SRI International

THE ONLINE COURSE EXPERIENCE: EVALUATION OF THE VIRTUAL HIGH SCHOOL'S THIRD YEAR OF IMPLEMENTATION, 1999-2000

Prepared by:

Robert Kozma
Andrew Zucker
Carlos Espinoza
Raymond McGhee
Louise Yarnall
Dan Zalles
Amy Lewis

Prepared for:

Elizabeth Pape
Hudson Public Schools
155 Apsley Street
Hudson, MA 01749

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EXECUTIVE SUMMARY

The Virtual High School (VHS) is a consortium of high schools that offer network-based courses taught by consortium teachers for students in participating schools. Each school contributes at least one teacher who teaches a VHS course online, typically in place of teaching a section of a regular course at the school. In the VHS model, the school also provides a site coordinator who handles administrative matters and supervises local students enrolled in VHS courses. The VHS teachers, with the help of experts, design netcourses to be offered over the Internet, using the *LearningSpace*™ software. Each school in the consortium can enroll 20 students in these netcourses for each section of a teacher's time (i.e., one netcourse) that it contributes to the pool. The quality of the course offerings is controlled, in part, by requiring each VHS teacher to successfully complete a graduate-level netcourse (called the Teachers Learning Conference) on the design and development of network-based courses. The netcourse for teachers is intended to provide participants with appropriate educational strategies and technology skills.

Funding for the Virtual High School comes primarily from a 5-year Technology Innovation Challenge Grant awarded to Hudson Public Schools in October 1996 by the U.S. Department of Education. The Concord Consortium, a nonprofit educational research and development organization, has been a full partner in the design and implementation of the VHS project.

The 1996-97 school year was a start-up year for VHS. Classes for students were first offered by VHS during the 1997-98 school year; 1999-2000 was the third year of operation. The 1999-2000 school year was one of tremendous growth for the Virtual High School. VHS increased its offerings significantly, from 37 courses in 1998-99 to 94 courses in 1999-2000. That same year, student enrollments increased to 2,516 students in 87 schools in 29 states, compared with 943 students in 30 schools in 25 states the previous year.

The VHS evaluation is conducted by the Center for Technology in Learning at SRI International, under contract to Hudson Public Schools. In previous years, the evaluation was focused on the implementation of the VHS infrastructure, the quality of VHS teachers and courses, and the satisfaction of administrators, teachers, and students. It was based on surveys of students, teachers, and administrators, as well as case studies of six participating schools. In brief, the previous reports found that VHS enlists high-quality teachers to design and offer courses that schools could not offer otherwise, teachers would not be able to teach otherwise, and students would not be able to take otherwise. Administrators, teachers, and students all expressed high levels of satisfaction with VHS. Standards for quality of netcourses have been established by panels of experts and have been used to confirm the quality of VHS courses.

At the same time, some problems were identified. Although teachers expressed satisfaction with the amount of interaction they had with students, this satisfaction was significantly lower for their VHS courses than for their face-to-face courses. Similarly, site coordinators felt that VHS students interacted less often with both teachers and other students in VHS courses than in their regular courses. Teachers also were satisfied with

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the amount of student learning in their VHS courses, but less satisfied than with the amount of learning in their regular courses.

Goals and Design of Year 3 Evaluation

This report, which evaluates the third year of the project's implementation (1999-2000), has a focus somewhat different from that of previous years. The focus this year was on the comparison of the VHS and face-to-face experiences. The overall goal was to look in more detail at the apparent differences between online and regular courses. Specifically, the goals of the evaluation in 1999-2000 were to examine similarities and differences between VHS and face-to-face courses.

Four VHS teachers participated in the evaluation, each teaching their courses in both online and face-to-face modes. Two of the four courses were primarily academic in nature; the other two were more career oriented. The evaluation draws on interviews with teachers and on observations in both classroom- and Web-based versions of the courses.

To assess the impact of the courses on student learning, SRI also examined student performance on two types of measures: teacher-generated "key assignments" and an assessment of Internet research skills. The key assignment was an important test, paper, or project selected by the teacher from those that were assigned to students in both versions of the courses. These assignments were unique to each course. The analysis used both the teachers' scores or grades on these assignments and those from qualified external graders hired by SRI. The external graders used the teachers' rubrics to independently rescore the assignments, without knowing whether the students were from the face-to-face or VHS versions of the courses. Only three of the four courses were used in this analysis because it was not possible for both the teacher and the independent graders to score the "hands-on" assignments of the VHS students in one of the courses (the Pre-Engineering course).

The Internet research assessment was designed by SRI to measure the impact of regular computer use on students' skills with technology use, reasoning with information, and communication. These are skills identified as being important to the information society of the future by the Secretary's Commission on Achieving Necessary Skills. Students in the VHS and face-to-face courses were asked to volunteer for this assessment; those who did were compensated. The Internet assessment was delivered online. These students also filled out an online questionnaire.

Although this quasi-experimental study provides a unique opportunity to look at four VHS courses and their face-to-face counterparts side by side, this approach has several limitations. First, these courses are not typical of the large majority of VHS courses. The large majority of VHS courses are offered only through VHS; there are no face-to-face counterparts. Of the 94 courses in the VHS catalog, only 8 were identified as being taught during 1999-2000 by the same teacher in both face-to-face and VHS versions. The four courses that are the focus of this evaluation were the only ones for which both versions were taught in the spring semester, the period of the evaluation activity.

Also, there are many potential differences between the two versions of the courses that might influence student outcomes, such as differences in students' characteristics or dropout rate. Several of these factors are considered below. Such factors confound a study and make it difficult to attribute causality to one particular approach or the other. Nonetheless, the comparisons resulted in some interesting and valuable findings.

The four courses that are the focus of the evaluation are:

- **Advanced Placement Statistics.** Advanced Placement Statistics (offered by Hudson High School in Hudson, Massachusetts) runs a full year and prepares students for an examination in May that qualifies those who pass for college credit. The course introduces students to concepts and statistical tools for collecting and analyzing data and drawing conclusions.

- **Modern Classics.** This is a high school literary analysis course (offered by Ellet High School in Akron, Ohio) in which students interpret texts and write expository essays. The course texts, written by English and American authors, contain a number of interrelated themes that the students explore throughout the course. Because the class is text based, students do a good deal of reading, information processing, and essay writing offline or out of class. The semester-long VHS course, "Modern Classics, Living Authors," is derived from a yearlong, face-to-face Advanced Placement (AP) English course, with which it was compared.

- **Photographic Vision.** The one-semester VHS photography course, "Expanding Artistic Vision Through Photography," (offered by Fort Hayes Metropolitan Education Center in Columbus, Ohio) is based on one segment of a 2-year face-to-face career program in photography. Both versions of the course teach the basic elements of photographic composition: vantage, frame, subject, breadth, and depth. In the face-to-face course, the photographic composition course follows 1 year of courses on film developing, printing, and photographic lighting.

- **Pre-Engineering.** Pre-Engineering and Design (offered by Dade County High School in Trenton, Georgia) is a "hands-on" laboratory course and therefore poses special challenges for instruction in an online environment. The course introduces students to the basics of engineering design and problem solving. Students develop, design, and create prototype solutions to fictional design and engineering problems. Construction projects typically require inexpensive materials, such as cardboard, paper, masking tape, batteries, wire, string, and Styrofoam. The one-semester VHS course covers only a portion of the syllabus of the face-to-face course, which carries twice the credit.

Findings

Based on Case Study Analyses

- The VHS courses selected for this evaluation and their associated teachers, students, and schools fall well within the range of the larger group of VHS courses and are typical in that sense.

- There were significant differences in student characteristics between the two versions of the career-oriented courses (Photographic Vision and Pre-Engineering), according to teachers. VHS students were reported to be better prepared academically than students in the corresponding face-to-face courses. On the other hand, the photography course face-to-face students were more focused on a career in that field, whereas VHS students approached the topic more as a hobby.

- The student dropout rate was low for both sets of courses but lower for the face-to-face courses than for the VHS courses.

- Content in three of the VHS courses (Modern Classics, Photographic Vision, and Pre-Engineering) was a subset of more substantial courses taught face to face.

- For the common segments, the VHS courses had the same or similar goals, content, structure, and assignments as their corresponding face-to-face courses.

- Assignments were sometimes modified in VHS courses, and VHS students often had less time for and/or spent less time on assignments than students in the face-to-face courses.

- VHS students were online regularly, and the technology provided access to some unique materials in two VHS courses (AP Statistics and Modern Classics).

- However, the technology generally inhibited interaction and had serious liabilities in the two courses for which student products required visual inspection by the teachers (Photographic Vision and Pre-Engineering).

- Compared with face-to-face courses, the interaction among students and between students and their teachers in VHS courses was less in quantity and lower in quality, both as observed and as reported by the teachers.

Based on the Student Questionnaire

- Comparing the VHS and face-to-face groups, VHS students were more likely to be 11th graders, and face-to-face students were more likely to be 12th graders.

- VHS students were more likely to be enrolled in six or more courses than were face-to-face students. Consequently, their VHS courses were often taken on top of a full course schedule.

- Students in both groups expressed interest in and enjoyment of their courses.

- VHS students were likely to agree that their VHS courses were of high quality and required hard work, but face-to-face students were more likely to agree strongly with these statements about their courses.

- VHS students were more likely than face-to-face students to use the World Wide Web, but there were no significant differences between the groups in their other computer, e-mail, or general Internet use.

- There were no reported differences between the two groups in the use of computers to do research projects or write reports as part of their course work.

- Face-to-face students were likely to agree strongly that discussion was a regular part of their courses, that they frequently communicated with other students, and that communications with other students were an important part of their learning. VHS students were likely to disagree with all of these statements.

- There were no significant differences between the two groups in the reported frequency with which they communicated with their teachers. On the other hand, face-to-face students were more likely than VHS students to agree strongly that communications with teachers were an important part of their learning and that they got their assignment grades back from their teachers in a timely manner.

Based on Student Assessments

- Across the three pairs of courses that were included in the key assignment analysis, there were no significant differences in teacher scores between the face-to-face students and the VHS students. Also, there were no significant differences in the external graders' scores between the face-to-face and VHS students in two of the three courses. The face-to-face group was scored significantly higher than VHS students in the Photographic Vision course by the independent grader.

- In every course, more VHS students than face-to-face students passed the technology use portion of the Internet assessment. Also, many more VHS students than face-to-face students in two of the courses (Photography and Pre-Engineering) passed *all* of the skill areas of the Internet assessment. In only one course (Modern Classics), on only one skill area (reasoning with information), did face-to-face students significantly outperform VHS students.

Conclusions

The analysis of four courses taught in both modes shows that the VHS experience was similar in some ways to experiences in face-to-face courses. For portions of the courses that were common to both, VHS versions had the same or similar goals, content, assignments, and structure as face-to-face courses. Both types of course were taught by high-quality teachers. There were few student dropouts from either. Face-to-face and VHS students received similar grades in the two types of course. In addition, VHS students acquired the technology-based reasoning and communication skills needed for the 21st century information society.

On the other hand, there were some important and significant differences. VHS courses were often a subset of face-to-face courses. VHS students were scheduled for and/or spent less time on common assignments and projects than face-to-face students. There also was much less student-to-student interaction and group work in VHS courses, and student-teacher interaction was rated less positively. Additional skills may be needed by VHS teachers to make their online courses as interactive as their face-to-face courses.

The VHS technology presented significant limitations for the visual and hands-on courses. In a highly graphic course, the technology inhibited the ability of students to simultaneously view and discuss their products. In a hands-on course, the limitations of the technology seriously interfered with the assessment of student products.

It is clear that, in general, technology enables VHS students to take high-quality courses, offered by high-quality teachers, that would not be available to them otherwise. But there are also significant technology-based problems, which have persisted over the initial years of the VHS project, that limit the student-student and student-teacher interaction. This limitation, in turn, negatively affects the type of feedback from teachers, the quantity and quality of student input, and the sense of community in VHS courses.

However, the VHS project is addressing these issues. As teachers become more effective in the use of technology to support collaborative learning, as technological environments become more powerful, and as schools develop their technological infrastructure, students will begin to experience the same quality of interaction that they do in face-to-face classes.

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I. INTRODUCTION

Across the country, investment in the development of online education, what Cisco Systems CEO John Chambers calls the "killer app" of the Internet, is growing. Much of this development is going on at the postsecondary level and in business. A recent report from the National Center for Education Statistics (1999) shows significant growth in distance learning in higher education. And a recent market report by a leading software manufacturer's association predicts that the market for technology-driven training and instruction will hit $11.4 billion by 2003 (SIIA, 2000).

The applications of technology in K-12 education are also increasing in importance in national policy. A presidential committee (PCAST, 1997) recommended that computing and networking technology be integrated throughout the K-12 curriculum and be applied to improve the quality of education in all subject areas. The committee also recommended a corresponding increase in research that can assess the impact of these developments and suggest improvements.

Although such reports document that online learning is the newest "new thing," they only verify the importance of what certain people have been doing for some time. The Virtual High School (VHS) is an example of this phenomenon. VHS is a unique online learning project that is currently in its fourth year of operation. During the present 2000-01 school year, the project is offering more than 200 high school courses to nearly 4,000 students in 350 schools in 30 states. This report describes the Virtual High School project. It examines the experience of students in four courses offered during its third year of operation (1999-2000) and compares this experience with that in corresponding face-to-face courses.

Description of the VHS Project

The Virtual High School is a consortium of high schools that offer network-based courses taught by consortium teachers for students in participating schools. Each school contributes at least one teacher who teaches a VHS course online, typically in place of teaching a section of a regular course at the school. In the VHS model, the school also provides a site coordinator who handles administrative matters and supervises local students enrolled in VHS courses. The VHS teachers, with the help of experts, design

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netcourses to be offered over the Internet. Each school in the consortium can enroll 20 students in these netcourses for each section of a teacher's time (i.e., one netcourse) that it contributes to the pool. The quality of the course offerings is controlled, in part, by requiring each VHS teacher to successfully complete a graduate-level netcourse (the Teachers Learning Conference) on the design and development of network-based courses. The netcourse for teachers is intended to provide participants with exposure to appropriate educational strategies and technologies.

Each participating school provides its VHS students with access to the Internet on computers located in the school. Using any Web browser software (such as Netscape or Internet Explorer), students use a password to log into the particular VHS course in which they are enrolled. With the browser, the students are able to view, print, and respond to materials already "posted" on the course's Web site by the teacher or by other students. In some courses, links are also provided to other, related Internet sites where pertinent materials can be found.

Although students can use a common browser to access VHS courses, the courses were developed and are electronically delivered through a proprietary technology called *LearningSpace*™. *LearningSpace* consists of virtual areas: the Course Schedule, Profiles of students and teachers, a Media Center, the Course Room, and an Assessment area. The Course Schedule displays the dates for topics, assignments, and tests. The Profiles provide brief descriptions and photos (if available) of teachers and students. The Media Center contains readings and other digital resources associated with topics and assignments. The Course Room provides a space for threaded conversations about teacher- and student-supplied topics. The VHS courses are designed to be asynchronous, allowing teachers and students to log on and participate whenever they want to do so.

Funding for the Virtual High School comes primarily from a 5-year Technology Innovation Challenge Grant awarded to Hudson Public Schools in October 1996 by the U.S. Department of Education. The Concord Consortium, a nonprofit educational research and development organization, has been a full partner in the design and implementation of the VHS project.

The 1996-97 school year was a start-up year for VHS. Classes for students were first offered by VHS during the 1997-98 school year; 1999-2000 was the third year of operation. The 1999-2000 school year was one of tremendous growth for the Virtual High School. VHS increased its offerings significantly, from 37 courses in 1998-99 to 94 courses in 1999-2000. That same year, student enrollments increased to 2,516 students in 87 schools in 29 states, compared with 943 students in 30 schools located in 25 states the previous year.

Goals for the VHS Evaluation

The goals for the evaluation of the Virtual High School are directly tied to the goals of the project. The VHS proposal submitted in 1996 to the Technology Innovation Challenge Grant program identifies an overarching goal for the project:

> "to create a national consortium of schools that expands members' curricular offerings through a wide range of excellent, current, innovative network-based courses that support reform. This can be done in a way that is scalable and can continue post-funding, while spawning independent, parallel efforts."

During the 1996-97 start-up year for the project, the Center for Technology in Learning at SRI International worked with VHS project staff to elaborate and clarify this goal so that it could guide the project evaluation (Zucker & Kozma, 1997). This process resulted in the specification of seven goal statements, as listed in Exhibit 1.

Exhibit 1
Primary Goals for the Virtual High School Consortium

1. The practical problems of establishing and managing the Virtual High School will be solved, demonstrating that the approach is feasible for many schools.

2. Students, teachers, schools, and districts will benefit from participating in VHS courses.

3. Courses offered through VHS will be of high quality and will support reform efforts aimed at raising education standards (e.g., VHS students will become more engaged in course work and take more responsibility for their own learning; greater attention will be given to teaching for understanding).

4. Internet-based VHS courses will demonstrate some advantages (e.g., an expanded community, new kinds of courses, technology skills for students), compared to traditional courses.

5. The VHS project will become a model of how to use the Internet to deliver high school courses.

6. VHS benefits will be made available to students equitably.

7. The network-based professional development provided to participating netcourse teachers will be of high quality and will make an important contribution to the quality of the netcourses offered to students.

Findings from Previous Years' Evaluations

In the initial year of VHS operation, the evaluation focused on an analysis of the teachers recruited by the project and on the implementation of the VHS infrastructure. A baseline survey of the first cohort of VHS teachers (Zucker, Kozma, Young, & Collier, 1997) found that the project had recruited a group of high-quality teachers for its first offerings. VHS teachers had an average experience of nearly 15 years of teaching, with 25% having taught at their current school for more than 20 years. A greater number of VHS teachers held advanced degrees than did teachers across the nation, with 60% holding a master's degree and 30% holding a second master's degree. A majority of the teachers (57%) had taught an honors course, and a large majority (90%) had previously designed a new course.

During 1997-98—the first year of VHS operation—the evaluation focused on Goals 1 and 2, overcoming the practical problems of delivering online high school courses and the benefits these courses would have for schools, teachers, and students. In this regard, teachers, site coordinators, principals, superintendents, and students were surveyed about their experience and satisfaction with the VHS project (Kozma, Zucker, & Espinoza, 1998). Although there were some initial start-up problems with the VHS infrastructure, these problems were resolved by the end of the first semester. By the end of the first year of operation, large majorities of students, teachers, coordinators, and administrators expressed overall satisfaction with the project. According to all groups of respondents, the most pronounced benefit of the project was that schools were able to offer, teachers were able to teach, and students were able to take courses that would not have been available to them otherwise. Large majorities of these groups also were satisfied with the quality of VHS courses. Although large majorities of teachers, coordinators, and administrators said that the project cost more than anticipated, they felt that the costs were acceptable, and most administrators said they would continue VHS even without outside funds. Large majorities of both teachers and students were pleased with student subject matter learning in their courses, and both teachers and students felt that they had learned new technological skills. However, teachers were significantly less satisfied with student learning in their VHS courses than in their regular courses. And although a majority of students were satisfied with the level of communications with their teachers and other students, both teachers and coordinators felt that there was less communication in VHS courses than in regular courses. Furthermore, although the participating VHS schools in 1997-98 were representative of the range of schools across the country, VHS students were not. A large majority of VHS students had above-average or exceptional academic backgrounds and were college bound. Teachers and coordinators typically characterized them as highly independent learners, and these were the kinds of students they were trying to recruit to the project.

The evaluation of the second year of operation found similar results (Espinoza, Dove, Zucker, & Kozma, 1999). Indeed, principals, teachers, and coordinators were even more satisfied with VHS and with the quality of the courses in the second year than they

were during the first. This change may have been due in part to significant improvements in the technological infrastructure employed by the VHS project.

The 1998-99 evaluation also included a significant component that directly addressed the quality of VHS courses, Goal 3 in Exhibit 1. In addition to asking teachers, coordinators, and administrators their attitudes about VHS course quality, SRI established an independent panel of national experts to review the quality of VHS courses (Yamashiro & Zucker, 1999). This panel of subject matter experts developed a set of quality standards in four areas: curriculum/content, pedagogy, course design, and assessment. The panel then applied these standards to a sample of 12 of the 37 courses offered that year. All but one of the 12 courses were rated as "satisfactory" or better, with 6 rated as "high quality." Only one course of the 12 was rated as "of serious concern."

In brief, the previous reports found that VHS enlists high-quality teachers to design and offer courses that schools could not offer otherwise, teachers would not be able to teach otherwise, and students would not be able to take otherwise. Administrators, teachers, and students all expressed high levels of satisfaction with the project and the quality of the courses, and this assessment was confirmed by panels of outside experts. At the same time, some problems were identified. Although teachers expressed satisfaction with the amount of interaction they had with students, this satisfaction was significantly lower for their VHS courses than for their face-to-face courses. Similarly, site coordinators felt that VHS students interacted less often with both teachers and other students in VHS courses than in their regular courses. Teachers also were less satisfied with the amount of learning in their VHS courses compared with their regular courses.

Goal for the 1999-2000 Evaluation

This report, which evaluates the third year of the project's implementation (1999-2000), has a focus somewhat different from that of previous years. The focus this year was on Goal 4, the advantages of VHS relative to face-to-face experiences. The overall goal was to look in more detail at the apparent differences between online and regular courses that had been identified in the findings of previous years. Specifically, the

evaluation examines similarities and differences between VHS and face-to-face course experiences related to the content, structure, use of technology, and student-teacher and student-student interactions. The evaluation also compares the two approaches with respect to students' learning.

II. EVALUATION DESIGN

Quasi-Experimental Design

The comparative nature of the goals for the 1999-2000 evaluation requires the examination of VHS and face-to-face versions of the "same course." An experimental design would require the differences between the two versions to be specified and controlled. It also would require randomness in the selection of the courses and the assignment of students to one version or the other. Comparisons would be made on outcome measures, and any differences in outcomes would be attributed to the controlled differences between the two versions. On the basis of the results, inferences could be made about the larger group of courses and students from which the sample was drawn. Obviously, such a design is not possible for this evaluation, given the nature of the project and the realities of educational situations. Furthermore, there are significant problems with trying to "hold all else constant" in a regular educational setting, especially when a number of things often change simultaneously when technology is used. This condition presents a natural confound that makes the use of experimental designs unadvisable (Kozma, 1994a, 1994b).

However, it so happened that several courses were offered during the winter semester, 2000, in both VHS and face-to-face versions. This situation presented the evaluators with the possibility of doing a quasi-experimental study. A quasi-experimental design involves the comparison of two approaches when tight controls and randomness are not possible. Careful observations are required that would enable naturally occurring differences and similarities between the two versions to be described. Consequently, the evaluation draws heavily on case studies of "comparable" courses.

Although this quasi-experimental study provides a unique opportunity to look at four VHS courses and their face-to-face counterparts side by side, this approach has several limitations. First, these courses are quite different from the large majority of VHS courses. The large majority of VHS courses are offered only through VHS; there are no face-to-face counterparts. Of the 94 courses in the 1999-2000 VHS catalog, 86 were taught only through VHS. There were a number of other differences between the

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two versions of each course, as described below, that were irrelevant to the VHS model but that make it difficult to attribute causality to one particular approach or the other. Furthermore, the lack of randomness in selection prevents inferences from being drawn about other courses or students outside of those directly participating in the evaluation.

Nonetheless, it was felt that the comparison of these two experiences might result in appropriately qualified conclusions about these courses and students that could not be made otherwise and could provide some useful insights. These conclusions might be combined with the results of earlier studies to permit a certain amount of speculation about the strengths and weaknesses and the advantages and disadvantages of the VHS project and how it could be improved.

Participants

Of the 94 courses in the 1999-2000 VHS catalog, 8 were identified as ones that might be taught in both forms. After contacting the corresponding teachers, it was found that only four of the eight were being taught in both forms during the winter semester, the target semester for the evaluation. These four teachers agreed to participate. The courses were: Advanced Placement Statistics; Modern Classics, Living Authors; Expanding Artistic Vision Through Photography; and Pre-Engineering and Design. The courses are described in detail in the sections below. The student enrollments in these courses during the winter semester are listed in Exhibit 2. Different numbers of students were involved in different aspects of the data collection, and these are indicated in the exhibit.

Exhibit 2
**Enrollments and Numbers of Students Participating in Various Data
Collection Efforts, by Course**

		AP Statistics	Modern Classics	Photography	Pre-Engineering	Total
Number of students enrolled	F to F*	7	28	14	19	68
	VHS	14	13	18	16	61
Number of students with key assignments	F to F	7	24	12	-	43
	VHS	12	7	17	-	36
Number of students responding to background questionnaire	F to F	4	21	8	10	43
	VHS	5	3	13	9	30
Number of students with Internet assessment	F to F	4	14	6	9	33
	VHS	5	3	12	8	28

*Face to face.

Observations and Instruments

Case Studies

The evaluation draws on interviews with teachers and observations in both classroom- and Web-based versions of the courses. These involved 2-day visits to each school and analysis taking several hours on each course Web site. The interviews were semistructured ones in which teachers were asked compare their VHS and face-to-face courses on the following topics: content, pace, assignments and materials (including the use of technology), teaching style (including the use of technology), student characteristics, and student learning. The classroom and Web site observations drew on a guide that focused on the learning environment, instructional practices, and student-teacher and student-student interactions. Case reports were written on the basis of these observations, and these reports are summarized below. An analysis was conducted that looked for patterns and trends across these case reports, and the results are reported below, as well.

Key Assignments

To assess learning in both versions of the courses, SRI examined student performance on two types of measures: teacher-generated "key assignments" and an

assessment of Internet research skills. The key assignment was an important test, paper, or project selected by the teacher from those that were assigned in both versions of the courses. These assignments were unique to each course (see Exhibit 3 for a description of each key assignment and the scoring criteria).

Exhibit 3
Description and Scoring Criteria for Key Assignments

Course	Key Assignment	Scoring Criteria
Advanced Placement Statistics	The final examination for the course, which consisted of a series of objective and short-answer questions. The questions measured students' understanding of key concepts, plus their ability to successfully carry out appropriate statistical analyses.	Objective questions that were worth 2 or 2.5 points, plus short-answer questions on which students accumulated points by carrying out the appropriate operations and analyses.
Modern Classics	An essay called "Accessing the Heart of Darkness," in which students compared three characters from three novels read in the course (*Heart of Darkness*, by Joseph Conrad; *Going to Meet the Man*, by James Baldwin; and *The Things They Carried*, by Tim O'Brien). The assignment measured how well the students were able to follow various organizational conventions laid out by the instructor (e.g., one paragraph for opening introduction, three paragraphs for theme-based key points and support, final paragraph for conclusion).	A=all requirements were met. Solid writing but nonexceptional writing split between A and B. B=most requirements were met except that the three middle paragraphs were organized by character instead of by topic. If organized correctly, writing was marred by flaws that made reading difficult (such as poor sentence structure). C=a topic sentence and thesis were included, but other expectations were not met (such as putting in the required amount of support). D=student wrote the required five paragraphs, but the effort had major flaws beyond what would bring him or her a B or C. F=student did not write the required five paragraphs.
Photography	The "frame assignment": students took photos in which they demonstrated their artistic vision with regard to the photograph's framing. The assignment measured how well students cut the image with the frame, made shapes with the frame, created relationships with the frame, and found a frame within the frame or a frame about the frame.	All photographs were bundled into high, medium, and low categories, then assigned letter grades. The emphasis in scoring was on the vision of the photographer rather than on technical skills.

Course	Key Assignment	Scoring Criteria
Pre-Engineering	Dizzy Roller Coaster and Downhill Vehicle Challenge, which measured how well students could design and build constructions within constraints imposed by the teacher on the design and on the materials that could be used.	5-point scales that measured the extent to which the students: - spent time brainstorming a solution - worked cooperatively with a partner - displayed evidence of preplanning limited themselves to using available resources only - made required journal entries during the project - built and designed the project within given limitations - used construction time wisely and efficiently - exhibited effort on the project - never had to start over - used the "design loop." (Most of these criteria could not be adequately applied online because they involved observing students in progress and viewing the finished products, neither of which was feasible for assessing the VHS students.)

As indicated, students did these assignments as a normal part of their course work. Exhibit 2 shows the numbers responding from each course. Because it was not possible to score the "hands-on" assignments of the VHS students in the Pre-Engineering course, the key assignment for this course was not included in the analysis.

The teachers scored or graded the assignment as they normally did. The evaluation team also asked the teachers to specify the criteria they used so that someone else could score the same assignments.

To address potential (if inadvertent) bias that the classroom teachers might introduce as a result of knowing which students were enrolled in which form of the course, SRI arranged to have students' work rescored by qualified teachers who did not know whether students were in face-to-face or VHS sections. The qualifications of these external graders appear in Exhibit 4. The external graders used the teachers' criteria to make their assessments.

Exhibit 4
Qualifications of External Graders of the Key Assignments

AP Statistics: The external grader is the AP Statistics instructor for a San Francisco Bay Area high school and holds a master's degree in teaching mathematics from the College of Notre Dame (1977) and a B.A. from San Jose State University (1971), with both a major and minor in mathematics. He has taught mathematics in community college, high school, junior high, and special programs. He is currently the Math Department Chair at his high school and teaches AP Calculus, AP Statistics, Pre-Calculus, Geometry, and Applied Math. He also worked for 4 years as the district math coordinator for South San Francisco Unified School District in the mid-eighties.

Modern Classics: The external grader is a Language Arts instructor from San Jose City College, holds a Ph.D. from Penn State University (1996), a master's from UC Irvine (1991), and a B.A. from UC Riverside (1989). She teaches a course titled "Survey of American Literature," as well as English composition courses, at the college.

Photographic Vision: The external grader holds a B.F.A. in photography from the San Francisco Art Institute (1973) and a master's in English/creative writing from San Francisco State University (1979). He has been on the faculty at De Anza Community College as a photography instructor since 1989 and previously taught the subject at City College of San Francisco from 1978 to 1989. His photography work has been exhibited in art museums and galleries in California, Arizona, Mexico, and Germany.

Internet Assessment

In addition to the key assignment, students were assessed with a specially designed performance measure of "Internet research skills." It is commonly claimed that the impact of regular computer use on learning is not measured by standard learning assessments. The Internet research assessment was designed by SRI to measure those skills that are likely to be influenced by regular use of computers in education, skills related to technology use, reasoning with information, and communication (see Exhibit 5 for a brief description of these components). These are skills identified as being important to the information society of the future (Secretary's Commission on Achieving Necessary Skills, 2000; National Research Council, 1999).

Exhibit 5
Components and Scoring Criteria for the Internet Assessment

Component	Criteria for Pass
Technology Use	
Citing URLS: citing the URLs of the exact Web pages that contain information identified by the student as relevant supporting evidence.	The URL cited as the location of the supporting information was at least on the correct topic, even if it did not go directly to the exact Web page that contained the evidence.
Formulating search query: generating the most effective query term for searching for answers to the student's research question.	The search query was likely to yield good or somewhat good search results.
Reasoning with Information	
Rating evidence: rendering evidence-based judgments about particular characteristics of a city.	The rating was consistent with the evidence.
Finding questionable information: finding noncredible text on a Web site and explaining why it is not credible.	Questionable text was found, though an explanation may not have been provided.
Generating research question: creating a research question that would serve as an effective starting point for checking the credibility of the questioned information.	The research question was likely to be at least somewhat effective as a line of inquiry.
Communication	
Organization: sentences in the culminating composition (a persuasive letter) are in logical order and the meaning of the sentences is clear.	No major flaws in organization.
Support: supporting details provided are accurate, consistently on topic, or consistently responsive to the audience's information needs.	At least two of the three characteristics of proper support were met.
Drawing conclusions: the conclusion about which of two choices would be better is logical and supported by a substantive amount of evidence.	To at least some extent, the conclusion was logically supported by the evidence provided.
Mechanics: the spelling, usage, and punctuation in the culminating composition are appropriate.	No major flaws in mechanics.
Written by student, not copied: the text of the culminating composition has been composed by the student.	At least some of the text was composed by the student.

The evaluation team chose a project-based approach for the design of the Internet assessment instrument. Project-based pedagogy has at its core the "active processing of information" (Means & Olson, 1995). Educators and psychologists widely agree (Bransford, Brown, & Cocking, 1999; Collins, Brown, & Newman, 1989; Resnick, 1987) that expertise in a field and advanced skills of comprehension, composition, reasoning, and experimentation are developed not by the passive reception of facts but by the kind

of active processing that the assessment was designed to assess. The Internet assessment that was designed is called "Choose-a-City." (See the Appendix for a copy of this instrument.) The premise was that "a foreign exchange student" wanted the student subjects to recommend which of two cities would be better to live in for a summer, with the possibility of permanently moving there later. The exchange student was interested in the cities' recreational opportunities, public transportation systems, and economies. To gather information on which to base their recommendations, the student subjects were given links to the two cities' official home pages to begin their search, but they could go anywhere they wanted on the Web from there. For each of the two cities, on each topic of interest, students had to select from a choice of four ratings, and then cite two pieces of evidence to support their rating, as well as the URLs to the Web pages that contained the evidence. They then answered three questions directed at seeing how well, in the course of their Web research, they could find a piece of questionable information, explain why it was questionable, generate a line of inquiry for checking the information's credibility, and generate a query that would launch them on an effective search. Finally, the students were asked to compose a letter to the foreign exchange student recommending a city and explaining why.

The Internet assessment was delivered online, under the supervision of the local site coordinator, and the same assessment was used for all of the courses. Students in both the VHS and face-to-face courses were asked to volunteer for this assessment; those who did were compensated. Two trained scorers scored student responses. The scores were analyzed on a pass/no-pass basis.

The student subjects also filled out an online survey that asked them about themselves and their experiences in the target courses. See the Appendix for a copy of these questions.

III. EVALUATION FINDINGS

Case Studies

Advanced Placement Statistics

Brief description of course. Advanced Placement Statistics runs a full year and prepares students for an examination in May that qualifies those who pass for college credit. The course introduces students to concepts and statistical tools for collecting and analyzing data and drawing conclusions.

Context. The course is offered in both face-to-face and online forms by Hudson High School, a school of more than 800 students in a fast-growing suburb near Boston, Massachusetts. The high school is over 90% white, with almost 30% of students in bilingual education (mostly Portuguese). More than 90% of students go on to postsecondary education. The 18,000-person community plans to build a new high school accommodating 50% more students. The local school district, Hudson Public Schools, received and administers the Technology Innovation Challenge Grant for VHS.

The AP Statistics teacher, Karen Deavers, has taught mathematics at Hudson High School for 3 years and has experience teaching mathematics courses at other high schools and universities. She holds a master's degree in statistics. Although she is not a computer expert, she is very familiar with a variety of software applications, particularly Microsoft Excel. This was her third year teaching the VHS AP Statistics course.

Students. Students enrolled in AP Statistics in both face-to-face and online versions were college-bound juniors and seniors who had completed Algebra II. There were 7 students enrolled in the face-to-face class, and no one dropped out; 14 were enrolled in the VHS version, but 2 dropped out.

All students in the face-to-face course were white; the ethnicities of the VHS students were unknown. The gender distribution was evenly split in the face-to-face course. Although gender identification was not confirmed in VHS course postings, it appeared that roughly half the VHS students were female.

Courses compared and contrasted. The content and assessment of AP Statistics and the students taking the online and face-to-face classes were very similar. They

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differed somewhat in schedule and assignments, and they differed significantly in patterns of interaction.

The courses followed slightly different schedules. The VHS course concluded before the AP exam, whereas the face-to-face course continued one more month, until the end of the school year. The courses also varied in general time structure and homework patterns. The face-to-face class ran daily for about 1 hour and 15 minutes, with homework assigned Monday through Thursday. In the VHS course, students would have a week to complete their assignments.

Students in both the VHS and face-to-face versions of AP Statistics were presented with real-world problems that required data collection, research, a review of facts, and analysis. In most cases, these were word problems embedded within students' assignments. However, larger projects that required at least a week to complete were also assigned, particularly to VHS students. More short-term, "hands-on" activities occurred in the face-to-face class, such as doing experiments (penny flipping) and creating display posters.

Students in both courses used calculators and spreadsheet software (Microsoft Excel) to conduct their analyses, and both used the software to create scatter plots, bar graphs, pie charts, and reports. The face-to-face students used such software slightly more than the VHS students did. VHS assignments also took advantage of the World Wide Web by providing students with links to a variety of data sets, resource links, news articles, and Web-based research opportunities, such as those related to sports statistics, dietary facts, or data on colleges and universities.

The overall structure of teaching was similar between the two courses, the teacher beginning with lecture, following with assignment, and concluding with review of student work. But the social interactions differed significantly between the courses. In the VHS version, about 75% of the student interaction with the teacher involved submitting completed assignments, and there were very few student questions to teachers about content. Interaction among the students was close to nonexistent. By contrast, students in the face-to-face class engaged in frequent questioning of the teacher about

content. There was also significant student-to-student interaction, much of it off-target but contributing to a sense of community, nonetheless.

Modern Classics, Living Authors

Brief description of course. The selected class is a high school literary analysis course in which students interpret texts and write expository essays. The course texts, written by English and American authors, contain a number of interrelated themes that the students explore throughout the course. Because the class is text based, students do a good deal of reading, information processing, and essay writing offline or out of class. The semester-long VHS course, "Modern Classics, Living Authors," is derived from a yearlong Advanced Placement (AP) English course.

Context. Ellet High School is located in a quiet suburban community on the southern fringes of Akron, Ohio. Akron has a population of more than 200,000 and is known for the production of rubber tires and polymers. Ellet High School has 1,200 students, who are predominantly white (84%); most of the remaining students are African American (14%). Just fewer than 50% of graduating Ellet seniors in the class of 1999 were college-bound. Students can choose from a variety of career and academic programs, honors courses, and 10 Advanced Placement courses.

The teacher, Thomas Redding, has more than 23 years of experience teaching English in the city's school system. Mr. Redding has a bachelor's degree in English from Kent State and a master's degree in comparative literature from Pennsylvania State University. He is proficient in using a variety of application software tools, as well as different programming languages. The 1999-2000 school year was his first teaching this VHS course.

Students. At Ellet High School, Mr. Redding teaches two sections of the AP English course, which had 28 students during 1999-2000. The observations focused on one section, in which there were 17 students; 16 were white and 1 was African American. There were 10 females and 7 males. There were 13 students in the VHS course, 9 of whom were females. Data on the ethnic backgrounds of the VHS students was not available. Three VHS students dropped out, and two students dropped out of the face-to-face target section.

Courses compared and contrasted. Mr. Redding said that most of the content overlapped between the courses, but there were some significant differences between the courses overall. The VHS course was adapted from a unit on the novel in the yearlong face-to-face AP English class, which also focuses on poetry and plays. In both courses, students purchased books and downloaded online reading materials for assignments. However, the writing assignments were modified to accommodate differences between the two settings. For example, many of the writing assignments given in the face-to-face class were changed to discussions in the online course. Additionally, several face-to-face assignments were combined to make one online assignment for the VHS students.

The schedules were different; the VHS students had 10 weeks to finish their course, whereas the face-to-face class had 15 weeks to complete the same content. Mr. Redding said he believed that the longer exposure to the classroom practices and activities provided an opportunity for face-to-face students to develop writing themes on a greater variety of texts and in greater depth.

Students in both classes used technology. Students in the face-to-face class made recordings of popular songs that represented the different stages of their lives. They exchanged the tapes, listened to them overnight, and discussed the meaning of these songs in relationship to a person's life. Mr. Redding regularly e-mailed students in both courses to clarify questions, exploring ideas related to meaning, and giving feedback on drafts of writing assignments. He also had both groups of students conduct Web searches about the texts and authors, but the VHS students did this more often. Students in the fall VHS course took a virtual tour of the Vietnam War memorial and wrote about their impressions.

The structures of the two courses were similar, the teacher beginning discussion with an excerpt from a novel, then reflecting back student comments, and finally giving the day's writing assignment. But the interactions differed significantly. The interactions between students and teacher in the face-to-face class were more intensive, with numerous opportunities to recapitulate an idea, listen to feedback, and reflect. Whereas student talk comprised 68% of the face-to-face classroom interaction, students in the VHS course interacted with the teacher only about a third as much. Meaningful exchanges between the teacher and individual students occurred regularly, but the VHS

environment limited the frequency and quality of the interaction. VHS students went online only about once per week, on average. Mr. Redding said he felt that this lack of interaction put VHS students behind schedule for completing their assignments. He recounted an incident in which it took 4 days for him to receive a message from a VHS student who was having difficulty with the course. Also, comparatively few students interacted with other students in the VHS course.

Photographic Vision

Brief description of course. The VHS photography course, "Expanding Artistic Vision Through Photography," is based on one segment of a career program in photography offered by the Fort Hayes Career Center in Columbus, Ohio. Both versions of the course teach the basic elements of photographic composition: vantage, frame, subject, breadth, and depth. In the face-to-face course, the 1-year photographic composition course follows 1 year of courses on film developing, printing, and photographic lighting.

Context. The photography courses were offered by the Career Center at the Fort Hayes Metropolitan Education Center, which is composed of the Fort Hayes Arts and Academic High School and the Fort Hayes Career Center. Located in a Civil-War-era Army facility in downtown, the Center draws on students from the entire Columbus area. The Center has won numerous awards, such as the 1997 Business Week Awards for Instructional Innovation, the 1995 Ohio's Best Practices Award, and the Redbook America's Best Schools Award in both 1992 and 1994. The Career Center provides half-day vocational training to about 560 high school juniors and seniors from all over Columbus, who are enrolled in half-day career programs in business, health, and the performing and visual arts. The 2-year photography program features darkroom developing and printing facilities, a photography studio, and classroom facilities.

Teacher Ed Elberfeld received his undergraduate degree in political science, along with a teaching certificate. He taught middle school English for a decade and has taught at Fort Hayes for 20 years. Along the way, he earned two master's degrees, in instructional technology and photography. The 1999-2000 school year was the first year he has taught his VHS course. Mr. Elberfeld is both the school's technology coordinator and the VHS site coordinator.

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Students. Students must apply to get into both the Arts and Academic High School and the Career Center. Students are selected on a first-come, first-served basis in the high school. Students in the Career Center are selected on the basis of their career goals, among other criteria. Consequently, there were major differences between the students in the two versions of the photography course. Students were in the face-to-face photography program because they wanted to become commercial photographers. By and large, VHS students just wanted to take better pictures. Some people in the VHS course had never held a camera; others were visually oriented and had taken art courses. Students in the face-to-face course were enrolled in their second year of a 2-year program and had learned how to develop film and use lighting.

There were 18 VHS students and 14 face-to-face students enrolled. The VHS students ranged from 9th to 12th grade; the students in the course at Fort Hayes were all seniors. Students were considered to be "independent," according to their teacher. Both groups included more females than males and had few African Americans. There were no dropouts in either version of the course.

Courses compared and contrasted. The content of the courses was similar in the common portions, but the effort that students put into the assignments and the amount and quality of the student interactions were different. Mr. Elberfeld estimated that his face-to-face students spent approximately 15 hours on a unit, whereas VHS students spent only about 5 to 7 hours on a unit.

The technology used by the students differed between the two courses. VHS students used a simple digital camera, or they used a regular still camera and had access to a scanner, so they could turn in their assignments digitally. Their photographs were in color. Face-to-face students used professional camera and darkroom equipment, and their work was usually in black and white, which is considered more artful. The Internet has not been part of the teaching in the face-to-face course; indeed, the school lacked Internet access. But Mr. Elberfeld was an early user of Photoshop and digital photography, going back to the early 1980s. Face-to-face students use these tools on a regular basis.

The interactions in the two course versions were similar in overall structure but different in frequency and depth. Structurally, both courses began with a brief lecture (or lecture-like reading in the VHS course) by Mr. Elberfeld and a discussion. Students viewed sample photographs that illustrated a concept of composition, and these were discussed. Then students shot their own photographs and subsequently presented them to their peers and Mr. Elberfeld for critique. Students were encouraged to reshoot photographs to address the compositional concerns raised in the critique sessions.

The interactions that brought this structure to life differed dramatically between face-to-face and VHS versions. In the face-to-face version, students discussed each other's photos in depth. The students received a lot of modeling from the teacher and each other in how to critique, and they got a lot of practice doing it. They frequently reshot their photographs in response to other students' critiques. In VHS, by contrast, the culture of critique was more difficult to foster. Mr. Elberfeld required everyone to comment on at least one other person's photographs, but he found that the comments tended to be superficial. The comments were "Nice picture, dude" rather than "You really use the frame well." Also, VHS students seemed to avoid saying anything viewed as negative. "I want them to talk less about it being a 'great picture,' more about what they are trying to accomplish with the photo," Mr. Elberfeld said. VHS students were less likely to reshoot their photos.

Mr. Elberfeld said that the *LearningSpace* technology used by VHS limited the social interactions in a couple of ways. The linear, asynchronous discussion structure was not sufficiently interactive, so students could not respond quickly or in depth. He also said the technology was limited because students were not able to make or see comments while they viewed photographs, nor could they communicate their compositional critiques by gesturing or pointing to elements of a photograph, as would be permitted by shared editing.

Pre-Engineering and Design

Brief description of course. Pre-Engineering and Design is a "hands-on" laboratory course and therefore poses special challenges for instruction in an online environment. The course introduces students to the basics of engineering design and problem solving. Students develop, design, and create prototype solutions to fictional

design and engineering problems. Construction projects typically require inexpensive materials, such as cardboard, paper, masking tape, batteries, wire, string, and Styrofoam.

Context. The course's face-to-face and online versions were offered by Dade County High School, which serves about 700 students in the rural mountain town of Trenton, Georgia. The nearest city is Chattanooga, Tennessee, about 25 miles north. The school principal described Trenton as a humble community, where about a quarter of the adults are semiliterate and good blue-collar jobs are increasingly scarce. Typically, only about a quarter of the high school senior class go on to college. The community is close-knit, and many teachers are "like family" for students, according to the principal.

The VHS teacher, Billy Millican, a 21-year veteran, teaches technology, communications technology, and pre-engineering courses to students at all grade levels. He is also the school's technology teacher and coordinator. He has an Educational Specialist degree in science education from the University of Alabama. The 1999-2000 school year was Millican's first as a VHS teacher.

Students. There were 19 students in the face-to-face course, and 16 students started the VHS course. Only 12 students finished the VHS course; there were no dropouts in the face-to-face course. There were five females in the face-to-face version of the course, but only one female in the VHS course. Most students in the face-to-face course were not headed for college, whereas most students in the VHS course were college bound.

Courses compared and contrasted. The face-to-face and online courses differed in content, technology, and interaction. Mr. Millican attributed the differences in course content primarily to the courses' different schedules. The face-to-face course carried a full year's credit packed into one semester of 90-minute daily classes. The VHS version was designed to provide only one semester of credit. Consequently, the VHS course involved fewer assignments. Mr. Millican initially identified 13 "design activities" for the face-to-face class but only 7 for the VHS class: paper tower, paper bridge, propeller-powered (rubber band) vehicle, poster board vehicle, space station activity, Delta Dart-powered (rubber band) plane, and CO_2-powered car. In addition, Mr.

Millican identified two activities as "common assignments" in the two versions of the course: Dizzy Roller Coaster design and Downhill Vehicle design.

Methods of assessing student performance also differed between the two course versions. Mr. Millican can closely monitor work interactions in the face-to-face class. With VHS, he tried to view students' products online, although the digital photos of student work were sometimes not posted. However, even when photos were posted, it was difficult for Mr. Millican to make judgments about other important factors, such as how well students solved problems or whether they used their time wisely and efficiently. In VHS, he asked students to find adults who worked with them to rate these other factors.

The face-to-face class benefited from a large working space, samples of previous student work, and a variety of building materials. These students also used computer-aided design software to draft their designs and used modeling software to test the structural integrity of their bridge designs and the speed performance of their car designs. In the face-to-face class, Mr. Millican also purchased model rocket kits and additional model rocket engines (used by students to build more rockets, not from kits) and, for some other projects, balsa wood. But in the VHS class, students were not required to obtain these types of materials.

The overall structure of the interactions was similar between the two courses. The teacher presented a problem, the students worked on it, and then there was a final presentation and critique. But the quality of interaction differed dramatically between classes. In the face-to-face class, students interacted frequently with each other while working together on teams; in VHS, they hardly interacted, and teams were not possible. Apart from an assignment in Week 1 called "Making Friends," in which each student had to review information in the Profiles and comment on it, there was essentially no student-to-student interaction in VHS. In the face-to-face class, students could observe the problems with prototypes created by their peers and learn from the teacher's critiques. Such dynamic demonstration and troubleshooting were not available in the VHS system. Finally, the interaction between students and teacher also differed. VHS students posed many fewer questions to the teacher.

A couple of other factors limited the quality of interaction. Mr. Millican's computer at school has never enabled him to use the full functionality of *LearningSpace,* so he often worked on VHS at home at the end of a long day. "They're not getting the same teacher as these face-to-face students," Mr. Millican said. "They're getting what's left of me at the end of the day." Another factor, as noted earlier, was Mr. Millican's difficulty in viewing and critiquing assignments online.

Cross-Case Analysis

Looking across the four case studies, there are some important similarities and differences in teachers, schools, and students, compared with each other and with the larger group of VHS participants. Within the case studies, there are a number of important and interesting similarities and differences between the face-to-face and Virtual High School versions.

Teachers, Schools, and Courses

The teachers of these courses are very typical of other VHS teachers. In our earlier reports (Zucker, Kozma, Young, & Collier, 1997; Kozma, Zucker, & Espinoza, 1998), we found that the VHS project attracts very well qualified teachers. The four teachers in the case studies fell within this group. All were experienced teachers; three of the four had more than 20 years of teaching experience. All four had advanced degrees; one had two master's degrees, and another had an Educational Specialist degree. All of them were very familiar with technology; two of them were the technology coordinators for their schools.

However, the 1999-2000 school year was the first year that three of the four (Redding, Millican, Elberfeld) taught their VHS courses. Perhaps because these teachers joined VHS in later cohorts, there seemed to be less support from their schools for their VHS courses. None of the three teachers felt that they received the appropriate release time from their standard course load, so that their VHS courses were an additional effort. Two of these teachers did not have sufficient Internet connectivity at school and had to do their VHS work in the evenings at home. Hudson provided release time and full Internet connectivity in support of Karen Deavers' VHS efforts, as might be expected from the originating school for the VHS project.

School characteristics ranged considerably among the four. Hudson High School and Ellet High School are suburban schools with limited ethnic diversity among their students, but they are different from each other, nonetheless. Hudson has an enrollment of 800 students, 90% of whom are white. A large number (90%) of Hudson's students typically go on to college. Ellet has an enrollment of 1,200 students, 84% of whom are white and 14% African American. About half of Ellet's graduating seniors go on to college. Dade County High School is also a suburban school, but only about 25% of the Dade students go on to college. Fort Hayes Metropolitan Education Center is located in the heart of a large city—Columbus, Ohio—and has a diverse student body. A majority of the students (52%) are African American. It is a high-performing school, with nearly 90% of its students going on to 4-year or 2-year colleges.

The four target VHS courses covered the range of types of courses included in the VHS catalog. All four courses were electives, outside the core high school curriculum. They were typical of the majority of VHS courses in this regard. Two of the four (AP Statistics and Modern Classics) focused on advanced or specialized academic content. The other two (Pre-Engineering and Photographic Vision) were oriented more toward work or career.

Differences between VHS and Face-to-Face Students

The students in these VHS courses also were typical of other VHS students, with teachers generally describing them as academically very capable and college bound. This was also the case for face-to-face students in the two academic courses (AP Statistics and Modern Classics). On the other hand, there were significant differences between the VHS and face-to-face students in the other two courses. Unlike VHS students in the Pre-Engineering course, many—perhaps most—of the face-to-face students at Dade County High School were not likely to go on to college. The difference between the two groups was even greater for the Photographic Vision course. Although Mr. Elberfeld characterized students in both groups as independent, the students in the face-to-face version of the course were much more experienced in the area of photography, and they had a career-oriented interest in the course. That is, the Fort Hayes students in the Photographic Vision course were second-year students in a 2-year photographic career program. Although the teacher characterized the VHS students as generally more

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academically capable than his face-to-face students, the photographic experience of the VHS students was limited, and they tended to approach photography as a hobby.

There were other differences between the two groups of students that might affect end-of-course performance. The enrollment sizes were somewhat different, with more VHS students than face-to-face students in the AP Statistics (14 VHS versus 7 face-to-face) and Photographic Vision (18 VHS versus 14 face-to-face) courses, and fewer VHS students in the Pre-Engineering (16 VHS versus 19 face-to-face) and Modern Classics (13 VHS versus 17 face-to-face) courses.

The dropout rate was low for all of the courses and somewhat different between VHS and face-to-face in three of the four courses. There were no dropouts in either version of the Photographic Vision course, but more VHS students dropped out of the AP Statistics (2 of 14 VHS versus none face-to-face), Modern Classics (3 of 13 VHS versus 2 of 17 face-to-face), and Pre-Engineering (4 of 16 VHS versus none face-to-face) courses.

Differences in Course Content

Nominally, the VHS and face-to-face versions of these courses were the same. However, although there were similarities in content and structure between the two versions of these courses, there were also significant differences. In actuality, the VHS courses were to some degree a subset of the content covered by the face-to-face versions in every case. For example, the face-to-face version of the AP Statistics course was a month longer at Hudson than its corresponding VHS version, although the additional work came after the advanced placement test was administered. The VHS Photographic Vision course was actually one-fourth of a half-day, full-year course that constituted the second year of a 2-year program at Fort Hayes Career Center. The one-semester VHS Modern Classics course covered novels, but the full-year AP English course taught at Ellet also covered poetry and plays. And students in the Pre-Engineering course at Dade County did 13 design projects in their one-semester, full-year-credit block course, whereas the VHS students did only 7 projects in their one-semester credit course.

There were some important similarities in content, structure, and materials in the portions of the courses that overlapped between the two versions, but also some

significant differences. For example, the objectives and content were the same for the common portions of the AP Statistics course, and students used the same textbook. However, the assignments for VHS students were larger and more project-like. The face-to-face students received shorter, more problem-like assignments.

In the common portions of the Modern Classics course, the VHS and face-to-face students had the same goals, readings, and assignments. The structure was the same, as well, with students reading the assignments, the teacher posing questions, the students answering questions, and the teacher reflecting the answers back to them without directly confirming their responses. On the other hand, VHS students spent 10 weeks on the content they shared with face-to-face students, but the face-to-face students spent 15 weeks on this content. The "same" assignments were modified for the VHS students; some of the assignments were simplified, and VHS students were allowed to revise their assignments before they were graded. This was not the case for face-to-face students. Some of the assignments for face-to-face were timed, in-class essays; none of the VHS assignments were timed.

In Pre-Engineering, some of the projects were the same for the portion of the course that overlapped for both sets of students. However, face-to-face students had access to samples of work from students who had taken the course previously, access to a rich set of materials needed to construct their designs, and access to large workspaces. VHS students did not have access to the work of previous students and may or may not have had access to a large workspace and a variety of building materials. In addition, the students in the face-to-face version worked in teams; the VHS students did not.

In photography, the goals, units, materials, and assignments were the same in the one-quarter of the photography course that was the same for face-to-face students at Fort Hayes and the VHS students taking the Photographic Vision course. But the VHS students used common still or digital cameras, whereas the face-to-face students had professional cameras, studios, and darkroom equipment. The instructor contended that for this portion of the course (as compared with the portions that VHS students did not take, such as film development), access to professional equipment did not make a difference. Of more significance is that the VHS students tended to spend about half to

one-third the time on their photo assignments that face-to-face students did, according to the teacher.

Differences in the Use of Technology

On the surface, the most obvious difference between the two versions of the courses was the use of technology. The VHS students used the Internet and the *LearningSpace* software on a regular basis to access the teacher, assignments, course materials, and other students. Students in the face-to-face versions of the courses used technology differently. For example, both face-to-face and VHS students in AP Statistics used calculators, but VHS students had access to a variety of online statistical databases for their problems. Face-to-face students in the Pre-Engineering course used a variety of software design tools. Face-to-face students in the AP English course occasionally used videotapes to see materials related to their readings. They used the Internet to access materials, although they did so rarely. More often, they used e-mail to communicate with the teacher about the assignments beyond the classroom time. The VHS Modern Classics students used the Internet extensively to access materials related to their readings. Photography students at Fort Hayes used various professional software programs, such as Photoshop, but they did not even have access to the Internet in their school.

However, the limitations of the technology used by VHS students had serious consequences for their learning in at least two of the courses. An important activity in the Photographic Vision course was to discuss the specific compositional elements of the photographs that students submitted. Although the students were able to use the Internet to post their photos for the teacher and other students to see, the structure of *LearningSpace* would not allow students to view photographs at the same time that they commented on them. This limitation may have contributed to the shallowness of student comments noted by the teacher. The limitations of technology were even more serious in the one "hands-on" course. The student design was the culminating activity of each Pre-Engineering unit. Yet Mr. Millican was seriously limited in his ability to inspect and comment on these student products. He asked students to post photographs of their designs in *LearningSpace* and have a local adult submit comments on them, using the criteria for the assignment. But this accommodation to the limitations of the technology was not implemented effectively. It was clear that these limitations were serious

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liabilities to VHS Pre-Engineering students. In fact, these limitations seriously jeopardized the quality of their whole learning experience in the course.

Differences in Interaction

The most serious technology-based limitation, and the biggest difference between the VHS and face-to-face experiences, was the limited amount of student-to-student and even student-to-teacher interaction in the VHS courses. All the instructors commented on the quantity—and two commented on the quality—of student-to-student interaction in their VHS courses. Ms. Deavers said that the student talk in the VHS AP Statistics course was minimal. Mr. Millican said that there was little or no student-to-student interaction in the Pre-Engineering course, and student-teacher interaction was limited. Mr. Redding estimated that student-to-student talk accounted for two-thirds of the face-to-face class talk and only one-third of the VHS talk in Modern Classics. He also felt that the quality of the student talk was better in the face-to-face version of the course. Mr. Elberfeld felt that the difference in quantity of student talk in the VHS photography course was much lower and the quality was more superficial. Face-to-face students were in the habit of talking much more and much more deeply about the quality of each other's work. "Nice picture, dude," would suffice for the VHS students.

This pattern of interaction was corroborated by an inspection of interactions in *LearningSpace* across the four courses. A large majority of the entries were made by teachers. Student-posted entries and students' comments on other students' postings were almost nonexistent. Most postings made by students were the submissions of their assignments.

This phenomenon seemed to be due to the fact that there was little opportunity for in-depth interaction when students typically signed on only once a week. This extremely asynchronous interaction significantly reduces the connectedness in the discourse that otherwise would create a sense of conversation. This reduced connectedness was compounded by the lack of a shared view of material. Shared viewing and synchronous discourse give grounding to a conversation and support understanding (Clark & Brennan, 1991).

This lack of frequency, depth, and connectedness in student interaction is likely to have had two effects that disadvantaged VHS students, relative to face-to-face students. The first was to limit the amount of feedback that VHS students received on their ideas and products. This limitation is likely to have negatively affected the amount they learned. The second effect was on a sense of community among students. All four instructors noted that there was a considerable amount of informal, small talk among face-to-face students and none among VHS students. This lack of informal interaction may have had a negative effect on student motivation in the course and a subsequent, indirect effect on learning for VHS students.

Results of Student Questionnaires

Each face-to-face and VHS student who participated in the Internet assessment was asked to also fill out an online survey. These questions asked about the student's background and experiences in the target course.

Student Characteristics

Across the four courses, there were some similarities but also important differences between face-to-face and VHS students. Approximately the same proportion of face-to-face students (48%) and VHS students (56%) were likely to be females. Just as many face-to-face students (92%) as VHS students (93%) said they were going to go to college after graduation.

On the other hand, slightly more students were minorities in the face-to-face courses (30%) than in the VHS courses (18%). Face-to-face students were more likely to be seniors; 90% of the face-to-face students were in the 12th grade, compared with only 50% of VHS students (43% were juniors). And significantly more VHS students (68%) than face-to-face students (34%) were taking six or more courses. It appears that VHS students were taking their online course on top of a normally full course load.

Course Experiences

There also were some similarities and important differences between the two groups in their course experiences. Students in both groups expressed interest in and enjoyment of their courses. Many VHS students (78%) and face-to-face students (95%)

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said that their course was as interesting as other courses they had taken or was one of the most interesting courses they had taken. Similarly, many VHS students (71%) and face-to-face students (92%) said that their course was as enjoyable as others or one of the most enjoyable courses they had taken.

On the other hand, whereas VHS students were likely to agree (68%) that their VHS courses were of high quality, face-to-face students were more likely to agree strongly about their courses (56%). Similarly, VHS students agreed (44%) that they worked as hard or harder in their courses than in others, but face-to-face students were more likely to agree strongly (46%).

Face-to-face and VHS students reported similar experiences in using computers to do research projects and write reports. There were no significant differences between the groups in their use of computers, e-mail, or the Internet generally, although the use of these tended to be higher for VHS student than for face-to-face students. Unsurprisingly, VHS students did report significantly higher use of the World Wide Web to gather information, with 79% saying that they on average they used it regularly, while only 54% of the face-to-face students said so.

Students reported significant differences in the communication patterns within their courses. Face-to-face students were likely to agree strongly with the statement that discussion was a regular part of their courses (67%), that they frequently communicated with other students (79%), and that communications with other students were an important part of their learning (66.7%). VHS students were more likely than face-to-face students to disagree with all of these statements (29%, 46%, and 43%, respectively).

There were no significant differences between the two groups in reporting frequent communications from their teachers. Large majorities of both groups of students agreed or agreed strongly that their teachers communicated with them frequently, although the face-to-face students tended more often to agree strongly. But other differences were significant. Face-to-face students were more likely (66.7%) than VHS students (40.7%) to agree strongly that communications with teachers were an important part of their learning and that they got their assignment grades back from their teachers in a timely manner (56.4% vs. 35.7%). The differences in student-to-student and

teacher-to-student communication patterns between these two groups, as reported by students, corresponds to patterns as reported by teachers and as observed by researchers in the case studies. These patterns reiterate findings reported previously (Kozma, Zucker, & Espinoza, 1998).

Outcomes of Assessments

Student learning in the face-to-face and VHS courses was measured in two ways, as described above in the section on instruments: key assignments and Internet assessment.

Key Assignments

As mentioned earlier, analysis of key assignments was possible for only three of the four courses. The Pre-Engineering course did not permit adequate assessment of the hands-on design assignment because the VHS students' products were available only via digital photographs. In the remaining three courses, teacher scores were rescaled to a common metric. The metric ran from 55 points (the equivalent of an "F") to 100 points (the equivalent of an "A+". The scores were then compared for face-to-face and VHS students. Qualified external graders used the teachers' criteria to rescore the students' products. These external graders did not know which students were in which version of the courses. Exhibit 6 shows these comparisons.

Exhibit 6
Mean Scores on Key Assignments

		Teacher	External Grader
AP Statistics	VHS	67.4	67.1
	Face to Face	71.5	76.8
Modern Classics	VHS	72.8	69.3
	Face to Face	77.6	83.1
Photography	VHS	84.4	65.7
	Face to Face	86.4	88.1*

*Mean score for face to face is significantly higher than for VHS, p<.01.

There were no statistically significant differences in teachers' scores between the face-to-face and VHS groups in any of the courses. Although there were differences in mean scores between the groups, they were statistically similar, given the size of the

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groups and the within-group variance. Nor were the external graders' scores significantly different between the groups for the Advanced Placement Statistics or Modern Classics course. However, the external grader did give the face-to-face students higher scores than the VHS students in one course, Photographic Vision.

Internet Assessment

Both face-to-face and VHS students in all four courses took the same Internet performance assessment, the task of "Choose-a-City." Their performances were independently scored by two raters. The mean score between the two was used for analysis. The scores were analyzed on a pass/no-pass basis. Exhibit 7 displays the scores.

Unsurprisingly, the most pronounced difference between the groups was on the technology use skill area. In every course, more VHS students than face-to-face students passed this portion of the assessment. Another major difference occurred in the Photography and Pre-Engineering courses. Many more VHS students than face-to-face students passed all of the skill areas of the Internet assessment. Also, on the reasoning with information skill area, the VHS students in the AP Statistics course performed better than did the face-to-face students. In only one course, on only one skill area, did face-to-face students outperform VHS students. In the Modern Classics course, more face-to-face students than VHS students passed the reasoning with information skill area. Consequently, it is reasonable to say that the VHS students in these courses acquired more of the skills needed for the information society than the face-to-face students did.

Exhibit 7
Number and Percent "Pass" on Internet Research Assessment for VHS and Face-to-Face Courses

Skill Area	Component	AP Statistics				Modern Classics			
		VHS		Face to Face		VHS		Face to Face	
		N Pass	% Pass	N Pass	% Pass	N Pass	% Pass	N Pass	% Pass
Technology Use	Citing URLs	5 (5)	100	4 (4)	100	3 (3)	100	12 (13)	92
	Formulating search query	5 (5)	100	3 (4)	75	3 (3)	100	9 (11)	82
	Total passes	10 (10)	100	7 (8)	88	6 (6)	100	21 (24)	88
Reasoning with Information	Rating evidence	5 (5)	100	4 (4)	100	3 (3)	100	14 (14)	100
	Finding questionable information	4 (5)	80	3 (4)	75	0 (2)	0	11 (12)	92
	Generating research question	5 (5)	100	3 (4)	75	2 (3)	67	10 (11)	91
	Total passes	14 (15)	93	10 (12)	83	5 (8)	63	35 (37)	95
Communication	Organization	4 (5)	80	4 (4)	100	3 (3)	100	11 (12)	92
	Support	5 (5)	100	3 (4)	75	3 (3)	100	10 (12)	83
	Drawing conclusions	5 (5)	100	3 (4)	75	3 (3)	100	9 (12)	75
	Mechanics	4 (5)	80	4 (4)	100	2 (3)	67	10 (12)	83
	Not copied	5 (5)	100	4 (4)	100	3 (3)	100	12 (12)	100
	Total passes	23 (25)	92	18 (20)	90	14 (15)	93	52 (60)	87

Skill Area	Component	Photography				Pre-Engineering			
		VHS		Face to Face		VHS		Face to Face	
		N Pass	% Pass	N Pass	% Pass	N Pass	% Pass	N Pass	% Pass
Technology Use	Citing URLs	12 (12)	100	4 (6)	67	8 (9)	89	2 (4)	50
	Formulating search query	9 (12)	75	4 (6)	67	7 (8)	88	0 (3)	0
	Total passes	21 (24)	88	8 (12)	67	15 (17)	88	2 (7)	29
Reasoning with Information	Rating evidence	10 (12)	83	5 (6)	83	8 (9)	89	2 (8)	25
	Finding questionable information	9 (12)	75	2 (5)	40	4 (7)	57	0 (3)	0
	Generating research question	8 (12)	67	4 (6)	67	7 (8)	88	2 (3)	67
	Total passes	27 (36)	75	11 (17)	65	19 (24)	79	4 (14)	29
Communication	Organization	11 (12)	92	3 (6)	50	8 (9)	89	2 (5)	40
	Support	11 (12)	92	4 (6)	67	8 (9)	89	2 (5)	40
	Drawing conclusions	11 (12)	92	4 (6)	67	6 (9)	67	2 (5)	40
	Mechanics	11 (12)	92	5 (6)	83	7 (9)	78	2 (5)	40
	Not copied	12 (12)	100	6 (6)	100	9 (9)	100	5 (5)	100
	Total passes	56 (60)	93	22 (30)	73	38 (45)	84	13 (25)	52

Exhibit 7
Number and Percent "Pass" on Internet Research Assessment for VHS
and Face-to-Face Courses (Continued)

Summary					
		VHS		**Face to Face**	
Skill Area	Component	N Pass	% Pass	N Pass	% Pass
Technology Use	Citing URL	28 (29)	97	22 (27)	81
	Formulating search query	24 (28)	86	16 (24)	67
	Total passes	52 (57)	91	38 (51)	75
Reasoning with Information	Rating evidence	26 (29)	90	25 (32)	78
	Finding questionable information	17 (26)	65	16 (24)	67
	Generating research question	22 (28)	79	19 (24)	79
	Total passes	65 (83)	78	60 (80)	75
Communication	Organization	26 (29)	90	20 (27)	74
	Support	27 (29)	93	19 (27)	70
	Drawing conclusions	25 (29)	86	18 (27)	67
	Mechanics	24 (29)	83	21 (27)	78
	Not copied	29 (29)	100	27 (27)	100
	Total passes	131 (145)	90	105 (135)	78

Note: Numbers of students taking assessment components are shown in parentheses.

IV. CONCLUSIONS

The analysis of four courses taught in both modes shows that the VHS experience was similar in some ways to experiences in face-to-face courses. For portions of the courses that were common to both, VHS versions had the same or similar goals, content, assignments, and structure as face-to-face courses. Both types of courses were taught by high-quality teachers. There were few student dropouts from either. Face-to-face and VHS students received similar grades in the two types of course. In addition, VHS students acquired the technology-based reasoning and communication skills needed for the 21st century information society.

On the other hand, there were some important and significant differences. VHS courses were often a subset of face-to-face courses. VHS students were scheduled for and/or spent less time on common assignments and projects than face-to-face students did. There was also much less student-to-student interaction and group work in VHS courses, and student-teacher interaction was rated less positively in the VHS sections. Furthermore, in a highly graphic course, students and the teacher were not able to simultaneously view and discuss student products. In a hands-on course, the teacher was not able to inspect student products, and this limitation significantly inhibited their assessment.

There are two potential sources for the lack of interaction in the VHS courses. First, teachers may be limited in their skills to conduct collaborative and highly interactive courses online. Although it is clear that the teachers involved in this evaluation are able to conduct such courses face-to-face, they may not have developed the skills yet to do so for students distributed across space and time.

Second, the current VHS technology is a limiting factor, at least for certain types of courses. Although it is clear that the use of the Internet enables VHS students to take high-quality courses, offered by high-quality teachers, that would not be available to them otherwise, there are significant technology-based problems that have persisted over the initial years of the VHS project. The limitations in the technology seriously constrain the amount and quality of interaction on the part of students. For example, the *LearningSpace* Course Room supports asynchronous rather than synchronous

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discussions. This limitation, and the fact that students may be online only once or twice a week, increases the lag between statements and replies and reduces the sense of conversation-like interactivity. Nor is there special support that would allow partners or teams to work together on a regular basis. Particularly lacking is support for collaboration on the same product, such as a jointly authored paper. These limitations reduce the student-student and student-teacher interaction, thereby negatively affecting the type of feedback from teachers, the quantity and quality of student input, and the sense of community in VHS courses. Because the limitation also extends to the use of multimedia, it also reduces the quality of the student experience for graphic and hands-on courses. *LearningSpace* also has limited support for simultaneously viewing and discussing materials. For example, students can post and see digital materials in the *LearningSpace* Media Center, but discussions occur in the Course Room, and students cannot be in both areas of the software at the same time. Consequently, students cannot talk about and look at multimedia materials simultaneously.

VHS staff members have recognized these problems and are taking actions to address them. For example, the Teachers Learning Conference (TLC) professional development course has been thoroughly revised on the basis of feedback from VHS teachers and evaluation findings. Among the changes is a renewed emphasis on pedagogical practices in networked environments. New courses developed in the TLC must include group activities and discussions that foster student-student interaction and collaborative learning.

The VHS project is also searching for new core technology that will better support interaction, collaboration, and multimedia applications. The capabilities of new online work and learning environments are growing dramatically, and they are being used to support interaction, collaboration, and community building. For example, Microsoft's *NetMeeting* (http://www.microsoft.com/windows/netmeeting/), TeamWave's *Workplace* (http://teamwave.com), and SRI's *TAPPED IN* (http://www.tappedin.org/) all include synchronous text-based chat and shared whiteboards that allow for the co-viewing and discussion of graphic material. *NetMeeting's* capabilities include video and audio conferencing. *NetMeeting* and *Workplace* allow the shared use of tools across the Internet, so that people can work together on the same project. *Workplace* and *TAPPED*

IN let users co-view Web pages. All these capabilities are designed to support increased online interaction and collaboration. Furthermore, *Workplace* and *TAPPED IN* use a building-and-room metaphor to provide users with project rooms or team rooms that contain persistent materials (such as shared documents). This capability supports the formation of group identity and community.

These software environments often have hardware and networking requirements that are difficult for schools to meet. For example, two of the four teachers in the current case studies did not have sufficient computer capabilities in their schools to use even the current VHS technology adequately. But this is a near-term issue. Across the country, schools are increasing the capabilities of both their hardware and networking infrastructures (Anderson & Ronnkvist, 1999; Ronnkvist, Dexter, & Anderson, 2000), and these improvements will enable the use of these more advanced software environments.

As these modifications are put into practice, improvements can be expected in the quality of the VHS course experience. As teachers become more effective in the use of technology to support collaborative learning, as technological environments become more powerful, and as schools develop their technological infrastructure, students will begin to experience the same quality of interaction that they do in face-to-face classes.

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Appendix

INTERNET ASSESSMENT ONLINE INSTRUMENTS

WELCOME

A foreign exchange student is planning to come to the U.S. for the summer. The student has asked you to recommend one of two cities she is considering living in: Knoxville, Tennessee, and Rochester, New York. She is interested in the cities' recreational opportunities, and wants to know about public transportation because she will not have a car. Because she is thinking of moving to the U.S. permanently after she gets out of school, she also wants to know about how good each city's economy is.

You will gather and analyze information about the two cities. Then, you will write the student a letter identifying which of the two you recommend, and why.

Each of the cities has a Web site with links to information about the city's attractions, services, and other characteristics.

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PART I: GATHER AND ANALYZE INFORMATION

To start gathering information, click these links and you'll go to the home pages of the city government Web sites. Clicking on them will bring up a second window. Use that window for your research. Use this window for your work.

- Knoxville (http://www.ci.knoxville.tn.us/)
- Rochester (http://www.ci.rochester.ny.us/)

1. Your first task is to rate each city on each of these three dimensions:
- How varied are its recreational opportunities?
- How good is its economy?
- How good is its public transportation?

Use the table below to rate the cities on the three dimensions and provide supporting evidence. For each city, on each dimension:

      a. Click the rating you want to assign;

      b. Find two pieces of evidence that support your rating. For each piece of evidence cite the URL that takes you to the exact Web page that contains the evidence. To do this, copy and paste (or type) the URLs into the designated spaces below

Knoxville

How varied are Knoxville's recreational opportunities?	How good is Knoxville's economy?	How good is Knoxville's public transportation?
Rating: ○ Greatly Varied ○ Somewhat Varied ○ Limited ○ Few Choices	**Rating:** ○ Very Good ○ OK ○ Some Problems ○ Poor	**Rating:** ○ Very Good ○ OK ○ Some Problems ○ Poor
URL for Evidence A:	**URL for Evidence A:**	**URL for Evidence A**
Evidence A:	**Evidence A:**	**Evidence A:**
URL for Evidence B:	**URL for Evidence B:**	**URL for Evidence B:**
Evidence B:	**Evidence B:**	**Evidence B:**

Rochester

How varied are Rochester's recreational opportunities?	How good is Rochester's economy?	How good is Rochester's public transportation?
Rating: ◯ Greatly Varied ◯ Somewhat Varied ◯ Limited ◯ Few Choices	**Rating:** ◯ Very Good ◯ OK ◯ Some Problems ◯ Poor	**Rating:** ◯ Very Good ◯ OK ◯ Some Problems ◯ Poor
URL for Evidence A:	**URL for Evidence A:**	**URL for Evidence A**
Evidence A:	**Evidence A:**	**Evidence A:**
URL for Evidence B:	**URL for Evidence B:**	**URL for Evidence B:**
Evidence B:	**Evidence B:**	**Evidence B:**

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Part I: Continued

2. Some information on the Web may be more believable than other information. Cite one particular paragraph or set of paragraphs from Web sites about the two cities that seem questionable, and explain why. Also, cite the URL to the page in which the questionable text appears.

3. What would you like to know that could help you figure out whether the information you just cited is accurate or reliable? Write what you would like to know in the form of a question.

4. If you were going to do a topic-based Web search to answer this question, how would you word your search topic? Write your search topic in the space below using the same words you would type into the search engine you would be using.

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PART II: COMPOSE A LETTER

5. Write a letter to the foreign exchange student recommending a city and explaining why you recommend it.

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VIRTUAL HIGH SCHOOL SPRING 2000 STUDENT SURVEY

Please read each question carefully, then check the appropriate answer.

A. YOUR EXPERIENCE IN THE COURSE

You are taking either the VHS version or the regular version of one of these four courses:
- **Expanding Artistic Vision Through Photography**
- **Pre-Engineering and Design**
- **AP Statistics**
- **Modern Classics, Living Authors.**

Please answer these questions about the course.

1. The content in the course is of high quality.
○ Strongly Agree
○ Agree
○ Disagree
○ Strongly Disagree

2. Discussion is a regular part of the course.
○ Strongly Agree
○ Agree
○ Disagree
○ Strongly Disagree

3. In the course, I frequently communicate with other students.
○ Strongly Agree
○ Agree
○ Disagree
○ Strongly Disagree

4. In the course, communications with other students are an important part of my learning.
○ Strongly Agree
○ Agree
○ Disagree
○ Strongly Disagree

5. In the course, the teacher frequently communicates with me, individually or as part of a group.
○ Strongly Agree
○ Agree
○ Disagree
○ Strongly Disagree

6. In the course, communications with the teacher are an important part of my learning.
○ Strongly Agree
○ Agree
○ Disagree
○ Strongly Disagree

7. For each assignment in the course, I get comments and/or grades from the teacher in a timely manner.
○ Strongly Agree
○ Agree
○ Disagree
Strongly Disagree

8. In the course, I work as hard as, or harder than I do, in other courses I am currently taking.
Strongly Agree
Agree
Disagree
Strongly Disagree

9. In the course, I have learned a lot of new information about the subject matter.
- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree

10. Compared with other courses I have taken during the current school year, this course has been:
- ◯ One of the most interesting
- ◯ As interesting as the others
- ◯ Not as interesting as the others but worth taking
- ◯ Not interesting at all

11. Compared with other courses that I have taken at my school during the current school year, this course has been:
- ◯ One of the most enjoyable
- ◯ As enjoyable as the others
- ◯ Not as enjoyable as the others but worth taking
- ◯ Not enjoyable at all

B. YOUR EXPERIENCE WITH COMPUTERS AND RESEARCH

12. How often have you used computers since the current school year began, either at school or at home?
- ◯ Not at all
- ◯ 1-5 times
- ◯ 6-11 times
- ◯ Average of 1-3 times a month
- ◯ Average of once a week or more often

13. How often have you used a computer to find information on the Internet since the current school year began, either at school or at home?
- ◯ Not at all
- ◯ 1-5 times
- ◯ 6-11 times
- ◯ Average of 1-3 times a month
- ◯ Average of once a week or more often

14. How often have you used a computer to write reports or other compositions (not including email) since the current school year began, either at school or at home?
- ◯ Not at all
- ◯ 1-5 times
- ◯ 6-11 times
- ◯ Average of 1-3 times a month
- ◯ Average of once a week or more often

15. How often have you used a computer to write or read email since the current school year began, either at school or at home?
- ◯ Not at all
- ◯ 1-5 times
- ◯ 6-11 times
- ◯ Average of 1-3 times a month
- ◯ Average of once a week or more often

16. How often have you used computer-based tools other than word processors since the current school year began (for example, programming tools, Web pagemakers, science simulations, geography visualizations, spreadsheets, etc.), either at school or at home?
- ◯ Not at all
- ◯ 1-5 times
- ◯ 6-11 times
- Average of 1-3 times a month
- Average of once a week or more often

17. How often have you done research projects since the current school year began, either with or without computers?
- Not at all
- 1-5 times
- 6-11 times

○ Average of 1-3 times a month
○ Average of once a week or more often

18. How often have you used the World Wide Web to gather comparative information, used that information to choose the best alternative?
○ Not at all
○ 1-5 times
○ 6-11 times
○ Average of 1-3 times a month
○ Average of once a week or more often

C. INFORMATION ABOUT YOU

19. What grade are you currently in?
○ 8th
○ 9th
○ 10th
○ 11th
○ 12th

20. What are you planning to do after you graduate from high school?
○ Attend a 4-year college
○ Attend a technical school, community college, or 2-year college
○ Get a job or internship, either voluntary or for pay
○ Join the armed forces
○ Travel
○ Do not know yet
○ Other (please specify)

21. How many different courses are you enrolled in this semester (including the course you have just been reporting about in this questionnaire?
○ Fewer than 4
○ 4
○ 5
○ 6
○ 7
○ 8
○ More than 8

22. How many VHS courses have you taken, including this year and in previous years?
(Include in your count Expanding Artistic Vision Through Photography, Pre-Engineering and Design, AP Statistics, and Modern Classics, Living Authors if you are taking or have taken the VHS version of it.)
○ 1
○ 2
○ 3
○ 4
○ 5
○ 5 or more

23. What is your gender?
○ Male
○ Female

24. What is your ethnic background?
   Caucasian/Anglo American
   African American
   Asian America
   Hispanic American
   Native America

- ⚪ **Other**
- ⚪ **Would rather not answer this question**

Next