# Assessing the Feasibility of Using Virtual Environments in Distance Education

Constance M. Johnson*

School of Nursing
Duke University, USA
E-mail: constance.johnson@duke.edu

Kirsten N. Corazzini

School of Nursing
Duke University, USA
E-mail: kirsten.corazzini@duke.edu

Ryan Shaw

School of Nursing
Duke University, USA
E-mail: ryan.shaw@duke.edu

*Corresponding author

**Abstract:** Learning is an active, social process. However, many distance education programs are flat and asynchronous with limited interaction. Virtual environments may be best equipped to foster an active social learning environment that provides optimal distance education. This study explored how nursing informatics students perceived the strengths and limitations of three different online modalities of learning: Learning Management System, Webinar, and Virtual Environments. Student perceptions of nine learning and instructional technology domains were explored using the Student Assessment of Learning Gains instrument (Seymour, Wiese, Hunter, & Daffinrud, 2000) with additional, open-ended question. Two concurrent themes arose from the three platforms: technical challenges and students showing preference for synchronous web-based learning. Virtual Environments emerged as the favored distance based education. As the availability and use of these technologies proliferates, educators are challenged to understand the effects of these technologies on student learning outcomes to optimize student learning.

**Keywords:** Internet; Online education; Virtual environments; Constructivism; Computer-assisted instruction

**Biographical notes**: Constance M. Johnson is an Assistant Professor, and the faculty lead of the Nursing Informatics Program in the Duke University School of Nursing. She received her Master's and PhD in Health Informatics from the University of Texas School of Biomedical Informatics, Houston, TX. She teaches health informatics courses in the School of Nursing Graduate Program and additionally uses virtual environments in both teaching and research.

Kirsten N. Corazzini is an Associate Professor, Duke School of Nursing (Durham, NC) and Senior Fellow, Duke Center for the Study of Aging and

Human Development. She received a doctorate in Social Gerontology from the University of Massachusetts, Boston. The focus of Dr. Corazzini's research is nursing management in long-term care, especially delegation and the role of professional nursing in nursing homes. She currently teaches statistics and social gerontology in the Duke School of Nursing Graduate Nursing Program, where she uses virtual learning environments.

Ryan Shaw, MSN, RN, is a PhD Candidate and Information Technology Fellow at the Duke University School of Nursing.

## 1. Introduction

Learning is an active, social process. Learners make meaning from interactions with each other and the environment they are in. It begins in a social environment, and is then appropriated by individuals (Vygotsky, 1978). Constructivists theory argues that it is these experiences that generate knowledge and learning (Bhattacharya & Han, 2001).

Many pedagogies employ constructivists theory. These pedagogical approaches utilize instructors not as teachers, but as facilitators of learning (Bauersfeld, 1995). In this role, the learner moves from a passive role receiving an instructor delivered didactic lecture, to an active role where they participate in learning. The learner collaborates with both the instructor and other learners creating a dynamic interaction. The learner is left to make their own discoveries, inferences and conclusions, thus creating ownership of the learning process. Thus, social processes of discussing ideas, cooperating in solving problems, and teaching one another, optimize learning.

Many institutes of higher education have developed distance education programs to cater to the unique needs of students. These programs reach across geographical boundaries allowing increased access to learning, provide flexibility for students to approach their course work, and can provide financial and social benefits to students; who would otherwise have to commute or leave their community, thus allowing them to maintain their personal, social, and cultural lifestyle. However, many traditional distance education programs, delivered predominantly through the Internet, are insufficient for optimal learning. These are often flat, asynchronous, with limited interaction and dynamism. This is in contrast with the underpinnings of constructivists learning which suggests that learning is an active social process between people and the environment.

Traditional distance education programs allow students to build on ideas of one another, rather than co-create new learning and knowledge. It is this latter that is fundamental to social constructivism and in which virtual environments may be best equipped to foster.

### *Learning Management Systems*

Well over 90% of distance education programs currently use a learning management system (West, Waddoups, & Graham, 2007). These are learning networks such as Blackboard (Blackboard Inc., Washington D.C.), Sakai (Sakai Foundation), or Moodle (Moodle Trust). Learning management systems (LMS) allow both online and campus-based student access to course materials through the use of password protected sites (Servonsky, Daniels, & Davis, 2005). Typical LMS features include an environment to post documents, assignments and announcements, as well as features such as e-mail, chat rooms, transferability of documents, and bulletin boards (Servonsky et al., 2005).

Additionally, faculty can also use learning management systems for testing and grading (Battin Little, Passmore, & Schullo, 2006).

Although learning management systems provide the benefit of consistency and continuity of content among multiple sessions of the same course, the preparation of an online class requires detailed planning and more preparation time on the part of faculty compared to a traditional course (Boulos, Maramba, & Wheeler, 2006). Course documents and content must be frequently reviewed and updated (Servonsky et al., 2005). The assessment and interactive features of learning management systems tend to be less frequently utilized and their full potential is not often reached by the majority of users (Kemp & Livingstone, 2006).

### *Webinar*

Web seminar, or webinar, are attracting increased attention due to their ability to facilitate synchronous communication in online learning environments (Wang & Hsu, 2008). These include software programs such as Elluminate (Elluminate, Inc., Calgary, Canada), GoToWebinar (Citrix Systems, Santa Barbara, CA), or Adobe Connect (Adobe Systems Inc., San Jose, CA). These applications enable many-to-many interaction between users, have the ability to transmit and record audio and video, offer access to the Internet, and provide opportunity for information exchange via whiteboards and application sharing (Wang & Hsu, 2008).

Advantages of this technology include affordability, multi-level interaction (Wang & Hsu, 2008) and real-time interaction between faculty and students; giving faculty the opportunity to present materials synchronously and giving students the ability to ask questions and receive immediate feedback (DiMaria-Ghalili, Ostrow, & Rodney, 2005).

### *Virtual Environments*

Virtual environments such as Second Life ® (Linden Lab, San Francisco, California), are simulated environments that mimic the real world through elements such as topography, communication, movement and gravity (Gorini, Gaggioli, Vigna, & Riva, 2008), affording real-time synchronous teaching and discussion. The medium is multimodal in nature and allows the selection and manipulation of virtual objects by the user (Stanney & Cohn, 2006). Virtual campuses and classroom settings that mimic their real world counterparts provide a semi-realistic university atmosphere for students. Users are able to interact with one another through avatars, virtual representations of a user that allow them to socialize and navigate through virtual environments.

These computer-mediated virtual learning environments combine pedagogical, communication and administration software tools integrated into one system that can be used to promote learning (Ellaway, Dewhurst, & Cumming, 2003). Thus, these environments can be built to present simulated classrooms, simulated clinical laboratories, and can offer scenarios to teach real clinical situations, where students can learn and be tested on procedural knowledge as well as critical thinking skills, for both individual and group learning (Boulos & Burden, 2007). This social interaction encourages active learning and enables direct feedback from mentors (Wenger, 2000), increasing student motivation (Levy, 2007). With virtual environments, students feel as if they are experiencing real-life, in real-time, and in multi-participant simulations (Heinrichs, Youngblood, Harter, & Dev, 2008).

Virtual environments incorporate all of the key elements to constructivism in distance education. They allow an active social learning process between faculty, students and the environment. This helps to create an optimal knowledge building and learning environment for students.

As the availability and use of these technologies proliferates, educators are challenged to understand the effects of these technologies on student learning outcomes to optimize student learning. Evaluation data of student learning outcomes is limited; what exists is largely comprised of comparisons of face-to-face versus online, rather than comparing student learning between diverse online instructional modalities.

The purpose of this study, therefore, was twofold; to explore the feasibility of teaching students using a virtual environment platform, and to determine student perceptions of learning using three different environments including learning management systems, webinars, and virtual environments.

## 2. Methods

The overall study design is a mixed-methods evaluation pilot study of student perceptions of the learning environment across three distance-learning platforms: a learning management system (Blackboard), webinar (Elluminate), and a virtual environment (Second Life). Prior to using the virtual environment, we had to build it in Second Life, thus the Duke University School of Nursing was built imitating the real-life structure of the school (Johnson, Vorderstrasse, & Shaw, 2009). It also included a classroom (see Figure 1), faculty offices, and a room for students to socialize with free resources (links


**Figure 1. Virtual environment classroom**

to other sites in Second Life, avatar building resources and orientation resources). The free resources were included so that students did not have to concentrate on the functionality of the system, but instead could focus on learning the content of the class. In

the Spring of 2008, prior to using the virtual environment as a platform for learning, students in an introductory informatics class were queried about their interest in using this platform as a venue. We initially asked for volunteers from the class to determine the feasibility of bringing students into this environment. Seven students volunteered to try out this environment. We learned how to quickly orient the students by teaching them only the basic functionality of the environment. These volunteer students were very accepting of the use of this platform, which gave us the confidence to bring in the remainder of the class. All informatics students in the summer semester class agreed to use this platform. This study was approved by the Duke University IRB.

### *Sample*

All students enrolled in a distance-based graduate nursing informatics class taught by one of the co-authors of the study were invited to provide anonymous evaluation data for the study (N=10). All 10 students were white, female, and had been practicing as a registered nurse for at least 1 year prior to enrolling in the graduate nursing informatics program. Additionally, all 10 students had taken a distance-based course taught in a learning management system and webinar platform in the program prior to the class held in a virtual environment.

### *Measures*

Measures included close-ended and open-ended self-administered survey questions of nine learning and instructional domains, drawn from the Student Assessment of Learning Gains (SALG) course evaluation instrument (Seymour et al., 2000), modified by the researchers for the purpose of this study. The SALG is designed to tap into student perceptions of gains made in knowledge that are directly linked to the pedagogy of the course. This focus is distinct from other course evaluation instruments, which typically focus on aspects of the teacher or course not directly linked to the pedagogical approach (Seymour et al., 2000).

The SALG was selected because of our underlying conceptual model of the study, whereby each of the three learning platforms inherently facilitated different pedagogies that ultimately impact student learning, ranging from a learning management system, which is linked to a traditional lecture pedagogy, to a virtual environment, which has the potential to support an active learning and constructivist learner pedagogy (Lane, 2008). Originally developed to assess student-perceived learning gains in undergraduate chemistry classes, the SALG has been used by instructors in a variety of natural, physical, and social sciences classrooms, and has demonstrated adequate reliability and validity when adapted for these diverse settings and learning content areas (Bluestone, 2007; Frantz, DeHaan, Demetrikopoulos, & Carruth, 2006; Keeney-Kennicutt, Gunersel, & Simpson, 2008). As such, we can describe student perceptions of pedagogically-linked learning gains that we hypothesize will vary across learning platforms.

We included the following 9 SALG measurement domains: 1) overall assessment of learning environment, 2) perceived quality of assignments, 3) perceived quality of information provided to learn content, 4) perceived quality of class resources, 5) perceived quality of learner support, 6) self-rated gains in content comprehension, 7) self-rated gains in integrating content, 8) self-rated gains in critical assessment of content, and 9) perceived impact on attitudes towards content. We did not include the original SALG domain tapping into perceived gains related to class activities, because the class activities

were not consistent across the learning management system, webinar, and virtual environment class sessions, and thus could not be compared across platforms.

Each measurement domain was comprised of 2 to 6, 4-point Likert scale items asking the students to either rate their perceived gains from no gains to very significant gains, or to rate perceived help from no help to great help, of aspects of the class pedagogy. All questions were applicable to each platform learning session, regardless of the specific learning technology. For example, domain 5 'perceived quality of learner support' includes items of student perceptions the degree to which 'interacting with the instructor during the class session' or 'working with peers outside of full class activities' was helpful in learning. Each of these pedagogical characteristics is common and applicable to the learning management system, webinar, and virtual environment class sessions, regardless if they include discussion board postings (learning management system), instant messaging (webinar), or avatars speaking (virtual environments).

To facilitate a mixed-methods approach, open-ended questions for each domain asked students to provide overall comments on each domain.

### *Data Collection & Procedures*

Students progressed into each successive mode beginning with the learning management system for three weeks, followed by webinar for three weeks, and finally the virtual environment learning tool for the final eight weeks of the semester. Students completed the survey three different times, once following use of the learning management systems, once following the webinar platform and lastly at the end of the semester after using the virtual environment. The survey was built and sent to students via SurveyMonkey.com, an online web-based survey tool. Students were given a week to complete the survey. Questions were modified during each distribution to reflect the previously used learning modality.

### *Data-Analysis*

Descriptive statistics of each domain scale and bivariate statistical analyses (one-way ANOVA) of each domain scale by modality were performed. Open-ended questions for each domain were coded using qualitative analysis to identify emerging themes as a way to classify, direct, remove, and categorize these data so that definitive conclusion could be made (Miles & Huberman, 1994). Through an iterative review of these data, all of the patterns led to the current coding scheme. There were meaningful, repetitive concepts within the breakdown of the answers. Once the concepts were developed, these data were iteratively reviewed for consistency of coding until saturation occurred. Saturation was defined as the point in which no new concepts were conceived from these data and all data were conceptually consistently matched.

## 3. Results

Results indicated adequate reliability for six of the nine scales ($\alpha$ > .70). All domains were rated highly for the overall assessment of the learning environment, quality of information provided in assistance of learning content, and quality of class resources. High ratings also were received across all domains for gains in comprehension, gains in critical assessment of content, and impact on attitudes towards content. Mean scores for the six scales, which demonstrated adequate reliability (all scale alphas >.70), ranged from 3.4-3.7 on a 4-point Likert scale (1 = dissatisfied, 4 = highly satisfied) (see Table 1).

**Table 1. Summary scale descriptive statistics for 6 SALG subscales (N=10)**

| Subscale (1=low – 4=high) | Mean | SD |
|---|---|---|
| Overall assessment of learning environment | 3.5 | .52 |
| Quality of information provided to learn content | 3.6 | .45 |
| Quality of class resources | 3.5 | .54 |
| Gains in content comprehension | 3.7 | .48 |
| Gains in critical assessment of content | 3.4 | .60 |
| Impact on attitudes towards content | 3.6 | .50 |

Two of the six subscales showed significant differences across instructional modality: overall assessment of learning environment and perceived quality of information provided to assist in learning content ( $\alpha <$ .10, with Bonferroni correction for multiple comparisons). Significant differences occurred in both overall perceptions of the effect of the instructional modality on individual learning, as well as of the quality of instruction provided to understand the fit between instructional modality and coursework. Students' rated experience of the virtual environment was significantly higher than that of the learning management system for both overall assessment of learning environment and quality of information provided to learn content (post-hoc Tukey; p<.10). Webinar was not significantly different (See Figures 2 and 3).

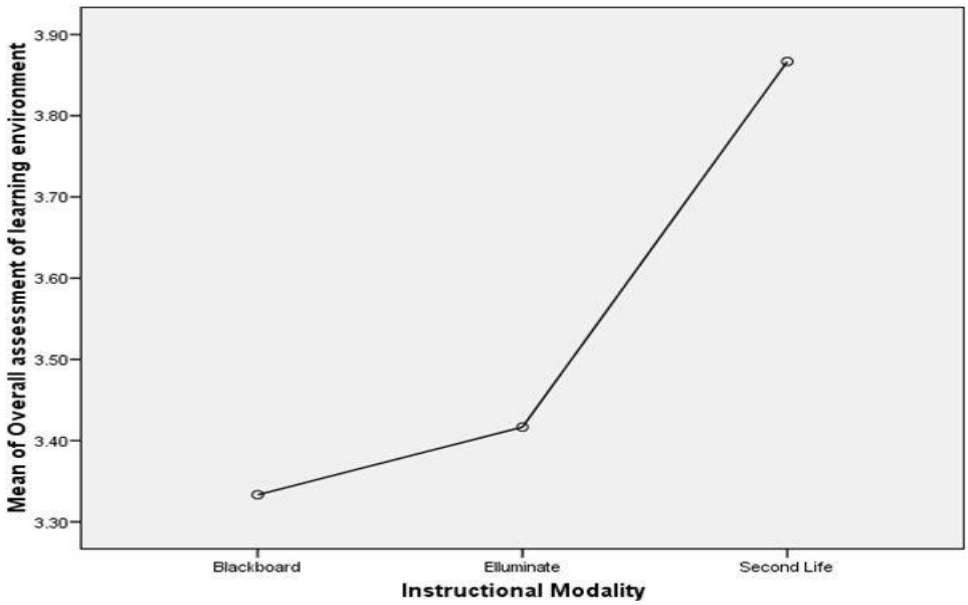


**Figure 2. Mean overall assessment by modality (n=10)**

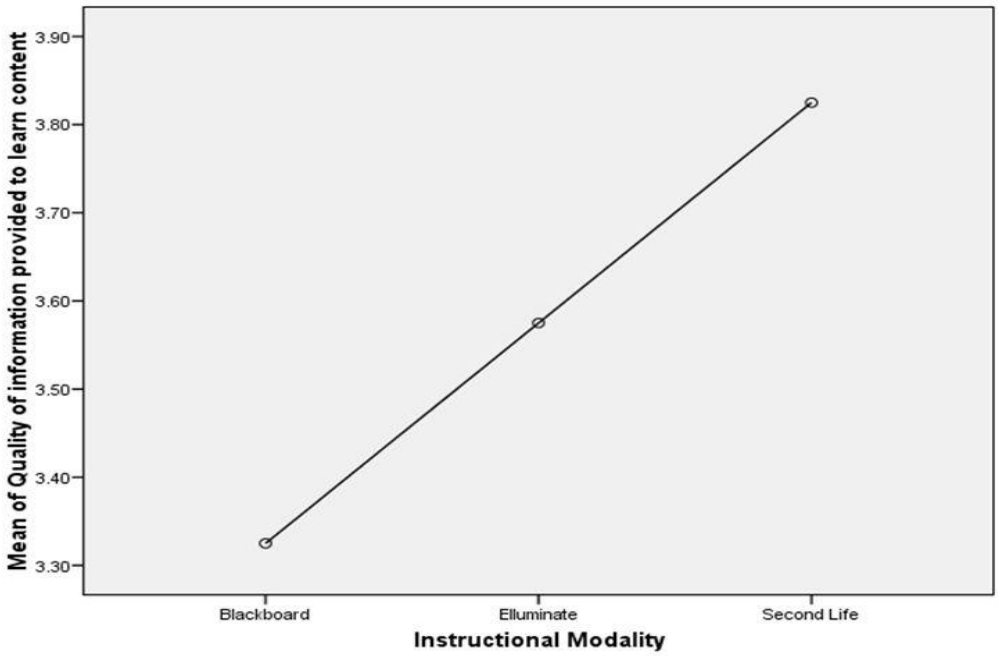


**Figure 3. Mean perceived quality of information by modality (n=10)**

**Table 2. Themes from open-ended questions (N=84 coded comments)**

| Platform | Themes |
|---|---|
| Learning management system (n=44) | Positive aspect of asynchronous learning (n=17) |
| | Limited Interaction/Flat communication (n=13) |
| | Confusion (n=4) |
| | Isolation (n=3) |
| | Technical challenges (n=3) |
| | Positive technological dimensions (n=3) |
| | Good resources (n=2) |
| Webinar (n=24) | Technical challenges (n=12) |
| | Real time exchanges support learning (n=7) |
| | Positive technological dimension (n=3) |
| | Too much ongoing activity (n=2) |
| Virtual environment (n=16) | Real time exchanges support learning (n=11) |
| | Technical challenges (n=2) |
| | Positive technological dimension (n=2) |
| | No distractions (n=1) |

Several themes emerged from the open-ended questions (See Table 2). The learning management system arose as being convenient for its display of class content. However, as one student expressed, "Early on when I did not have any contact with my classmates, I sometimes found the discussion board to be intimidating. I usually don't have any problem participating in a class discussion, but this format decreased spontaneity and lively discussion." Webinar was found to be preferable to the lack of real time communication in a learning management system. Technical problems in webinar were pervasive and students found it "difficult to manage all the activity that was occurring at the same time, i.e. discussion, instant messaging, etc…" Students found the virtual environment to be "extremely effective" and helped increase participation, interaction with others, and the number of classroom discussions.

## 4. Discussion

Social learning where students are interacting through conversations with others promotes an environment where ideas are easily shared and discussed. Social learning is based on the premise that our understanding of content is socially constructed through conversations about the content and through grounded interactions, especially with others, around problems or actions (Brown & Adler, 2008). Students working in small groups learn more than those who work on their own (Brown & Adler, 2008). As demonstrated by the results in this study, learning in an online virtual environment gave students a sense of presence giving them the perception of being in close proximity and thus enhancing the learning environment and perception of the quality of the content delivered. Presence is defined as the subjective feeling of being in a particular place even though the user is situated in another environment. In relation to virtual environments, the user feels as though they are really present in the virtual environment or have the feeling of "being there" (Blascovich et al., 2002; Witmer & Singer, 1998) even though they may be physically at home at their desks. Two different psychological states are required to experience presence; involvement which is focused attention; and immersion or feeling "enveloped by" the environment through a continuous stream of experiences (Witmer & Singer, 1998). Presence is also a function of agency or co-presence (whether people see other avatars as representations of real people) and behavioral realism (the degree to which all objects including avatars mimic real world objects) (Blascovich et al., 2002). Presence has been linked to (1) knowledge transfer (transferring knowledge gained in a virtual world to the real world) (Slater, Linakis, Usoh, & Kooper, 1996); (2) potential for better learning and performance (Witmer & Singer, 1998); and (3) behavior consistent with that of the real world (Slater, Usoh, & Chrysanthou, 1995). Virtual environments like Second Life offer the ability to extend beyond traditional learning and support collaboration in learning groups.

Consistent with the literature (Cartwright & Menkens, 2002; Murray, Belgrave, & Robison, 2006), two concurrent themes arose from the three platforms: technical challenges and students showing preference for synchronous web-based learning. The virtual environment emerged as the favored distance based education. This may be due in part to the richness and depth that it offers. Students attended lectures in a classroom similar in appearance to the real world classrooms found on the Duke University campus. This immersion is enhanced by the classroom being situated in a virtual building that very much mimics the real-world Duke University School of Nursing.

For distance and online education students, virtual environments help create a sense of belonging, an academic home. The creation of a virtual school caters to the need

for the predictable, the familiar, and the stable in education (Erlandson, 2002). It may help alleviate feelings of isolation that are experienced with some distance education classes. Virtual environments help create more vivid, lively and interesting discussions through spontaneous communication.

Initially online distance education using Web 1.0 provided only unidirectional information using technologies such as word processing, spreadsheets, presentation programs, and advanced technologies such as computer-assisted instructional packages (Bloom & Hough, 2003). This environment was considered static and allowed professors to "connect to" (Kapp & O'Driscoll, 2010) students. Web 2.0 along with computer-assisted instructional packages enabled professors to "connect through" (Kapp & O'Driscoll, 2010) the Web, thus in addition to information sharing, collaboration, and active discussions became the norm within online education. The immersive Web or 3-D Internet is now providing another paradigm, thus allowing instructors and students to "connect within" (Kapp & O'Driscoll, 2010) the environment, providing the best of all versions of the Web to date, allowing course content sharing, real-time collaboration, simulated real-time classrooms as well as other educational simulations. As a result of advances in online learning technology, course delivery is undergoing rapid changes (Hiltz & Turoff, 2005). As such, faculty are challenged with the task of reconceptualizing the distance education process in order to create environments which immerse students in their surroundings, providing them not only the opportunity to learn, but the opportunity to become co-creators of learning communities (Okita, Bailenson, & Schwartz, 2008).

Web-based education is changing the face of education in health care in particular (Tilley, Bowell, & Cannon, 2006). However, additional empirical research related to virtual 3-D learning technologies is still needed (Hansen, 2008). We need to understand the benefits and limitations of these environments so that we can develop optimal educational environments that take into consideration the constructivist approach. Careful thinking, testing and evaluation are necessary to increase teaching and learning productivity and to support the continuing professional development and education of those in the health care fields (Boulos, Hetherington, & Wheeler, 2007).

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