of study (see benchmarks for Standard 3).
Project 2. Researching Career Paths • Standard 13: Exemplified in task assignment to discuss any equipment or technologies used to perform a job associated with the selected career.
Project 3. Research Colleges and College Majors • Standard 6: Illustrated in task to include a company that employs individual with that career.
Project 4. City Modeling: Development of Infrastructure and Maintaining/Controlling Growth • Standard 18: Demonstrated in aspect of task (i.e., design transportation system). • Standard 9: Engineering design could be woven into the text in terms of modeling (as well as testing, evaluating and modifying models). Prototypes could also be discussed (see benchmarks).

7

Conclusion

From the analyses of Units 9 to 12, and from the analyses of Units 1 to 8 (see VisTE Second Year Evaluation Report), we found that students who participated in the VisTE units significantly increased their knowledge in the areas of technology covered by the units. In addition, teachers rated all of the units (1 to 12) as effective in enhancing students' understanding of the intended learning goals and objectives of the unit. This rating confirms the results of the student test scores.

There was little change in students' self-concepts of ability in technology, mathematics, and science. This lack of change might be due to the fact that self-concepts of ability have been formed throughout students' lives, and perhaps there was not enough time for them to change while participating in the VisTE units. In analyses for all 12 units, students' attitudes toward technology in general and toward specific areas of technology addressed in the units generally stayed the same (there were some decreases and some increases, but they were fairly small). It is not quite clear why students' attitudes typically remained unchanged during the VisTE units. It could be that the length of time that each unit lasted (Units 9 to 12 typically lasted about 1.8 weeks; Units 1 to 8 typically lasted about 3 weeks) was insufficient to create changes in attitudes. As with the first eight units, the teachers were positive about Units 9 to 12, while continuing to offer feedback to the VisTE team about ways to improve the units.

With regard to students improving their understanding of the role of technology in the workplace and other real-world contexts, there was not much change in student data. The only meaningful change was that students reported having a better understanding of the way biometrics and nanotechnology are used in the real world after participating in the VisTE units. However, as was the case with the first eight units, teachers thought that Units 9 to 12 were somewhat or very helpful in increasing students' understanding of the role of technology, science, and/or mathematics in real-world contexts.

The majority of the teachers responded that it was "not at all difficult" to integrate the VisTE units into their curriculum. These teachers reported that this was something new to try, that one of the units was similar to something that had been developed for the school's scivis curriculum, and that they do a career unit for every class (so that the unit on Careers & Technology fit in well).

The training workshops were found to be efficient. On average, teachers reported that they spent about 2 extra hours preparing to teach the VisTE workshops compared with other new material—this is good considering that many of these topics are new to the teachers as well as the students.

Due to lack of data from the VisTE Advisory Board members we could not determine whether the VisTE units successfully addressed the ITEA standards they were designed to address. However, board members gave some feedback about how the units addressed the standards and some ideas for enhancing the units (see ***Exhibits 6-3*** through ***6-6***).

As with the first eight units, the teachers provided useful information about specific parts of the VisTE units that they liked, and specific parts that they would like to see changed. They provided suggestions for any changes they wanted to see. Overall, the teachers had positive responses to the last four units. They felt that for the most part the background materials were adequate, the learning objectives were addressed, and the material was at the appropriate level of difficulty.

Appendix A: Example of a VisTE Teacher Log

VisTE Teacher Log—Weather

This form asks for your thoughts about your overall experience with this VisTE unit, including components such as the VisTE materials, the teaching strategies used, and the effect of VisTE on your students. Please complete this form within a week of finishing this unit; use the "Comments" boxes to expand on your answers. *If you are teaching this unit to more than one class, please write information on this log about only one class to which you taught this unit. To provide us with the best information possible, please complete separate logs for as many of the other classes as you are able; however, it is not required that you complete more than one log per unit. Please e-mail or call RTI if you need additional logs.* Thank you for completing this form.

Teacher Name: ___________________________________ Today's Date: ____/____/____

Class Name(s): ____

Class Period (e.g., 1st, 2nd): ____________________

Date you began teaching this unit: _____/_____/_____

Date you finished teaching this unit: _____/_____/_____

____

Number of weeks you taught this unit: ________________

Which units had you already taught to this class (or these classes) **this semester** before teaching this unit? (Please check the box next to each unit that you had already taught.)

- ☐ Communications Technology: Introduction to Visualization Unit
- ☐ Medical Technology: Imaging
- ☐ Biotechnology: The PCR
- ☐ Transportation Technology: Visualizing Rocketry
- ☐ Communications Technology: Introduction to 3-D Modeling and Animation
- ☐ Bioprocessing Unit
- ☐ Prosthetics Unit
- ☐ Power and Energy
- ☐ Biometrics
- ☐ Nanotechnology
- ☐ Careers & Technology

What were the grade levels of the students you taught? (Please check the box next to each grade that applies.)

☐6th ☐7th ☐8th ☐9th ☐10th ☐11th ☐12th

A. VisTE Materials

1. Not all teachers may be familiar beforehand with the subject matter contained in each VisTE unit. Did the materials supplied with this unit contain adequate background information to give you the content knowledge you needed to teach the following projects effectively?

   The items below ask about introductory-level projects. (Please check one box for each row to indicate your opinion about whether the materials were adequate for you.)

Introductory-Level Projects	Were the background materials adequate?			
	Yes	Somewhat	No	I did not teach this project
Project 1 – Weather Satellites and Remote Sensing Images	☐	☐	☐	☐
Project 2 – Manipulating Color Look-up Tables	☐	☐	☐	☐
Project 3 – Image Resolution	☐	☐	☐	☐
Project 4 – Measurement Calculations with Images	☐	☐	☐	☐

   If you answered "Somewhat" or "No" for any of the projects listed above, please comment on what additional background materials should have been included with the unit.

2. Listed below are the learning objectives for each project in this unit. Please indicate whether, in your opinion, the materials in this unit successfully addressed the intended learning objectives. (Please check one box for each row to indicate your answer.)

Introductory-Level Projects

Did the materials address the learning objective?

Project 1 – Weather Satellites and Remote Sensing Images	Yes	Somewhat	No	I did not teach this project
Achieve a basic understanding of remote sensing in general and weather satellites in particular.	☐	☐	☐	☐

Project 2 – Manipulating Color Look-up Tables	Yes	Somewhat	No	I did not teach this project
Introduce students to the ways in which digital images are generated from remote sensing satellite data.	☐	☐	☐	☐
Explain how the data is visualized using color look-up tables.	☐	☐	☐	☐

Project 3 – Image Resolution	Yes	Somewhat	No	I did not teach this project
Use digital cameras to simulate some of the technologies and concepts used in remote sensing satellites.	☐	☐	☐	☐

Project 4 – Measurement Calculations with Images	Yes	Somewhat	No	I did not teach this project
Use image processing software to explore how measurements can be made from remote sensing images.	☐	☐	☐	☐

If you answered “Somewhat” or “No” regarding the extent to which the materials addressed any of the intended learning objectives, please comment on what needs to be added to this unit.

B. Teaching Strategies

3. What teaching strategy did you use to teach this unit? (Please check all boxes that apply.)

- ☐ Traditional (lecture)
- ☐ Hybrid (combination of traditional and modular)
- ☐ Modular
- ☐ I am not familiar with these teaching strategies.
- ☐ Other (Please describe): ____

4. Compared to the average amount of time you typically spend preparing to teach material that you have not taught before, please indicate the number of extra hours, if any, that you spent preparing to teach this unit. (Include preparation time before you began teaching the unit but not time spent at the VisTE summer workshop.)

Approximately _____ extra hours

Comments:

5. How difficult was it to integrate this unit into your existing curriculum? (Please check one box to indicate your answer.)

Not at all difficult	Somewhat difficult	Very difficult
1	2	3
☐	☐	☐

Please explain your answer.

6. Did teaching this unit give you any new ideas about different teaching strategies that you might use in the future for teaching other material? (Please check one box to indicate your answer.)

Yes ☐ No ☐

If you answered "Yes" to question 6, please describe those teaching strategies.

7. In order to teach the material in this unit effectively, did you use instructional strategies other than those suggested in the unit material? (Please check one box to indicate your answer.)

Yes ☐ No ☐

If yes, please describe those instructional strategies.

8. If you needed to make any modifications to the material in this unit to match your students' needs, was the material flexible enough so that you could do so easily? (Please check one box to indicate your answer.)

Yes ☐ No ☐ Did not modify ☐

If yes, please describe those modifications.

9. Did you and your students have adequate access to computer programs, computers, and technology, such that you and your students were able to achieve what you expected during this VisTE unit? (Please check one box to indicate your answer.)

Yes ☐ ⟶ If yes, skip to question 10.

No ☐

If you answered "No" to question 9, please check any answers below that apply, and then explain further in the comment box provided.

- ☐ I was able to successfully use an alternate computer program(s).
- ☐ I had to alter the materials in the unit due to lack of a computer program(s) or equipment.
- ☐ I had to skip one or more projects in the unit because I did not have the necessary computer program(s) or equipment.
- ☐ I was able to successfully teach all the material in the unit that I wanted to despite a lack of computer program(s) or equipment.

In your comments, please tell us more about specific problems you had (e.g., not enough computers, trouble using the Internet, problems because of outdated equipment, did not have the computer programs used in the summer training workshop) and what computer program(s) and equipment you needed to be better able to teach this unit.

10. Please list…

…any computer programs that **you would have liked to use** to teach this unit, but did not use because you were not familiar enough with them:

____

____

____

…any computer programs that **you made use of** to teach this unit, but that caused a problem for you because you were not familiar enough with them:

____

____

____

11. Was the material in this unit at the appropriate difficulty level for your students? (Please indicate your answer by checking one box for each row.)

	Material was too easy	Material was at the appropriate level	Material was too hard
a. Subject matter	☐	☐	☐
b. Computer programs	☐	☐	☐

If you answered that the difficulty level of the material was too easy or too hard, please explain below.

12. Do you think that you will use this unit again once your official participation in the VisTE project is over? (Please check one box to indicate your answer.)

No	Probably	Yes
1	2	3
☐	☐	☐

13. Do you feel prepared to train other teachers to teach the VisTE units? (Please check one box to indicate your answer.)

Yes ☐ No ☐

Comments on questions 12 and 13:

C. Students

14. Overall, how effective was using this unit in enhancing your students' understanding of the intended learning goals and objectives? (Please check one box to indicate your answer.)

Not at all effective	Somewhat effective	Very effective
1	2	3
☐	☐	☐

Comments:

15. Using the scale below, please rate how interested your students were in the material taught during this unit. (Please check one box to indicate your answer.)

Not at all interested	Somewhat interested	Very interested
1	2	3
☐	☐	☐

Comments:

16. On average, while teaching the unit, did you notice any change in students' attitudes toward the material covered? (Please check one box to indicate your answer.)

Students' attitudes became more negative	No attitude change	Students' attitudes became more positive
1 ☐	2 ☐	3 ☐

Comments:

17. Was the material in this unit equally appealing to your male and female students? (Please check one box to indicate your answer.)

Much more appealing to my female students	Somewhat more appealing to my female students	Equally appealing to my male and female students	Somewhat more appealing to my male students	Much more appealing to my male students
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Comments:

18. Is the material in this unit culturally sensitive to students from different backgrounds (for example, is it equally appealing to Hispanic or Latino students and to White students)? (Please check one box to indicate your answer.)

Not culturally sensitive	Somewhat culturally sensitive	Very culturally sensitive
1 ☐	2 ☐	3 ☐

Comments:

19. How helpful was participation in VisTE for increasing your students' understanding of the role of technology, science, and/or mathematics in real-world contexts (e.g., the workplace)? (Please check one box to indicate your answer.)

Not at all helpful	Somewhat helpful	Very helpful
1 ☐	2 ☐	3 ☐

20. If you answered "Somewhat helpful" or "Very helpful" for question 19, please tell us about the types of real-world contexts your students learned about.

21. Do you think that participating in this unit improved your students' skills in math? (Please check one box to indicate your answer.)

No	Somewhat	Yes
1	2	3
☐	☐	☐

22. Do you think that participating in this unit improved your students' skills in science? (Please check one box to indicate your answer.)

No	Somewhat	Yes
1	2	3
☐	☐	☐

Comments on questions 21 and 22:

D. Overall Experience

23. Please indicate the frequency and type of contact you have had with any of the VisTE staff during the time that you were preparing for this unit by checking one box for each row below.

	No contact	Less than once a month	About once a month	A few times a month	About once a week	Several times a week
a. Phone contact	☐	☐	☐	☐	☐	☐
b. E-mail contact	☐	☐	☐	☐	☐	☐
c. Listserv contact	☐	☐	☐	☐	☐	☐
d. In-person contact	☐	☐	☐	☐	☐	☐
e. Contact through materials that the VisTE staff posted on the VisTE website	☐	☐	☐	☐	☐	☐

24. What constructive criticism can you offer the VisTE staff based on your experience teaching this unit? (For example: What aspects of the unit were the most effective and why? Which aspects were the least effective and why? What parts of the materials were the most useful?)

Thank you very much for filling out this form. Please return the completed form within a week of finishing the unit to Pam Frome, using the enclosed self-addressed, postage-paid envelope (to 3040 Cornwallis Drive, P.O. Box 12194, Research Triangle Park, NC 27709-2194), or by e-mail to pfrome@rti.org. If you have any questions please call Pam at 1-800-334-8571, extension 6434, or (919) 541-6434.

Appendix B: Students' Test Score Change Based on Gender, Race/Ethnicity, and Geographic Location

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Appendix B: Testing for Differences in Student Test Scores Based on Gender, Race/Ethnicity, and Geographic Location

Unit	F-value Overall Model	F-values for Significant Group Differences	Average Test Score Change for Significant Differences
Unit 9. Weather		(No subgroups large enough to test)	
Unit 10. Nanotechnology	15.1***	Urban (versus Rural and Suburban) = 10.0**	Urban students = .9 Rural and Suburban students = 4.4
Unit 11. Biometrics	16.83	Race = 3.79 (not significant)	
Unit 12. Careers & Technology	7.08***	Urban (vs. Suburban) = 6.14*	Urban students = .8 Suburban Students = 2.8

*$p \leq 0.10$, ***$p \leq 0.001$.

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Appendix C: Students' Attitude Change Towards the VisTE Units

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Exhibit C-1. Students' Attitudes Toward Weather

Attitude toward Unit	Pre-Unit Attitude	Post-Unit Attitude	Paired *t* test	n	Average Test Score Change (Range)
a. I have a good understanding of the ways in which satellites are used to collect weather data through the use of remote sensing images.	3.1	3.4	1.1	28	0.3 (–2 to 4)
b. I would enjoy a job that involves the use of weather satellites and remote sensing images.	2.4	2.5	0.56	28	0.1 (–2 to 4)
c. You have to be smart to study how digital images are generated from remote sensing satellite data on weather.	2.8	3.2	1.8	28	0.4 (–1 to 4)
d. Weather satellites and remote sensing images are good for the future of our country.	4.0	3.9	–0.83	28	–0.1 (–2 to 1)
e. I would like to know more about the use of remote sensing images.	3.3	2.9	–1.3	25	–0.4 (–4 to 3)

*Students answered on a 1 to 5 scale where 1 = disagree and 5 = agree.

Exhibit C-2. Students' Attitudes Toward Nanotechnology

Attitude toward Unit	Pre-Unit Attitude	Post-Unit Attitude	Paired *t* test	n	Average Test Score Change (Range)
a. I have a good understanding of the ways in which nanotechnology can be used in the future.	2.9	3.8	5.6***	64	0.8 (–2 to 4)
b. I would enjoy a job that involves using nanotechnology.	2.6	2.9	1.7	64	0.3 (–4 to 4)
c. You have to be smart to study nanotechnology.	3.4	3.4	0.1	64	0.0 (–2 to 4)
d. Nanotechnology is good for the future of the country.	3.6	3.9	2.1*	63	0.3 (–3 to 4)
e. I would like to know more about nanotechnology.	4.0	3.6	–2.94**	62	–0.4 (–3 to 4)

* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

Exhibit C-3. Students' Attitudes Toward Biometrics

Attitude toward Unit	Pre-Unit Attitude	Post-Unit Attitude	Paired *t* test	n	Average Test Score Change (Range)
a. I have a good understanding of the ways people use biometrics technology.	2.1	3.9	7.2***	45	1.8 (–2 to 4)
b. I would enjoy a job designing biometric devices and/or analyzing biometric data.	2.4	2.8	1.4	44	0.4 (–4 to 4)
c. You have to be smart to study biometrics.	3.3	3.0	–1.5	45	–0.3 (–4 to 2)
d. Biometrics technology is good for the future of the country.	3.7	4.1	2.0*	44	0.4 (–4 to 2)
e. I would like to know more about biometrics technology and its applications.	3.8	3.4	–1.9	45	–0.4 (–4 to 4)

***$p \leq 0.001$.

Exhibit C-4. Students' Attitudes Toward Careers & Technology

Attitude toward Unit	Pre-Unit Attitude	Post-Unit Attitude	Paired *t* test	n	Average Test Score Change (Range)
a. I have a good understanding of the how to find out what post-high school training is required to enter into careers that I am interested in.	3.2	3.3	0.7	86	0.1 (–4 to 4)
b. I have a good understanding of the different types of degrees, training, certification and/or licensure needed for different jobs that I may want to have after I finish high school.	3.3	3.5	1.5	86	0.2 (–2 to 3)
c. You have to be smart to study how the design of a city can impact and shape the local economy and workforce.	3.5	3.6	0.7	86	0.1 (–2 to 4)
d. It is important for the future of the country that high school graduates receive further training in order to create a workforce that can use the new technologies that are being developed.	3.9	3.8	–0.3	86	0.0 (–2 to 3)
e. I would like to know more about the educational and training requirements for careers that I am interested in.	3.8	3.8	0.2	86	0.2 (–4 to 4)

Appendix D: Sample Evaluation Form for VisTE Advisory Board Members

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Unit 9. Weather

As part of the evaluation of the VisTE project, we are collecting information on the alignment of the VisTE units with the International Technology Education Association's (ITEA) Standards for Technological Literacy. We are asking you to complete three tasks for this process:

1) Each project in this unit is designed to address several of the ITEA standards. These standards are indicated by shaded squares in each project column. In each of the shaded squares below, please write a 1 or a 2 to indicate whether you think the project addresses the standard. Please be sure to fill in each shaded square.

    1 = This project addresses this standard.
    2 = This project does not address this standard.

2) We are also interested in getting your opinion on whether the projects address any of the other standards. If you think that a project addresses any standard for which the squares are not shaded, please write a 1 or a 2 in those squares as well.

3) On the third page of this document, please give examples of how the projects address the standards or suggestions for changes that can be made to ensure that projects address the standards. For example, if a project meets the standard, please tell us the aspect of the project that addresses the standard and provide details. If the project does not meet a standard, please suggest how to improve the project so it better meets the standard. Your examples/suggestions may be for any project and for any standard. We are asking you to give a *minimum of two* examples/suggestions; however, if you have time, please provide more examples/suggestions. Some of the examples you give may be used in reports on this project, but your identity will be kept confidential.

Standards for Technological Literacy	**Project 1. Weather Satellites and Remote Sensing Images**	**Project 2 – Manipulating Color Look-up Tables**	**Project 3 – Image Resolution**	**Project 4 – Measurement Calculations with Images**
1. The Characteristics and Scope of Technology				
2. The Core Concepts of Technology				
3. Relationships Among Technologies and the Connections Between Technology and Other Fields				
4. The Cultural, Social, Economic, and Political Effects of Technology				

Standards for Technological Literacy	Project 1 – Weather Satellites and Remote Sensing Images	Project 2 – Manipulating Color Look-up Tables	Project 3 – Image Resolution	Project 4 – Measurement Calculations with Images
5. The Effects of Technology on the Environment				
6. The Role of Society in the Development and Use of Technology				
7. The Influence of Technology on History				
8. The Attributes of Design				
9. Engineering Design				
10. The Role of Troubleshooting, Research and Development, Invention, and Innovation, and Experimentation in Problem Solving				
11. Apply Design Processes				
12. Use and Maintain Technological Products and Systems				
13. Assess the Impact of Products and Systems				
14. Medical Technologies				
15. Agriculture and Related Biotechnologies				
16. Energy and Power Technologies				
17. Information and Communication				
18. Transportation Technologies				
19. Manufacturing Technologies				
20. Construction Technologies				

Project 1 – Weather Satellites and Remote Sensing Images
Standard # __________ Examples/Suggestions:

Project 2 – Manipulating Color Look-up Tables
Standard # __________ Examples/Suggestions:

Project 3 – Image Resolution
Standard # __________ Examples/Suggestions:

Project 4 – Measurement Calculations with Images
Standard # __________ Examples/Suggestions: