

Virtual Reality Classrooms Strategies for Creating a Social Presence

Elizabeth M. Hodge, M.H.N. Tabrizi, Mary A. Farwell, and Karl L. Wuensch

Abstract—Delivering course material via a virtual environment is beneficial to today’s students because it offers the interactivity, real-time interaction and social presence that students of all ages have come to accept in our gaming rich community. It is essential that the Net Generation also known as Generation Why, have exposure to learning communities that encompass interactivity to form social and educational connections. As student and professor become interconnected through collaboration and interaction in a virtual learning space, relationships develop and students begin to take on an individual identity. With this in mind the research project was developed to investigate the use of virtual environments on student satisfaction and the effectiveness of course delivery. Furthermore, the project was designed to integrate both interactive (real-time) classes conducted in the Virtual Reality (VR) environment while also creating archived VR sessions for student use in retaining and reviewing course content.

Keywords—Virtual Reality, Social Presence, Virtual Environments, Course Delivery Methods.

I. INTRODUCTION

SCOTT, Lauren and Taylor enter their Web design class which encompasses a classroom filled with other students awaiting instruction. The classroom includes desks, chairs, whiteboard, computers and projection screen. As they await the arrival of their professor they notice that the other students are communicating with one another. Just then the professor comes in with a tablet computer in her hands and begins to address the class. The students settle down and await instruction.

Interestingly enough you might believe I was describing a typical face to face “traditional” on campus classroom setting. When in actuality what was just described was a virtual learning environment. If you have never interacted in real time online before this type of environment might seem unrealistic. But to students scattered across the United States and other countries virtual reality is the latest rave in delivering course content to a generation that is poised in the gaming society. What makes delivering course material in a virtual environment so beneficial to today’s students is that it offers the

interactivity, real-time interaction and social presence that students of all ages have come to accept in our gaming rich community.

Whether you refer to this new medium as virtual reality or immersive education one thing is “real,” students feel connected to the professor and students in the environment. Providing access to educational programs has been touted as a main reason for the development of enhanced interactive learning environments. “Distance education has a strategic role in responding to the dynamic, changing educational needs of society, in relation to the creating of a knowledge-based society” (p. 100)[31]. The NCES, 2001 surveyed institutions of higher education and almost 70 percent of institutions surveyed indicated that increasing student access (in a variety of ways) was an important goal of their distance education programs [24]. That access was in the form of (in order of most popular response) making courses available at convenient locations, reducing time constraints for course taking, and making educational opportunities more affordable for students. Accessibility included populations with disabilities [8]; students in rural locations [10]; students in racially, socially or culturally-oppressed countries [16]; and students in developing countries [31].

With this in mind the research project was developed to investigate the use of virtual environments on student satisfaction and the effectiveness of course delivery. In a large Southeastern University, the project was developed to integrate both interactive (real-time) classes conducted in the virtual reality environment while also creating archived VR sessions for student use in retaining and reviewing course content. The premise of this research study is to determine the level of engagement and social presence the Agent based Virtual Reality (AVR) system provides. The study hypothesizes that the AVR system most affects student learning when it thoroughly integrates the technology to facilitate communication, interaction and engagement, thereby increasing the effectiveness of learning for course participants. While the goal of this study was to analyze and review the use of the AVR system within traditional and nontraditional online courses, there are many other factors that were assessed. These include the theoretical framework of Garrison, Anderson and Archer (2000), who purport that three elements exist in a media rich environment that makes communication and interaction possible in the teaching and learning process. The three core elements that comprise the model include: cognitive presence, teaching presence, and social presence. The central premise of the model is that within the education environment, learning occurs through interaction [9]. In combination these elements support both the cognitive and affective objectives of learning [22]. Social presence affects both the cognitive and affective objectives by supporting critical thinking and engaging learners in the social interaction process [23]. By incorporating a dynamic learning environment that supports communication and interaction among professor and students, educators are developing a social presence that mimics the experiences received in on campus classrooms [12].

Manuscript received June 11, 2007.

E. Hodge is Assistant Professor with the Department of Business, Information Technologies Education and Associate Director for the Center for Scholarship in Education, Greenville, NC 27858 USA (e-mail: hodgee@ecu.edu).

N. Tabrizi is Professor with the Computer Science Department, Greenville, NC 27858 USA (e-mail: tabrizim@ecu.edu).

M. Farwell is Professor with the Biology Department, Greenville NC 27858 USA (e-mail: farwellm@ecu.edu).

K. Wuensch is Professor with the Department of Psychology, Greenville, NC 27858 USA (e-mail: wuenschk@ecu.edu).

II. LITERATURE REVIEW

In the quest to incorporate innovative instructional strategies, educators have delineated a number of elements that lead to student success. These elements encompass the use of communication, and participation of students within a learning community [2]. Bielaczyc and Collins suggest that it is important for students to participate in learning communities where they can become interconnected [3]. As student and professor become interconnected through collaboration and interaction in a virtual learning space, relationships develop and students begin to take on an individual identity. Dede proposes that once an individual identity is accepted in the learning community, roles shift which lead to the professor and students taking ownership of the knowledge dispensed within the virtual environment [6]. The connection and interaction develops a community that creates a social learning space. As with any virtual environment, creating a learning atmosphere for students to be successful and feel as if they have a social presence in a “classroom” environment is the premise for the development and integration of the (AVR) system.

As research suggests, a new “participatory culture” exists amongst today’s society. Participatory culture refers to a culture that is open to artistic expression and engagement in sharing one’s creations. As noted by Jenkins et al. (2006), participants ingrained in this culture share one another’s creations and to a certain degree feel a connection with one another. According to Jenkins et al a variety of participatory forms include:

- Affiliations: formal and informal, in online communities centered on various forms of media such as Friendster, Facebook, MySpace, message boards and game clans.
- Expressions: the production of various forms of digital sampling, skinning and modding, fan video making.
- Collaborative Problem-solving: working in groups to complete tasks and develop new knowledge. For example Wikipedia.
- Circulations: For example blogging or podcasts [13].

As seen with the AVR system, the ability for students to collaborate and share material in a virtual environment fosters the participatory culture that overcomes the distance barriers and affords students and professors the ability to create a social presence within a social space. As research suggests there are several benefits from a participatory culture. These include the ability to interact peer to peer, to express oneself in a media format, to increase problem solving and analytical skills, to mentor peers, and develop technology skills that are sought out in the workplace [13]. Other researchers have noted that virtual learning can be as effective as traditional instruction if levels of student interactivity are high [13]. Russo and Koesten (2005), found a connection between individual student performance and numbers of interactions between that student and the instructor and classmates [19]. Their study analyzed the dynamics between originating, receiving, and responding to messages as indicators of interactivity and class success. Rossett, reported the results of a study in which 94% of the participants responding stated that their online classes which contained synchronous communication and conversation opportunities were equally or more engaging than their traditional courses, resulting in higher levels of student satisfaction with instruction [20]. Conversely, students who rarely interact in online course activities tended to earn poorer grades in online classes [27].

The AVR system designed and developed by Nasseh Tabrizi can be characterized as a virtual environment rich with opportunities for students to interact, communicate and share material. Developing a deep understanding of its limitless ability to create a learning community for students to develop a social presence and transcend cultural boundaries has been critical to the learning process

Lave and Wenger (1991) discuss the concept of learning as not simply internalizing information and knowledge, but as a personal transformation defined by participation in a social community [14]. By not creating a social presence in courses, students will further their feelings of isolation. The use of Virtual Reality or Immersive Education is an interactive environment for students and professors to interact. Immersive Education, as defined by its originators (Media Grid), is a learning platform which combines interactive 3D graphics, commercial game and simulation technology, virtual reality, VoIP, Web cameras and rich digital media to provide collaboration and interactivity in online course environments [18].

Vygotsky (1978, 1986) states that learning is a social process. The role of the professor is to create a dynamic learning environment which encompasses several outlets for learning to take place [25-26]. If the professor provides the appropriate environment students should have several opportunities to interact and communicate with other students. By integrating an effective technological infrastructure both instructor and student will be able to create a social space in which communication is abundant to ensure that both instructor and student have a social presence [4]. The AVR system and/or Immersive Education provide students with the sense of being connected even when they are not present on a college campus. The system provides educators with the ability to present course content (demonstrations) in an interactive environment which allows communication (both question and answer) to take place real time.

Students’ retention increases when their learning environment allows them to see and hear their instructor, interact with instructor and others, and directly view educational information such as notes written on a blackboard. Developing a conceptual framework which supports a virtual environment is supported by many researchers. Creating such a virtual space was examined by [15-17] with the development of three social space constructs.

- 1) Spatial practice – the online learning community
- 2) Conceptual constructs – the virtual environment supported by technology
- 3) Representational space – spaces which students can associate by means of images and symbols.

By creating a virtual classroom environment, we are imitating the traditional on-campus space and improving upon it by breaking down the barriers of distance. This environment will increase students’ participation in class which will help to increase their motivation. As addressed earlier Garrison et al., (2001) developed a model which encompassed; cognitive presence, teaching presence, and social presence. [9].

1. “Teaching presence involves course design, discourse facilitation and direct instruction in text based computer conferencing environments;
2. social presence is the ability of learners to project their personal characteristics to their group members and classmates;
3. cognitive presence involves the ability of learners to construct meaning through sustained communication” (p.1) [9]

The commonalities of each element addressed by Garrison, et al, as it relates to the virtual reality classroom environment asserts that multimedia could be used effectively to support a constructivist paradigm of instruction [28, 29]. Winn suggested that including a 3D immersive environment could help bridge the gap between experimental learning and information representation [28]. By constructing the virtual environment utilizing low bandwidth technology the research team has created an environment which promotes continuous collaboration in which communication and interaction take place as it normally does within the physical

boundaries of a campus. Several successful applications have demonstrated the potential of 3D virtual worlds in creating learning environments for traditional and distance teaching [7]. Active Worlds Educational University (AWEBU) is one of the oldest and most dynamic 3D virtual applications. Adobe Atmosphere and On Live Traveler are other virtual reality tools that can be used to enhance the online education experience. Each of these dynamic environments include teaching in an interactive environment, the ability of learners to develop a social presence through questions, comments and responses, while meeting the cognitive need in a virtually rich classroom environment. Three-dimensional models provide students with fully interactive content to ensure an enriching learning experience. These web-based 3D-model technologies are shown to be important tools for visualization in the classroom to ensure an enriching learning experience [21]. Amon & Valencic (2000) also have developed 3D biological structures based on Virtual Reality Model Language (VRML) [1].

III. TECHNICAL INFRASTRUCTURE

East Carolina University has one of the largest distance education programs in the state (note: this may be one of the largest in the country) with over 4,000 students currently enrolled in distance education courses. The AVR system is a means for delivering online courses with multimedia content to areas within low bandwidth network infrastructure. Students view lectures online in a virtual reality environment setting. The instructor appears as an agent, or animated figure, with real-time facial expression, body posture, position, and movements captured by the system. Students can hear the instructor, see notes written on the blackboard, observe demonstrations, ask questions, and engage in classroom discussion. An interactive lecture with a full screen multimedia content can be received in real time or archived, regardless of the type of network connection, including dial-up. For example, students can "join" the virtual classroom space and expect to view an avatar character of the instructor. Also included in the virtual classroom is a whiteboard, and presentation screen. The instructor is able to provide slide presentations along with the ability to write on the presentation or whiteboard area. During the interactive session, students may ask questions of the instructor and receive an immediate narrative response coupled with annotated drawings when particular concepts require further elaboration. During these question and answer periods, students will see the avatar move about the screen and facial and body movements are associated with the discussion taking place. These virtual reality classroom sessions provide interaction, communication and collaboration to create a social presence among teacher and students.

The technology also affords the teacher the ability to create archived sessions. Although not a synchronous activity, these virtual classroom sessions provide audio annotated lectures and character movement so that students feel as if they are in the classroom. The pilot project resulted in the creation of a virtual world to enhance and enrich the learning experience traditional and nontraditional students by creating a synchronous virtual learning environment. Furthermore, the AVR system works with low-bandwidth environments so that students living in rural areas or countries can easily access the course material. This element decreases the students' feelings of isolation and increases the interactivity and social presence for all individuals involved.

IV. METHODS & FINDINGS

The purpose of this study was to examine the level of engagement and social presence the AVR virtual reality system provided.

1. What are student perceptions of the AVR system versus traditional instructor-led courses?
2. Are synchronous AVR sessions more effective for learning than archived AVR sessions?
3. Does the use of the AVR system provide a media rich environment for students to interact, communicate and share resources?

A review of literature was used to develop the survey instrument for this study. The process included the following steps; 1) review of literature, 2) the development of a research question, 3) survey construct development, and then 4) survey question development. The validation process was conducted within the Perseus system software which requires a pilot test and question revision if appropriate. The Perseus survey software provides participants with a web-based survey. The survey was deployed to students enrolled in the courses by providing a URL and disseminated through a notification to participate through email. The survey was administered over a five week period of time.

The data from this project will be used to build experimental conceptual learning models for both online and face-to-face environments. Comparative modeling will enable us to adapt online delivery to include those techniques that contribute most strongly to student learning. Further analysis will provide a basis to show how AVR has affected the findings. This project will also provide the initial data for longitudinal studies to examine extended learning outcomes of AVR, traditional online education, and face-to-face instruction. As argued by many organizations that accredit educational institutions (such as the Southern Association of Colleges and Schools), it is this learning outcome assessment that is the key to understanding whether educational goals are being met.

Proposed follow up studies will include assessments related to:

- student retention in undergraduate programs,
- student performance in the classes in this study and in subsequent courses,
- student employability and job performance,
- attraction and retention of minority and female students,
- future iterations of the AVR system.

V. RESULTS

The satisfaction levels according to the student's perception of the AVR system were high. Below is table 1 that depicts specific questions that the students addressed when utilizing the AVR virtual reality system to complete assignments and access course material. In most instances the system was utilized to deliver course presentations in an interactive manner with students accessing the environment from a distant location. Many students utilized the system to review course concepts and follow specific tutorials which allowed them to complete assignments. Through the use of the system professor and students were able to communicate real-time. In addition, students who missed the real-time class for any reason used the archived version to review material. Even students who viewed the original class would use the archive for study. In some instances the professor would create a course seminar for students to view at their leisure, then provide specific times for them to discuss the material. In both delivery methods educators bridged the gap between the distances normally associated with online students.

TABLE I
STUDENT SATISFACTION WITH THE AVR SYSTEM

| Item | Median | Mean | SD |
|--|--------|------|------|
| I expected the AVR system to help me a lot more than it did.* | 2.00 | 2.36 | .95 |
| The AVR system turned out to be much better than I had expected it to be. | 2.50 | 2.64 | 1.00 |
| I had a lot of problems running the AVR system on my computer.* | 2.00 | 2.82 | 1.33 |
| I was not comfortable expressing my feelings in this course.* | 4.00 | 3.91 | .97 |
| I would have learned better if the AVR system had not been used in this course.* | 4.00 | 3.55 | 1.18 |
| The AVR system made me feel isolated from the instructor.* | 4.00 | 3.64 | 1.05 |
| Overall, my learning experience was degraded by the AVR system.* | 4.00 | 3.86 | .99 |
| The AVR system was a silly waste of time.* | 4.00 | 3.68 | 1.09 |

*Reflected

Three of the 25 items which were designed to measure satisfaction with the AVR were dropped from the scale because they had low item-total correlations. The resulting 22 item scale had exceptionally good internal consistency reliability, Cronbach alpha = .923.

Satisfaction scale scores were computed, for each student, as the mean of the student's responses on the 22 items. Scores could range from 1 (extreme dissatisfaction) to 5 (extreme satisfaction). Both the mean (3.23) and the median (3.18) level of satisfaction were greater than the midpoint (3) of the scale.

Satisfaction with the AVR was not significantly correlated with any of the demographic variables, which is not surprising given the low sample size (22). Despite lack of statistical significance, some of the sample correlation coefficients were large enough to be of some interest, and they are reported here. Single students were more satisfied than were married students ($r = .28$), students who were not employed were more satisfied than those who were employed ($r = .37$), and students with advanced degrees were less satisfied than those with lesser degrees ($r = .30$).

Computation of item means identified four items on which student satisfaction was relatively low and five items where it was relatively high (see Table I).

VI. RECOMMENDATIONS

The premise of this paper explored the use of the synchronous and archived sessions using AVR system to deliver course material. The research demonstrates that students support the integration of the AVR system. By building a participatory culture in which students can interact and communicate in a virtual environment we are able to see how students work and communicate to achieve learning. As educators we must continue to assess this new generation of students often referred to as Napster or Gaming generation to determine the reasons why they opt for media rich resources. As recommended, researchers must examine if the field of academia is doing the educational community a disservice by delivering course content in a "Gaming" context. Further research is needed on the assessment of

the AVR system and its ability for developing social networks for on and off campus students. Furthermore, the researchers suggest that more evidence is needed to understand the effects of virtual reality, as it is vital to understand the roles of each participant and its effect on learning.

VII. LIMITATIONS

A potential limitation was the population surveyed. Survey participants were students in online courses during a fall course session, and the response rate was low.

VIII. CONCLUSIONS

As we seek to offer solutions to the social challenges that face our educational system, it is important to address the constantly changing and evolving world of academia. As institutions offer more options for learning to take place, it will be necessary for educators to develop new and innovative visions for the future. It is apparent that we must ask ourselves how, why and where is education heading. Therefore, as we continue to increase opportunities for students to interact and communicate in environments which are inherent to their upbringing, there will be specific elements that must be addressed. To address these elements we need to closely examine the traditional learning theories, as well as the new innovative instructional strategies that campuses nationwide are opting to integrate. The question still remains, that if we are bridging the distance through virtual reality environments, are we in fact changing the culture of our institutions? Furthermore, the social and collegial components of campus life are critical features of learning within the educational environment and are what institutions of higher education are based upon. By making our programs so readily available to the "virtual" community we have in fact fostered the same environment online. As we continue to offer these various formats, we need to embrace the challenge of implementing new technological approaches while continuing to foster the social interaction and collegial atmosphere in which academia was founded.

REFERENCES

- [1] Amon, T., & Valencic, V., (2000). VRML. Enhanced learning in biology and medicine. *Future Generation Computer Systems*, 17(1):1-6.
- [2] Bannan-Ritland, B., Bragg, W. & Collins, M. Linking Theory, Educational Constructs, and Instructional Strategies in Web-based Course Development. Retrieved online 07/14/06 from <http://www.virtual.gmu.edu/EDIT611/BannanWBC.pdf>
- [3] Bielaczyc, K., & Collins, A. (1999). Learning communities in classrooms: a reconceptualization of educational practice. In C. Reigeluth (Ed.), *Instructional-design theories and models. A new paradigm of instructional theory*, 2. 269-292. Mahwah, NJ: Lawrence Erlbaum Associates.
- [4] Bossé, Michael J. & Rider, Robin L. (October, 2005). Investigating distance professional development: lessons learned from research. Published in the Proceedings of the North American Chapter of the International Group for the Psychology of Mathematics Education, Roanoke, VA, October 20-23.
- [5] Cobb, P., Stephen, M., McClain, K., & Gravemeijer, K. (2001). Participating in classroom mathematical practices. *The Journal of the Learning Sciences*, 10 (1&2), 113-163.
- [6] Dede, C. (2004, September). Enabling distributed learning communities via emerging technologies - Part one. *T.H.E. Journal*, 32(2), 12-22. www.thejournal.com.

- [7] Dickey M. D., (2003) Teaching in 3D: Pedagogical affordances and constraints of 3D virtual worlds for synchronous distance learning. *Distance Education* 24(1): 105-121.
- [8] Foley, A. R. (2007). Distance education: Understandings of disability and the provision of access to content. *International Journal of Instructional Media*, 34, 1, 17-27.
- [9] Garrison, R., Anderson, T. and Archer, W. (2000) Critical Inquiry in a Text-based Environment: Computer Conferencing in Higher Education, *The Internet in Higher Education*, 2, 2-3,, 87-105, <<http://communitiesofinquiry.com/documents/CTinTextEnvFinal.pdf>> (retrieved March 15, 2007)
- [10] Hiemstra, R., and Poley, J. (2007). Lessons pertinent for teaching with computers. *Clearing House*, 80, 3, 144-148.
- [11] Hodge, E., (2006). If you can't beat um...join um! The quest to create a social presence in student's lives. Submitted for publication.
- [12] Hodge, E., Bosse, M., Faulconer, J., Fewell, M., (2006). International Journal of Instructional Technology and Distance Learning December 2006 5 Vol. 3. No. 12. Innovations in Distance Education. (1998). *An emerging set of guiding principles and practices for the design and development of distance education*. University Park, PA: The Pennsylvania State University. Retrieved 01/22/07 from http://www.worldcampus.psu.edu/ide/docs/guiding_principles.pdf
- [13] Jenkins, H., Clinton, K., Purushotma, R., Robison, A., & Weigel, M., (2006). Confronting the challenges of participatory culture: Media education for the 21st century. (White Paper). MacArthur Foundation. Retrieved 06/01/07 from http://www.digitallearning.macfound.org/site/c.enJLKQNiFiG/b.2108773/apps/nl/content2.asp?content_id=%7BCD911571-0240-4714-A93B-1D0C07C7B6C1%7D¬oc=1
- [14] Lave, J. & Wenger, W. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.
- [15] Lefebvre H. (1991) *The production of space*. Cambridge, MA: Blackwell.
- [16] Makoe, M. Q. (2006). South African distance students' accounts of learning in socio-cultural context: A habitus analysis. *Race, Ethnicity & Education*, 9, 4, 361-380.
- [17] McPherson, M., & Baptista-Nunes, M., (2004). The failure of a virtual social space (VSS) designed to create a learning community: Lessons learned. *British Journal of Educational Technology*, 35(3), 305-321.
- [18] Media Grid Initiative: Immersive Education (Boston College). Retrieved 06/05/07 at <http://immersiveducation.org/>
- [19] Russo, T., & Koesten, J. (2005). Prestige, Centrality, and Learning: A Social Network Analysis of an Online Class. *Communication Education*, 54(3), 254-261.
- [20] Rossett, A. (2005). Moving Online. *T+D*, 59(2), 14-15.
- [21] Rourke, W., (2000) Who benefits from learning with 3D models? the case of spatial ability *Journal of Computer Assisted Learning* 22 (6), 392-404.
- [22] L. Rourke et al., "Assessing Social Presence in Asynchronous Text-based Computer Conferencing," *Journal of Distance Education*, Vol. 14, No. 2, 2001, <http://cade.athabascau.ca/vol14.2/rourke_et_al.html> (retrieved March 15, 2007)
- [23] V. Tinto, *Leaving College: Rethinking the Causes and Cures of College Attrition* (Chicago: University of Chicago Press, 1987), as cited in Rourke et al., *ibid*.
- [24] U.S. Department of Education, National Center for Education Statistics. (2003). *Distance Education at Degree-Granting Postsecondary Institutions: 2000-2001* (NCES 2003-017), retrieved May 4, 2007 at <http://nces.ed.gov/fastfacts/display.asp?id=80>
- [25] Vygotsky, L.S. (1978). *Mind in society: The development of higher order psychological processes*. Cambridge, MA: Harvard University Press.
- [26] Vygotsky, L.S. (1986). *Thought and language*. Cambridge, MA: MIT Press.
- [27] Wang, A., & Newlin, M. (2001, August). Online Lectures: Benefits for the Virtual Classroom. *T H E Journal*, 29(1), 17.
- [28] Winn, W. (1993). *A Conceptual Basis for Educational Applications of Virtual Reality*. Technical Report TR-93-9, Human Interface Technology Laboratory - University of Washington.
- [29] Winn, W. 1997. Advantages of a Theory-Based Curriculum in Instructional Technology. *Educational Technology*, 97(1):34-41.
- [30] Wise J M (1999) Culture and technology CULTSTUD-L Columns. Retrieved on 8/20/2006 from <http://www.cas.usf.edu/communication/rodman/cultstud/columns/jw-24-10-99.html>
- [31] Zuhairi, A., Wahyono, E., & Suratinah, S. (2006). The historical context, current development and future challenges of distance education in Indonesia. *Quarterly Review of Distance Education*, 7, 1, 95-101.