Effects of virtual reality support compared to video support in a high-school world geography class

Yukiko Inoue

The author

Yukiko Inoue is an Assistant Professor at the College of Education, University of Guam, Guam, USA.

Keywords

Virtual reality, Video, Schools

Abstract

Virtual reality (VR) is a new computational paradigm that redefines the interface between human and computer. VR may result in a significant improvement over traditional instruction because it is not only an interactive multimedia tool but also a learning environment that is extremely close to reality. Yet there have been few empirical studies on the use of VR compared to that of other computerized or non-computerized educational tools. Examines VR both in different scenarios and for different applications in learning and teaching. The evaluation plan reported here addresses one aspect of such an assessment specifically – the effect of VR support compared to that of video support in tenth graders' learning of world geography. One world geography course ($N = 36$) selected for this experiment was composed of five units. A rotation treatment was used, each group using VR for two units and videos for two units; in addition, one unit was optional for every student. Three procedures were used for data collection and analysis: to determine the effect of VR support, competency tests were administered; to determine student attitudinal responses toward VR, students were required to complete a survey and be interviewed; and to determine the tendency of returning to VR, students were given the option of attending the VR lab. This investigation was limited in several respects (e.g. data from a sample of students in a single class may not be representative of the population).

Electronic access

The current issue and full text archive of this journal is available at

http://www.emerald-library.com

Campus-Wide Information Systems
Volume 16 · Number 3 · 1999 · pp. 95–103

> We live in a physical world whose properties we have come to know well through long familiarity. We sense an involvement with this physical world which gives us the ability to predict ... where objects will fall, how well-known shapes look from other angles, and how much force is required to push objects against friction ... A display connected to a digital computer gives us a chance to gain familiarity with concepts not realizable in the physical world. It is a looking glass into a mathematical wonderland (Ivan Southerland, 1965).

Introduction

General description of the area of concern

"Virtual reality (VR) is coming; make of it what you may" (Bricken, 1990, p. 7). VR may have a significant impact on educational systems of tomorrow. Current educational systems have been designed for an era in which human minds, textbooks, and pencils were the major tools used to store and process information. That is no longer the case. On entering the twenty-first century, education must become responsive to changing social needs and become more effective in the learning and teaching process. Generally, VR refers to a new computational paradigm, which fundamentally redefines the interface between human and computer. Technically, in Glenn's (1991) words, "VR refers to an environment or a technology that provides artificially generated sensory cues sufficient to engender in the user some willing suspension of belief" (p. 12). In the VR world, people believe that what they are doing is real, even though it is an artificially simulated phenomenon. Sophisticated VR can simulate sight, sound, and touch and combine these senses with computer-generated input to people's eyes, ears, and skin. Many people can share and interact in the same environment. VR is thus a powerful medium for learning and training.

Purpose of the proposed evaluation

Currently, most of the media attention on VR lies in the area of entertainment (such as VR arcade machines), yet possibilities of VR seem

Paper presented at the Teaching with Technology (Rethinking Traditions) Conference at Rollins College, Winter Park, Florida, 15-18 October 1998.

almost limitless. Many educators, researchers, industry trainers, and software vendors predict that the use of VR for supporting school subjects may result in a significant improvement over traditional instruction, providing unparalleled and unprecedented opportunities because VR is not only an interactive multimedia tool but also a learning environment that is extremely close to reality. Students can actively participate in and learn by experimenting with all the options of the VR program. In spite of these promising predictions, there have been few empirical studies on the effect of VR compared to that of other computerized or noncomputerized educational tools. It is thus necessary to evaluate the effect of VR both in different scenarios and for different applications in educational settings.

The evaluation plan reported here addresses one aspect of such an assessment, specifically the effect of VR support as compared to that of video support in a high-school class. The reason world geography was selected for this evaluation was that students could "travel" to any place in the world via VR. Although videos (which combine text, picture, voice, and animation) are popular in world geography classes, they may not be as effective as VR because they offer only two-dimensional (2D) graphics and are passive forms of learning. In contrast, VR is a three-dimensional (3D) environment, challenging students to play an active role by experiencing for themselves the "inside" of an environment, such as a jungle, a desert, or the top of an iceberg.

Audience for the evaluation

The issue of the effectiveness of VR as an educational tool will be of interest to educators as well as researchers, particularly those who are interested in teaching with technology. The second potential audience includes educational administrators and educational planners at the federal, state, county, city, and school levels. Success of VR may have important implications for course planning, budgets, purchasing of computers, and supporting software development. Finally, both hardware and software venders may be interested in this evaluation.

Feasibility of doing the proposed evaluation

This proposed evaluation requires a VR program to enhance the learning of high school world geography. Although a well-developed VR program for world geography is not available now, it is possible to develop the necessary one by modifying existing commercial systems. For instance, Isaac Asimov's Science Adventure 2.0, Animal Adventure (Newsbytes, 1993), and WorldToolkit for Windows (Computer Select, 1994) can be suitable for this purpose. Software vendors may be willing to absorb the associated developmental costs. Finding researchers and appropriate schools for this evaluation should be no problem. Interest in multimedia educational tools in general, and in VR programs in particular, is abundant. Funding may be secured from the National Science Foundation (NSF) or other sponsoring agencies. Once the program for demonstrating VR is developed, it is reasonable to assume that VR educational programs will become economically feasible. The proposed evaluation is therefore feasible.

Review of the literature

Theory relevant to the evaluation

Technology is expanding human capacity and enhancing human reasoning ability as well as facilitating information processing that promotes new insight and depth of thinking (Lowenstein and Barbee, 1990). New technologies have vital roles to play in the transformation of educational systems, which are concerned with how people can learn most effectively. VR has the potential to be the most effective method for helping students learn and remember best (Taitt, 1993). This technology enables difficult tasks to become simpler when students practice in the VR world, a world in which mistakes are only temporary and the learning process is streamlined when students experience events first hand. Many theories or beliefs suggest that educators can design the best curricula for students by using VR. For instance:

- Ashton (1992) sees VR as helping educators break down barriers of race and gender because students are able to visit different countries and experience different cultures;

- Biocca (1992) compares the introduction of VR to that of television in 1941;
- Nilan (1992) defines the characteristics of the cognitive space where VR is used as distinguished from the physical space;
- Schwier (1993) believes that in the VR world students and the system are mutually adaptive, which is extremely important to the enhancement of learning;
- Shapiro and McDonald (1992) assert that the increased sensory richness of VR may influence the unconscious cognitive mechanism so that the memory of what students experienced in the VR world will be judged as real events;
- Winn and Bricken (1992) believe that students learn best when they construct understanding for themselves and that VR does teach an active construction of the environment; and
- Woodward (1992) emphasizes the possible contributions of VR technology to educational services for students with disabilities.

Current empirical studies

To support the aforementioned theories or beliefs, it is useful to examine some empirical studies that have documented learning and training available in the VR world.

Study 1: Bricken and Byrne (1992) conducted an experiment in a summer day-camp, in which 59 students (ages 10-15) used VR to construct and explore their own virtual worlds. Data collected by using videos captured what was going on for a ten-minute VR experience for seven days. Students answered opinion analyses about VR experiences. Informal observations were made for studying social behaviors and broad patterns of student responses to VR. The results showed that the students were fascinated by VR and expressed strong satisfaction with it. They spent a lot of time and made efforts to prepare their VR experiences and demonstrated rapid comprehension of complex concepts and skills, such as computer graphics, batch renderings, Cartesian coordinate spaces, and 3-D modeling techniques. This experiment concluded that VR would provide a significantly compelling creative environment for learning and teaching.

Study 2: The relationship between VR and the abilities of children to create, manipulate, and utilize mental images for problem-solving exercises was studied by Merickel (1992). Twenty-three elementary school students (ages 8-11) were divided into two groups: One group worked with VR and the other with a regular computer system. Four cognitive ability tests were then administered to the participants: the differential aptitude test, Minnesota paper form board test, mental rotation test, and Torrance test of creative thinking. The results of the tests indicated that VR was a highly promising technology deserving extensive development as an instructional tool.

Study 3: Many students experience difficulties in learning algebra, chiefly because the symbol systems of algebra provide major stumbling blocks to the development of conceptual models, which are especially useful in learning algebra. Winn and Bricken (1992) created an experimental algebraic environment, in which students could learn through direct interactions with the algebraic systems. In this case, VR was used in ninth-grade algebra classroom settings.

Study 4: In a research by Shlechter *et al.* (1992), an interactive visual simulation involving VR was investigated for its effectiveness as a training device. VR allowed role playing by soldiers. A group of several hundred students were trained with the VR system and were compared to a group trained in concentration methods. Subjective evaluations by the instructors were conducted twice during the field exercises, using standard military evaluation questionnaires. Complex statistical tests were designed to analyze the data. Empirical support was found for the relative training effectiveness of the VR system over the traditional training methods. Of special interest was the increased pace of learning during the exercises.

Overview of content

VR is a unique computerized technology whose features are perhaps not available in other technologies. Teachers may help keep students' interest by using the VR program to provide multisensory simulated environments occurring in real time. Students can see different parts of the world and feel that they are there. They can touch things (and even smell with the sophisticated VR); anyway, experience in the VR world is almost real. In addition, VR is interactive and students can manipulate and control their learning environment. Thus VR has potential to revolutionize the learning process. It is indeed interesting to read the following scenarios of virtual learning that Wishnietsky (1992) has envisioned:

> Students who enter the virtual world could find themselves touring any city in the world. They could view the Washington Monument, the buildings of the Smithsonian Institution, and the Capitol in Washington, DC. Each student would decide which buildings to visit and what to explore: while one student visits the Capitol, another may be taking the elevator to the top of the Washington Monument. Each student decides a destination based on his interests and needs.
>
> Classes will also be able to travel to virtual reality destinations as a group. The teacher's and each student's head-mounted display will be connected to the same computer. If the computer modeled Paris, a French teacher would be able to direct students through the streets of Paris. The group could travel by boat down the Seine and eat lunch at a French café, where students would order their lunch in French. After the teacher finishes the tour, students are free to explore Paris on their own or exit virtual reality and return to the physical world (p. 31).

These scenarios indicate the potentialities of VR to revolutionize the learning and teaching process. Proving that VR can enhance the learning of world geography may increase the chances that VR will be used in other high-school subjects. The proposed evaluation can be the first step in a series of similar evaluations to examine the effectiveness of VR for supporting school subjects.

Method

Evaluation questions/focus

The idea for this evaluation came from a study by Regian *et al.* (1992), who recommended VR for instructional technology for the following reasons:

- there could be benefits to learning because students are experimentally engaged in the learning context;
- the highly visual features of VR could capitalize on the disproportionate visual capabilities of the human brain; and
- VR may one day prove to be an extremely cost-effective interface for simulation-based learning.

In sum, the "realistic" and "active" learning of VR technology are beneficial for information processing because students are able to engage in full body-mind, kinesthetic learning. And the following evaluation questions are raised:

- How is learning enhanced by VR support as compared to video support in a high-school world geography class?
- What are the differences of the effects between VR support and video support in a high-school world geography class?
- In what ways do students' satisfaction with VR support enhance their learning of world geography as compared to video support?
- What a kind of research is needed to assist instructional designers in developing effective VR learning environments?

Goals and objectives

This evaluation examines the effect of VR support on tenth graders' learning of world geography. Based on the above research questions, the three major evaluational goals are raised:

(1) to develop or improve students' academic performances in a high-school world geography class;
(2) to develop or enhance students' positive attitudes toward learning world geography; and
(3) to develop or improve students' involvement with the learning of world geography (its objectives are measured by the attendance records taken when using VR is an option).

Table I presents goals, objectives, evaluation methods, and the student virtual reality experience questionnaire (SVREQ) items related to each of the objectives.

Information collection plan

Design of the evaluation. The world geography course selected for this experiment will be composed of five units. In the experiment, a rotation of the treatment is going to be used; each group will be using VR for two units and videotapes for two units. In addition, one unit will be optional for every student. The design of the unit assignment is illustrated in Table II.

Sampling procedure. This evaluation concerns the comparison of two classes (e.g. regular and gifted); however, in order to keep the initial

Campus-Wide Information Systems
Volume 16 · Number 3 · 1999 · 95–103

Table I A summary of goals, objectives, evaluation methods and the SVREQ items

Goals	Objectives	Evaluation methods
1. To improve students' academic performance in world geography	1. Students when using VR will score higher on tests than they will when using video	1. SVREQ 2. Interview
2. To enhance students' positive attitudes toward taking the world geography class	1. Students will positively rate the multimedia interactive experience with VR	1. SVREQ 2. Interview
	2. Students will report that learning with VR is more interesting than with video	1. SVREQ 2. Interview
	3. Students will report that it is easier to learn with VR than with video	1. SVREQ 2. Interview
	4. Students will report that they enjoy learning with VR	1. SVREQ 2. Interview
	5. Students will report that VR motivates their learning	1. SVREQ 2. Interview
	6. Students will report that using VR is an effective way to learn	1. SVREQ 2. Interview
3. To improve students' voluntary participation in the VR supporting	1. Eighty percent of students will attend the VR lab when the use of VR is optional	1. Attendance record

Table II Design of unit assignment

Unit	Group A	Group B
1	VR	Video
2	Video	VR
3	VR	Video
4	Video	VR
5	Optional	Optional

experiment simple, only one class is examined. The one world geography class (N = 36) is randomly divided into two groups: Group A and Group B. Students randomly assigned to Group A are exposed to the VR program during units 1 and 3, and students assigned to Group B to the VR program during units 2 and 4.

Procedures for gathering information. Three procedures are used. First, to determine the effect of VR support, four tests are administered to the students: two are administered following units when VR is used and two are administered following units when video is used. The testing instrument could be a kind of standardized test (preferably one that is given state-wide), and a closed-ended, multiple-choice format designed specifically to correspond to the area supported by VR (but should be non-cumulative, one after each unit). Researchers should identify the test questions relevant to VR. Second, to determine student attitudinal responses toward the VR support, students are required to complete a survey at the end of the semester and are interviewed as a follow-up to the survey. Third, to determine the tendency of returning to the VR support, students are given the option of attending the VR lab and their attendance is recorded.

Overview of evaluation instruments

The above four competency tests will be used for Goal 1, and the SVREQ with interviews (for the entire SVREQ, see Appendix) will be used for Goal 2.

Competency tests, which measure the level of world geography knowledge, are of utmost importance. An unreliable test instrument can introduce serious errors into the experiment of the evaluation (internal validity). The tests should be designed specifically to correspond to the areas supported by the VR program. The best approach is to look for an existing test that has been validated; in such a case, there is no need to pilot test this instrument. If a special instrument is designed, however, it should be pilot tested to assure that the students understand the meanings of questions and that the questions really measure their knowledge of geography.

The SVREQ (survey questionnaire) has three parts (attitudinal responses, open-ended questions, and demographic information) that total 30 items: 20 items measure the satisfaction and usefulness of VR support; ten items measure the perception of computers in general. Each item consists of a statement and a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = not sure, 4 = agree, 5 = strongly agree). To avoid any response bias, items are arranged in a random order. The SVREQ also includes demographic data regarding gender and ethnic backgrounds, which may impact the perception of the VR program.

Validity and reliability

Since the proposed experiment will be well controlled, it should be fairly validated. The following areas, however, need special attention:

Test validity. As stated before, competency tests should measure the knowledge level in world geography, and the best way is to use existing tests that have been validated. If special tests are designed, they should be pilot tested to assure that students will understand the meaning of each question. Regarding the survey instrument (SVREQ), one effective way to determine its content validity is to use a panel of persons to judge how well the instrument has met the standards. Several judges (e.g. computer instructors, VR experts, educational consultants, measurement experts, and the teacher of the class) will examine all the items in the SVREQ. In order to have adequate content coverage, it is important for the judges not to define "content" too narrowly.

Reliability. In this evaluation, reliability can be improved if external sources of variation are minimized: thus the researchers can achieve enhanced equivalence through improved investigator consistency by using only well trained, supervised, and motivated persons to conduct this evaluational research. With measurement instruments such as competency and attitude, the researchers can increase equivalence by improving the internal consistency of the tests.

Pilot testing. The preliminarily SVREQ is pilot tested to ensure that students will respond in accordance with instruction. It will be revised and pilot tested again with personal interviews of students. After the third trial, there should be only minor adjustments for further revision in reproducing the final version of the SVREQ (for the draft of SVREQ, see Appendix A).

Protection of the participants. Since participation in the experiment could have a negative impact regarding the grade achieved in the class (thus some students may be negatively affected), precautions should be made in order to protect the participants against any psychological or other harms. It is advisable to obtain the consent of the students and possibly their parents.

Overview of data analysis and interpretation

Scores are determined for each student using the results of competency tests when the student is supported by VR and when the student is supported by video. A T-test is performed to determine if significant differences exist in academic performance between the VR support and the video support. Analysis of variance (ANOVA) is performed to determine group differences and interactive effects. Additional tests will be conducted to determine if any significant difference exists due to student gender, ethnicity, and computer experience. Descriptive statistics indicating means and standard deviations will be generated by the results of the survey instrument to assess the student attitudinal responses toward the VR support. The results of student comments and suggestions in interviews are used to determine if the results of the survey are reflecting actual compliments and criticisms. Finally, VR lab attendance records for those students participating in this experiment are analyzed. The data will be used to determine frequency and percentage of those students electing to continue using VR when the use is optional.

Closing comments

Virtual reality (VR) could become the most important computerized multimedia technique in educational systems of the twenty-first century. Thus, this investigation is going to be very important, but it will be limited in several respects. First, it will be based on data from a relatively small sample of students in a single class who may not be representative of the population. Second, there is no randomization because every student in the class participates in this experiment. Randomization occurs only when dividing groups A and B. Third, VR support is given at different times; if sequence is not important, and if there is enough VR equipment, it is possible to use VR with both groups at the same time. Fourth, only one teacher will be involved. If the teacher is biased for (or prejudiced against) VR support, it may influence the results of the evaluation.

In conclusion, however, and as Taitt (1990) maintains, VR has the potential to be the most effective learning technology or environment for helping students accelerate their learning and retention of information. It usually takes ten years for a new technology to be widely accepted, but it is necessary to prepare for the day when VR is readily available as a learning tool. More important, as when using any other technological innovation for teaching purposes, VR needs to be accepted by teachers before it can be used productively in educational systems. The results of this evaluation, therefore, will be valuable in expediting the design and the implementation of VR support in high-school curricula. Although this evaluation plan focuses on a high-school subject, world geography, it can be expanded to such university courses as archeology, biology, and zoology. After all, twenty-first-century students must master sophisticated information-age learning media, having access to more powerful learning resources than students of today.

References

Ashton, K. (1992), *Technology and Interactive Multimedia: Identifying Emerging Issues and Trends for Special Education,* COSMOS Corporation (ERIC Document Reproduction Service No. 350 767), Washington, DC.

Biocca, F. (1992), "Communication within virtual reality: creating a space for research", *Journal of Communication,* Vol. 42 No. 4, pp. 5-22.

Bricken, M. and Byrne, C.M. (1992), "Summer students in virtual reality: a pilot study on educational applications of VR technology", paper presented at the annual meeting of the American Educational Research Association, San Francisco, ERIC Document Reproduction Service No. ED 358 853.

Bricken, W. (1990), *Learning in Virtual Reality,* Washington Technology Center (ERIC Document Reproduction Service No. 359 950), Washington University, Seattle.

Computer Select (1994), February.

Glenn, S. (1991), "Real fun, virtually: virtual experience amusement and products in public space entertainment", *Proceedings of Virtual Reality,* Meckler, Westport, CT, pp. 62-3.

Lowenstein, R. and Barbee, D.E. (1990), *The New Technology: Agent of Transformation,* Department of Labor, Office of Strategic Planning and Policy Development, Washington, DC.

Merickel, M.L. (1992), "A study of the relationship between virtual reality and the ability of children to create, manipulate and utilize mental images for spatially related problem solving", paper presented at the annual convention of the National School Boards Association, Orlando, FL (ERIC document Reproduction Service No. 352 942).

Newsbytes, (1993), April 6.

Nilan, M.S. (1992), "Cognitive space: using virtual reality for large information resource management problems", *Journal of Communication,* Vol. 42 No. 4, pp. 115-35.

Regian, J.W., Shebilske, W.L. and Monk, J.M. (1992), "Virtual reality: an instructional medium for visual-spatial tasks", *Journal of Communication,* Vol. 42 No. 4, pp. 136-49.

Schwier, R.A. (1993), "A taxonomy of interaction for instructional multimedia", paper presented at the Annual Conference of the Association for Media and Technology in Education in Canada, Vancouver (ERIC Document Reproduction Service No. 352 044).

Shapiro, M.A. and McDonald, D.G. (1992), "I'm not a real doctor, but I play one in virtual reality: implications of virtual reality for judgments about reality", *Journal of Communication,* Vol. 42 No. 4, pp. 94-114.

Shlechter, T.M., Bessemer, D.W. and Kolosh, K.P. (1992), "Computer-based simulation systems and role-playing: an effective combination for fostering conditional knowledge", *Journal of Computer-Based Instruction*, Vol. 19 No. 4, pp. 110-14 (ERIC Document Reproduction Service No. 457 936).

Southerland, I. (1965), "The ultimate display", *Proceedings of the IFIP Congress*, pp. 506-8.

Taitt, H.A. (1993), "Technology in the classroom: planning for educational change", *Curriculum Report,* Vol. 22 No. 4, National Association of Secondary School Principals, Reston, VA (ERIC Document Reproduction Service No. 359 922).

Winn, W. and Bricken, W. (1992), "Designing virtual worlds for use in mathematics education: the example of experiential algebra", *Educational Technology,* Vol. 32 No. 12, pp. 12-19.

Wishnietsky, D.H. (1992), *Hypermedia: the Integrated Learning Environment*, Phi Delta Kappa Educational Foundation, Bloomington, IN.

Woodward, J. (1992), *Virtual Reality and its Potential Use in Special Education: Identifying Emerging Issues and Trends in Technology for Special Education,* COSMOS Corporation, Washington DC (ERIC Document Reproduction Service No. ED 350 766).

Campus-Wide Information Systems
Volume 16 · Number 3 · 1999 · 95–103

Appendix: Student virtual reality experience questionnaire

Part I - Perceptions of the VR and Video Programs

Please use the following scale to rate each statement and circle the number that best describes your answers. (Note: Virtual reality is abbreviated as "VR" in the statements)

1 . . . . 2 . . . . 3 . . . . 4 5
Strongly Disagree (SD) Disagree Not Sure Agree Strongly Agree

Factor one: usefulness and satisfaction of the VR program (circle one)

	SD SA
1. I found the VR program easy to use.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
2. The VR program motivated me to learn.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
3. The VR program was dull and uninteresting.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
4. I would prefer to learn from the VR program rather than from the video program.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
5. The VR program was enjoyable and educational.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
6. The VR program was not easy to understand.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
7. I believe that the VR program was not effective for educational use.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
8. The VR program was user-friendly.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
9. I could learn faster using the VR program than using the video program.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
10. The VR program did not help increase my understanding of the world geography context.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
11. I could not clearly understand the material presented in this VR program.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
12. I believe that the VR program would be an excellent educational tool.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
13. Three-dimensional presentations helped me to learn.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
14. I would prefer to learn with a video-based class rather than from a VR-supported class.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
15. I believe that I could learn more in other subjects if VR programs such as this one were available.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
16. The simulated environment of the VR program enhanced its educational value.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
17. The VR program was not an effective way to learn about world geography.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
18. I would appreciate the interaction with the simulated world provided by the VR program.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
19. More VR programs are needed for enhancing student learning in other subjects.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
20. The pictures, graphs, and sound in the VR program did not help me learn the material presented.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5

Factor two: computer as a learning tool (circle one)

	SD SA
1. Computers are important to my future goals.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
2. I feel at ease learning by using computers.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
3. If given a choice, I do not want to learn from a VR type of computer program.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
4. I feel confident in my abilities to work with computers.	1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5

Campus-Wide Information Systems
Volume 16 · Number 3 · 1999 · 95–103

5. I do not think that computer technologies will be useful to learn school subjects. 1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
6. I would rather read a textbook than learn from a computer lesson. 1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
7. I believe that the use of computers is not an effective method of instruction. 1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
8. Interactive computers such as VR computers are more exciting than lectures. 1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
9. I would prefer to learn in a traditional instructor-based class than in a computer-supported class. 1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5
10. The layout of the computer screens makes it easy to follow the content of lessons. 1 . . . . . . 2 . . . . . . 3 . . . . . . 4 5

Part II – comments and suggestions about the VR program

For the following questions, write your answers about the VR program you have used in the world geography class.

1. In what ways do you think the VR program was effective as an educational tool?

2. Name the two major strengths and two major weaknesses of the VR program.
   Strengths:
   (1)
   (2)
   Weaknesses:
   (1)
   (2)

1. Are you (check one): ____ Male ____ Female?
2. Are you (check one):
   ____ American Indian ____ Asian/Oriental ____ Black/African-American
   ____ Hispanic/Latin ____ White/Caucasian ____ Other, please specify:
3. Do you have a computer at home? (Check one)
   ____ Yes ____ No
4. How often do you use computers at home or at school? (Check one)
   ____ Always ____ Frequently ____ Sometimes ____ Seldom ____ Never
5. In what way do you use computers at home or at school? (Check all appropriate answers)
   ____ Word processing ____ Drill-and-practice ____ Internet
   ____ Electronic mail ____ Games ____ Others, please specify:

6. Did you know about "virtual reality" before taking this course? (Check one)
   ____ I knew nothing about virtual reality.
   ____ I had some knowledge about virtual reality.
   ____ I had lots of knowledge about virtual reality.
   ____ I experienced the virtual reality environment.
7. Would you like to use VR programs in other school subjects? (Check one)
   ____ Yes ____ No
8. If "yes", in which school subjects would you like to use VR support? (Name high school subjects)

Thank you very much for your cooperation!