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Engaging Group E-Learning in Virtual Worlds

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of social and work-oriented groups that have emerged around Web 2.0 technologies and their implications for strategy, marketing, management, and entrepreneurship. He previously held senior management positions with Deloitte Consulting, Cordis Corporation (Johnson & Johnson), and the Wurth Group. He was also president and owner of Trend Distributors, a building supply distribution company.

ABSTRACT: E-learning has seen tremendous growth in recent years. More and more, university courses are now available online to a potentially global audience. However, a significant shortcoming of e-learning technologies has been poor support for group-oriented learning. We believe that virtual worlds offer a potential solution. Unlike videoconferencing (for instance), virtual worlds provide a shared visual space for students to meet and interact (via avatars). Not only do students share the quasi-realism of a 3D environment where participants can see and hear one another, they also have the capability to manipulate artifacts together. These factors provide a strong sense of group presence, which leads to engaging group learning interactions.

KEY WORDS AND PHRASES: business education, e-learning, MMOG, MMORPG, online learning, social presence, virtual engagement, virtual worlds.

IN APRIL 2006, A WELL-LOVED MEMBER OF A GROUP (“guild”) in World of Warcraft suffered a stroke in real life and died. The other group members, who knew her only through her virtual persona, nonetheless felt saddened and decided to hold a virtual funeral for her.¹ During the funeral service, members of a rival gang crashed in and violently disrupted the ceremony. This event generated heated commentary over the blogs ranging from moral outrage to humorous sympathy for the invaders [36]. An aspect that was so obvious that it did not warrant comment from anyone was the sense of presence and engagement. Everyone in that funeral ceremony, guests and crashers alike, were there in the moment. This paper is about bringing this sense of group presence and engagement to e-learning environments. This, we believe, could substantially enhance the effectiveness of remote learning.

Group learning is an important component of education—especially business education. Managers must be effective in groups of many kinds: ad hoc brainstorming groups, problem-solving groups, project teams, boards of directors, and others. They need to understand the dynamics of creating a group, leading a group, entering an established group, power and influence of the group, getting people to work together, dealing with intransigence, when to go along with consensus, and when to resist group pressures. These are all important lessons that improve with instructor-guided experience.

Many business students are already practicing managers. Thus, they have time constraints and travel schedules. E-learning is especially attractive for these students. Current e-learning works quite well for textbook kinds of topics. These can be studied via online readings and audio and video clips. There are a variety of discussion boards and forums that allow students to interact asynchronously. However, these various e-learning modalities miss the lessons of group collaboration. Group collaboration involves synchronous interactions that often depend on nonverbal cues such as tone

of voice, gestures, proximity, and facial expressions—that is, the features of a typical face-to-face interaction.

Videoconferencing technology provides a good substitute for this when the interaction is literally one face to another face—that is, a one-on-one interaction. These interactions are basically “talking heads”—each with a relatively fixed perspective and with little sense of the surrounding environment. Future forms of videoconferencing will provide more camera control to the remote users and the capability to enable multipoint interactions.

Another possibility is the use of virtual worlds—3D environments with interactions via avatars. Unlike videoconferencing, these do not (yet) capture facial expressions. However, virtual worlds do offer aspects of full body appearance, gestures, locomotion, and directional voice. In addition, they offer a strong sense of being in the *same* “place”—with the other group members, as well as the possibility to explore that place and interact with (virtual) artifacts that are available.

In our opinion, virtual worlds are not yet “ready for prime time” in real business settings such as board rooms or budget negotiation meetings. However, we do believe that virtual worlds are suitable and useful for group learning in business education. In this situation, it is useful to have a wide variety of group collaboration experiences. Furthermore, because the focus of group learning exercises is on student exploration, seeing the other person in avatar form versus the real thing can be more acceptable. Indeed, the role-playing possibilities of avatars—that one can completely change appearance—offer a much wider range of group collaboration experimentation than would be available in a physical setting.

In ordinary classroom settings, group learning has been found to significantly enhance learning and student engagement [7]. Thus, it has become one of the most popular pedagogical methodologies. Moreover, in e-learning contexts, it has been found that e-learning students favor the use of collaborative learning techniques where students are able to work together, even if only via text communications [1]. However, group collaboration remains limited in such text-based modalities. We argue that the use of virtual world technologies could provide significant improvements in group-based e-learning. To give a simple illustration, Figure 1 shows a virtual class session.² Here a student group is giving a slide presentation in Second Life. This functionality of making slide presentations to a remote audience is easily matched by webinar technologies (for instance). Yet students have shown strong acceptance of this modality. They get to see one another (in avatar form). They ask questions by raising their avatar’s hand. Communication is audio, at a quality comparable to a group telephone conversation.

Social Presence in Virtual Worlds

BARTLE CHARACTERIZES VIRTUAL WORLDS as “places where the imaginary meets the real” [5, p. 1]—emphasizing the balance of fantasy and realism that virtual world designers strive to achieve. By virtual worlds, we mean online sites that support many (sometimes millions of) people simultaneously, in a 3D simulated environment with virtual

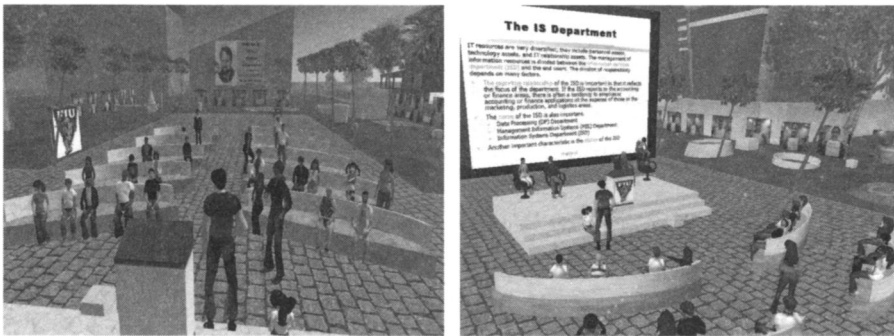


Figure 1. A Virtual Class

landscapes, buildings, and artifacts, where users interact through the use of avatars. Some of the most common and distinguishing characteristics of these worlds are the support of multiple players, a persistent 3D environment, social networking capabilities, and visual similarity to the real world. A common use of virtual worlds is for role-playing games, where users may adopt fantasy identities that are quite different from their real-world selves. However, here we are not specifically concerned with set-top versions of computer games where individuals interact with a computer at home, but not online. Our specific interest is with online virtual environments where it is possible to meet new people and form new groups. Furthermore, virtual worlds are persistent in that they continue to exist between the times of users' interactions. This means that the results of a shared endeavor, such as building and furnishing a virtual house, will be there the next time the parties log on. Persistence is a key factor in achieving continuity in virtual interpersonal relationships [9]. We distinguish two broad kinds of virtual worlds: game-oriented virtual worlds, which usually have a predefined "virtual culture"; and open culture virtual worlds, whose virtual culture emerges based on the constructions and activities of its users.

Game-oriented virtual worlds are characterized by having a story line behind the emergence of the virtual world that delineates the activities and goals of the users while interacting with it. The game designers create images, sounds, activities, and other aspects of the virtual environment in support of this story line and theme. Users are provided choices so that they feel they are having a unique experience, but the choices provided are limited in order to allow for the continuation and consistency of the story line. For this reason, we refer to these game-oriented virtual worlds as having a "closed culture."

In contrast to the closed cultures of the gaming worlds, "open culture" virtual worlds provide tools for users to create their own cultural artifacts with an emphasis on creativity and self-expression. These are the kinds of virtual worlds that are most attractive for educational purposes. In an open culture virtual world, the richness of the culture is due entirely to the users. Thus, in joining one of these worlds, one acquires blank land and access to a set of creativity tools. Using these tools, users may create virtual buildings of their own architectural design; produce landscapes that include streams

and beaches; invent artifacts such as furniture and operational vehicles; and decide how they will appear as an avatar, including physical features such as musculature as well as hairstyle and clothing fashions. A visit to an open culture virtual world is like a visit to a multicultural neighborhood as all users have the power to modify and create the world in order to express their individuality. This creative flexibility has contributed to the rapid proliferation and growth of virtual worlds in recent years [34].

Many educators are experimenting with virtual worlds, mainly of the open culture kind. A common first application is to hold lectures and conferences in a virtual auditorium. For instance, Harvard University chose Second Life as their platform for their virtual schools [54]. In these platforms, one can restrict access to certain virtual areas, as seen in the State of Play Academy of the New York Law School, which uses There.com [45]. Various nonprofit organizations also make use of virtual worlds for educational purposes. For example, the National Oceanography and Atmospheric Administration (NOAA) and the National Aeronautics and Science Administration (NASA) have richly developed locations in Second Life, including simulations with avatar participation [12, 31, 50]. The visual characteristics and spatial orientation of the technologies used to create virtual worlds assist in the development of online groups and communities [33]. Some virtual world groups emerge to achieve a particular goal or project in the world. Other virtual groups may emerge in pursuit of a broader shared purpose such as a political agenda [33, 34].

Virtual groups in game-oriented virtual worlds arise from the desire of successfully accomplishing the challenges presented in the culture of the particular gaming world. Communities of users in these worlds, called “guilds,” are formed following the story line of the world. Guild members are responsible for developing and enforcing group norms. Such norms provide cohesion within the guild that enables its continued existence [33].

Open culture virtual worlds offer even more community building opportunities than game-oriented virtual worlds. In these, users may form a community with the goal of supporting their in-world activities and interests. However, they may also create groups around their real-life interests. A good example of this is the active community of real-life educators that use Second Life to support and expand their academic activities through the use of virtual worlds [28].³ Another example is the case of the Better World Island in Second Life, where organizations such as CARE and the Peace and Justice Center do an excellent job of illustrating the goal of their real-world efforts [49]. Nonprofit organizations take advantage of the world to educate the public as well as to raise funds for their real-world efforts such as the American Cancer Society and its “Second Life Relay of Life” campaign [39]. The facilitation of community emergence in open culture virtual worlds can generate many kinds of collaborative efforts among the users.

Engagement

ENGAGEMENT IS A MATTER OF KEY INTEREST for virtual world developers. The virtual gaming industry has been able to develop a level of engagement so high that it borders on

addiction [24]. This ability of game designers to engender such high levels of engagement leaves educators in awe. As a result, there have been many attempts to develop educationally oriented video games in recent years [40, 55]. The term "engagement" refers to the situation in which an individual's attention is completely focused on a particular task [37]. The virtual gaming industry focuses on engagement as a tool to sustain the participant's interest in the game in order to increase the game's popularity and the associated income. As a result, their center of attention is on the game features that help achieve the flow state in the user's experience.

The state of flow is the psychological state of enjoyment and satisfaction and sense of control experienced by a user when his or her attention is entirely absorbed in the pursuit of the activity at hand [41]. A user that experiences "flow" overcomes all distractions, loses track of time, and achieves maximum performance levels [5, 22]. Flow is maximal engagement. Csikszentmihalyi [11] identified eight conditions that make flow possible: (1) a challenging activity that requires skills, (2) concentration on the task at hand, (3) clear goals, (4) direct feedback, (5) the merging of action and awareness, (6) the paradox of control, (7) the loss of self-consciousness, and (8) transformation of time. When experiencing flow, the users' absorption in the activity causes the users' awareness of external stimuli to fade. They become so deeply involved that their actions become spontaneous or automatic. At the same time, users are given control over their virtual actions, which provide them with a simulated sense of control over the situation. Loss of self-consciousness in the experience of flow refers to the user's identification with the experience when he or she becomes a part of the activity and the concern for the self becomes unimportant. Finally, the state of flow or complete involvement alters the user's sense of time, stretching or shrinking it according to the activity [11].

The strategy of video game designers [10] has been to balance various conditions in an effort to enhance the experience of flow or engagement for a wide number of users. A game developer, LeBlanc [26] (see also [21]), identified eight principal sources that assist in the development of engagement through a player's gaming experience. The identified sources are Sensation, Fantasy, Narrative, Challenge, Fellowship, Discovery, Expression, and Submission. Sensation as a source of engagement refers to the design of a gaming experience that is rich in sensorial input in order to generate enjoyable emotions in the participant. The next source, Fantasy, achieves the goal of engagement through the creation of an alternative reality to which the user is exposed throughout the course of the gaming experience, exploiting the pleasure that individuals derive from make-believe or from temporarily escaping reality. The use of narrative is very common in video games. The goal of this practice is to capture the user's attention by adding drama to the experience. Similar to Csikszentmihalyi's [11] conditions of flow, LeBlanc's [26] sources of engagement propose the use of adjusting levels of challenges as a tool for the development of user engagement. Fellowship provides user engagement by incorporating tools that take advantage of the users' desire to connect with others and facilitate the emergence of a social network through the game experience. Another source of engagement in the design of virtual worlds is addressed by supplying the users with enough content so that they feel a desire to explore and

discover the virtual environment. The design of an environment that allows the users to express themselves through the experience also engenders engagement. Finally, an experience that promotes the users' submission to it is another way to foster user engagement [26].

Game-oriented virtual worlds rely on the incorporation of the characteristics of an engaging experience in the design in order to achieve user engagement. The principal characteristics that produce engagement in game-oriented worlds include the use of narratives describing the fantasy that surrounds the world; the incorporation of various challenges that require different skill levels to be achieved, with outcomes that vary according to the skill level used; support of user community activities and the provision of a limited amount of choices to give a degree of control of the experience to the user. Open culture virtual worlds offer a different experience to their users—a more flexible experience than their counterparts. As a result, their sources of engagement are different. They do not limit the user experience through the use of narratives or a fixed fantasy setting. While open culture virtual worlds give users the opportunity to create their own unique experience, they also face the challenge of how to grab the attention and engagement of visitors. The gaming worlds build upon a long evolution of what features lead to an engaging game (even so, there are flops). Companies that develop game-oriented virtual worlds spend millions and recruit highly specialized game creators to achieve maximum engagement. In the open culture virtual worlds, the environment that the users create tend to be more ad hoc and consequently less engaging. On the other hand, they are generally oriented toward a group with already established common interests (e.g., a class of students), so the engagement can be more specific to the topics of group interest. In contrast to game-oriented worlds, open culture virtual worlds provide users with much greater creative flexibility, which can itself be a source of engagement. For example, consider the activity of decorating a virtual Christmas tree in the town square of a virtual community. Participants might create their own virtual ornaments that would persist and be visible to the virtual public throughout the holiday season.

Presence

FOR MANY YEARS, RESEARCH ON VARIOUS KINDS of virtual technologies has focused on the role of presence as it relates to the user's sense of a successful and rewarding experience.

The ultimate goal is to psychologically transport the user to an artificial environment during the experience. This psychological transportation is known as the user's sense of presence during the virtual experience. As a result, presence has been considered a key element of virtual worlds [20] and has been the subject of various research efforts. Most of the research on virtual presence is based on psychological studies that focus on the identification of design elements that enhance the sense of presence for the user while experiencing the virtual environment [6, 44]. The bulk of this research concentrates on the development and measurement of the *individual's* sense of presence evoked through a virtual reality experience [20, 43], while only limited attention has

Table 1. Glossary of Working Definitions

Term	Working definition
Engagement	A psychological state in which an individual's attention is completely focused on a particular task.
Flow	A psychological state of enjoyment and satisfaction and a sense of control associated with highly focused attention on a task. Flow is associated with a high level of engagement. Also referred to as "state of flow" or "flow state."
Immersion	A sense of inclusion that results when a user interacts with a virtual environment and is exposed to a continuous stream of sensory stimuli that captures the user's full attention.
Individual Presence	The individual's sense of presence evoked through a virtual reality experience.
Physical Presence	The traditional concept of presence that relates to the physical world and physical location of an individual within that world.
Presence	"The state or fact of being present, current existence or occurrence." Presence can be defined in the context of the physical world ("physical presence") or the virtual world ("virtual presence" or merely "presence").
Social Presence	A feeling of group participation and belonging associated with multiple users of a virtual environment. Also referred to as "group presence" or "copresence."
Virtual Presence	Presence in a virtual environment. (Virtual) presence has been defined as "a state of consciousness, the (psychological) sense of being in the virtual environment." Other authors have provided similar definitions of virtual presence, for instance.

been given to the *social* presence aspect [19]. Our interest here is on the role of social or group presence in the success of the user's experience in a virtual world e-learning environment, particularly its role in collaborative experiences. In this section, we provide an overview and comparison of the concepts of engagement and presence. From this, we define the concepts of individual presence and social presence as they are used in our study. These are closely related to the definitions proposed by Lee [27]. For clarification purposes, a glossary of working definitions for engagement, presence, and related terms is provided in Table 1.

Whereas, as noted earlier, engagement refers to the focus of a user's attention on the task at hand, presence refers to the psychological sense of being in the virtual environment that surrounds the user [37]. Various virtual reality researchers argue that user engagement is required before a sense of presence can be developed. This may seem counterintuitive. In real-world environments a person has to be physically present before engagement in the activity arises (e.g., students daydreaming in class).

In the case of virtual environments, presence is defined as the user's psychological state of being in the virtual environment rather than in a real-world location. A user that is deeply engaged in the activity that is being performed in the virtual environment will be able to develop a sense of presence in the virtual environment, whereas a nonengaged user will always perceive it as a technological creation and will not be psychologically transported. Therefore, in virtual worlds, engagement is a precondition of presence.

Virtual Presence

THE NOTION OF VIRTUAL PRESENCE DERIVES from our sense of physical presence. However, our sense of presence in everyday life situations is not always constant. Physical presence does not guarantee that the individual feels a strong sense of presence. For instance, when we drive the same stretch of highway day after day, we are hardly aware of it after a while. On the other hand, in an emergency situation, such as a hurricane, one is intensely aware of all aspects of the immediate situation. Thus, there are some instances where we have a stronger sense of presence than in other instances. We also have a sense of artificial presence from various artistic and communication media. A stirring concert or opera or film may transport us to another reality.

This artistic sense of presence requires both the depiction of a world with salient features easily recognizable by the individual and his or her "willing suspension of disbelief" [32, p. 9].

Various authors have addressed the notion of presence in virtual environments (e.g., [4, 14, 51, 52]). Virtual presence has been defined as "a state of consciousness, the (psychological) sense of being in the virtual environment" [44]. While most other researchers accept this definition of presence, there are some variations of interpretation that impact the measurement of presence in experimental contexts. To begin, we distinguish between objective and subjective presence [42], where one is measured by the successful completion of the task and the other by user's self assessment of feeling as being physically in the virtual environment. Objective measures of presence refer to the effect that the virtual environment has on the users' less controlled physiological responses (e.g., perspiration, heart rate) [38]. Subjective measures refer to the use of direct or indirect questions to measure the user's sense of presence in the virtual environment. The physiological reactions, changes in blood pressure, heart rate, and so forth that result from the user's feeling of presence in a virtual environment are mostly experienced in situations of perceived danger. These kinds of experiments tend to encounter ethical problems [32]. As a result, the majority of the research on presence uses the subjective measures.

Immersion is a widely discussed concept and is considered a related and important element of presence. Slater and Wilbur [43] define immersion as the degree of inclusion that a surrounding and vivid virtual reality is delivered to the user's senses through the computer-generated virtual environment. Immersion is achieved when the user interacts with the virtual environment and is exposed to a continuous stream of sensory stimuli that captures the user's full attention [53].

Efforts to explicate and measure presence emphasize its cognitive and environmental dimensions. Another important aspect is emotional. Huang and Alessi [20] contend that the consideration of the user's emotions when studying or measuring presence is important because emotions have an impact in all the dimensions of presence, such as behavioral, physiological and cognitive. The study of presence in virtual environments must consider the fact that the user's sense of presence is continuously changing while interacting with the various stimuli provided by the environment.

Social Presence in Virtual Environments

AN ADDITIONAL SET OF FACTORS THAT INFLUENCE the sense of presence is associated with the social dimension of virtual environments [19]. These social factors regulate the levels of immediacy and intimacy that participants feel toward other avatars, real or agents, in the virtual world. Social richness in a virtual world increases the strength of presence while interacting with others through a virtual experience by facilitating the user's perception of a "sociable, warm, sensitive, personal, or intimate" [29, p. 2] environment. These factors assist in the transmission of the social, symbolic, and nonverbal cues that complement human communications. The incorporation of social factors in a virtual world empowers the user to control the general level of intimacy of the interactions with others.

When participating in a virtual environment with multiple other parties, the achievement of the user's sense of social presence will depend on the extent to which the user's interactions with other virtual parties (presumably representing real people, but not necessarily) provide a feeling of group participation and belonging to the user. In these cases, it is also important to consider the elements for the development of individual presence. More importantly, the virtual environment must be designed in a way that it conveys the elements of group presence. Thus, individual presence is regarded as a kind of precondition for social presence.

Virtual worlds incorporate many of the factors that support social presence such as body and head movements of the avatars, simultaneous representations of users, representations of agents, verbal and textual communications, and gestures. Designers use these indicators of social presence as a source of user engagement as well as to provide the user with a virtual environment that supports a sense of social presence. An important factor for the sense of social presence is the responsiveness of the other parties. Paying attention to someone in a virtual world setting involves the use of avatar gestures and body language responses or actions that people normally use as signals when interacting with others. For instance, if my avatar makes a gesture, say, a wave hello, and no one responds, I am not likely to feel welcome or belonging. By contrast, to the extent I sense that (virtual) others are paying attention to me and responding to what I say and do, I get the sense of group involvement. A study by Bailenson et al. [2], where the users interacted with other virtual representations of humans, showed that visual contact directly affects the way a user interacts with others within a virtual environment. The results showed that the users experienced

a better sense of presence of the other virtual representation when there was mutual gaze. These findings reflect the fact that in face-to-face interactions, individuals feel more engaged when there is visual contact.

Another research study, by Basdogan et al. [6], on the effect of touch on the sense of presence in a shared virtual environment showed that users felt more immersed in the virtual environment when there was haptic feedback—that is, communication by virtually touching another avatar. The study also showed that haptic feedback provides a better sense of interacting with another individual, supporting the author’s thesis that “the fundamental aspect of shared experiences is the sensory communication that takes place between participants which enables them to display their actions and express their emotions to each other” [6, p. 2]. Psychological research (in the real world) has shown that nonverbal cues provide additional information in the communication process through physical and behavioral signals [35]. Nonverbal cues are considered to be subconscious responses, and for that reason they are regarded as a complement of the message in verbal communications. In the case of conflict between the messages of verbal communication and nonverbal communications, priority is given to the nonverbal one. Nonverbal communication cues together with gestures, proximity, and eye contact, among others, make up what is known by researchers as social presence cues [48]. Perhaps not surprisingly then, it has been found that nonverbal interactions among virtual participants, including gestures and physical responses, are important elements of social presence [2, 48]. Bailenson et al.’s [2] research emphasizes that gestures are important to maintain interpersonal immediacy between the user and other virtual representations of humans.

Social presence cues also include the signals that make the individuals aware that they are being acknowledged by the other party and that they are engaged in the interaction [48]. Thus, the mapping of social presence cues in virtual environments to the real-life cues is important for the goal of positively affecting presence. If the user is not able to correctly interpret the nonverbal cue, the sense of presence will be negatively affected. For that reason, designers need to incorporate generic and widely accepted social cues into the design of the virtual world.

There are two basic approaches for the incorporation of gestures and other nonverbal cues in virtual worlds. First, the developers program the social cues of the agents and avatars to be triggered by certain actions. The numerous merchant agents or nonplayer characters (NPCs) that can be found in most virtual worlds initiate a dialogue with the avatars that are within a certain proximity. Accompanying gestures, such as pointing to their selling posts and the avatar’s head gaze and movements, are triggered when in proximity of the virtual representation with which interaction is allowed. The second approach is to allow the users to create nonverbal signals that reflect their virtual self and which can be easily interpreted by their in-world communities.⁴ This second method, coupled with the wide variety of social presence cues available, increases the users’ need to map the visual cues of the virtual environment with their previous knowledge in order to enhance the sense of presence. The use of a variety of these social presence cues helps to overcome the lack of direct physical gesturing in these types of virtual worlds.

How to Make Group Collaboration Engaging Using Virtual Worlds

EFFECTIVE GROUP COLLABORATION REQUIRES that all participants commit to the group activity and the existence of an appropriate working environment—an environment that makes all group members feel comfortable and fosters their participation. This is more difficult in distance group collaboration due to the lack of face-to-face contact. The development of the appropriate working environment for the group and the effective achievement of the goal is a key step for collaborative projects. Virtual worlds can potentially benefit from this aspect of e-learning by providing an engaging platform that can support multiple users and collaboration among them.

The study of virtual world dynamics is full of rich examples of how strangers with a shared interest have come together to form large communities in a short period of time. They arrive at an informal synergy, using each other's virtual skills to achieve the benefit of all the parties involved. These specialized communities within virtual worlds are thus customized to be especially engaging to their members.

Getting to Know You

It would seem obvious that group collaboration requires that the group members get to know each other. But what does it mean, to get to know someone? Presumably, this has something to do with the predictability of their behavior, what we might call familiarity. As has been noted in the more than 30 years of research by Ekman and colleagues [15], facial expressions provide rich information about the emotions and intentions of others. For this reason, probably, executives continue to travel thousands of miles to have face-to-face meetings. Videoconferencing is on the rise as a substitute for meeting travel. However, this modality seems to work best when people already know one another.

Virtual world environments, by contrast, so far have only weak representation of facial expressions, as compared to the subtlety of expression of actual human faces. It is rather surprising, therefore, that virtual worlds appear to work quite well for group formation and becoming familiar with one another. This is seen especially in the game-oriented virtual worlds where people cluster into “factions” that are socially intense and long lasting. The point is that, based on the empirical success of dozens of game-oriented virtual world platforms that rely on teams or groups pitted against one another, the “getting to know you” phase of group formation can apparently be achieved via avatar representations. Exactly which features of these virtual worlds are the key enablers of “getting to know you” are still in debate. Our conjecture is that a strong factor is the consistent appearance associated with an observed reliability of behavior—for example, one party might be more aggressive while another might be more diplomatic.

Game-oriented virtual worlds apparently work quite well for the formation of goal-oriented groups. At issue is to what extent these features can be applied to group-oriented e-learning. Clearly, in the e-learning context, the task orientation is quite different than in a virtual game designed for entertainment purposes. For

games, engagement is the primary purpose; for e-learning, it is only the means to an educational end.

Sense of Being Together in the Same Place

At present, videoconferencing is still mainly point-to-point. Multipoint videoconferencing for three to four people is just emerging, but we may expect that soon larger numbers will be supported. The obvious advantage of videoconferencing over virtual worlds is that facial expressions are clearly visible.⁵ On the other hand, a big advantage of virtual worlds over videoconferencing is the sense of being together in the same place—that is, a shared information space.

Note that for the sake of argument and emphasis, we are presenting the relative merits of virtual worlds versus videoconferencing as if they are an exclusive choice. Of course, one may combine these and possibly other tools (such as a digital whiteboard) to synergize the features of these various technologies. However, coordinating multiple software tools in this fashion may overburden beginning students.

Added Value of Voice Communications

So far, we have primarily emphasized the visual quality of virtual worlds. Many virtual worlds have now added what is called “directional voice.” With directional voice, one has a distinct sense of the direction as well as distance of a speaker’s voice. For instance, in a conference held in a virtual world meeting room, some parties are farther away while some are close up. With directional sound, one also hears the voice of people virtually seated on your left coming from the left, while the voices of people at the other end of the table come from their direction, but sound fainter, and so forth. Prior to the incorporation of voice in virtual worlds, people would sometimes phone one another to add voice communication instead of just text chat. It is interesting to note the added sense of presence that directional voice adds over phone. One has a definite sense that the voice is emanating from a certain avatar, rather than just being an ambient sound. (Once facial movements are added to avatars, the sense of presence will no doubt be stronger.)

Gestures and Body Language

Another form of human communication is via gestures and body language. This mode of communication is supported to a limited extent in current virtual worlds. Avatars can walk or run around (sometimes they can also fly). They can point to things, grasp things, and move things around. They can draw on a whiteboard (still with some difficulty). They can also execute preprogrammed gestures such as waving hello. Elementary gestures can also be combined into longer sequences such as a salsa dance. At present, the functionality of gesturing is too clumsy to contribute very much to group interpersonal communication.

Support for Student Creativity

The easy-to-learn and user-friendly creativity tools provided by open culture virtual worlds make them attractive for a wide variety of learning applications. When interacting with a virtual world, teachers as well as students face few limitations in terms of the use they can give the virtual world's resources. The support of creativity has long been shown to be a critical factor in achieving student engagement [23]. The wide variety of virtual activities and the capabilities to create imaginative virtual artifacts is highly stimulating to students and their teachers. Other e-learning environments do not support this kind of creativity on the scale and variety offered by virtual worlds.⁶ In our experience, team competitions involving virtual constructions can be so engaging that students start to ignore their other classes.

Structured Tasks to Measure Group Engagement

The challenge here is developing and measuring group engagement. Our goal is to determine the enabling factors necessary to achieve the desired level of group engagement for effective collaborative work and how to measure it. Clearly, this requires more than simply assigning specific tasks to each team member and observing their subsequent performance. We need to measure their synergistic behavior. Group engagement requires that all participants get fully involved in the whole process. Students should be aware of the status of their contribution at all times as well as that of their collaborators in order to corroborate that the final result will indeed comply with the shared vision of the expected outcome. It also requires that team members assist and support each other in the performance of their individual tasks and in the understanding of the goal and outcome throughout the duration of the collaborative effort. If the students simply perform their task individually, then there is no group engagement because each performed their task separately. Group engagement emerges when the students participate in the whole process—that is, even if their task is already fulfilled, they continue to participate. They stay from beginning to end and actively support their team members.

This argues for the potential benefits that virtual worlds have for e-learning collaboration involving structured activities. However, such activities are “self-organizing” in that participants can see what needs to be done in advance. The success of less-structured collaborative endeavors, such as problem-solving situations, depends more on a persistent sense of group engagement where participants need to be continuously attuned to changing definitions of tasks and roles.

Empirical Study

EXPERIENTIAL LEARNING THEORY SUSTAINS that an effective learning experience is better supported through the engagement of a variety of the learner's senses. It promotes the creation of a dynamic learning environment that supports creativity and productivity. The active involvement of the student in the learning process is key to the learner's success. Today's fast-changing environment emphasizes the need for effective and

efficient learning. In an attempt to achieve this goal, educators have long relied on different types of group interaction activities. Collaborative work actively engages the student in the process facilitating the attainment of the learning goal.

Another tool used by educators to facilitate faster, efficient, and effective learning processes is the use of e-learning technologies. E-learning addresses the need for fast changes and globally available education. Its use facilitates today's training and professional development programs by allowing distributed learning. Current e-learning technologies support distributed learning but they do not provide enough support to achieve active *group* involvement of the participants. One of the most common complaints of students who participate in e-learning is that they feel disconnected from their classmates and the instructor and, as a result, their performance is often affected.

Virtual worlds offer most of the capabilities of e-learning technologies and they also offer an excellent opportunity for the active involvement of the student's senses in the learning processes. Therefore, virtual worlds facilitate the incorporation of virtual experiential learning into the e-learning experience. It is expected that this type of e-learning environment will foster higher levels of student engagement and in turn better performance than the environments that do not facilitate the incorporation of virtual experiential learning.

Social presence in e-learning situations using virtual worlds will foster higher levels of student engagement than other e-learning environments. As a result, performance in collaborative efforts will be enhanced as will be the overall student's performance. The sense of social presence required to achieve effective collaboration will be engendered by the use of real-time virtual visualization of other students and real-time communications—particularly the use of nonverbal signals and the creative tools provided. Virtual worlds might be more suitable for problem-solving collaboration and might result in higher engagement levels than in structured activities.

Research Claim and Hypotheses

This research was designed to address the claim that a virtual world learning environment provides better support for group-oriented collaborative e-learning than other e-learning environments because it facilitates the emergence of group presence. The goal of this research is to test the hypothesis that participants in a virtual world learning environment will perform better in collaborative tasks than their counterparts. It also tests the hypotheses that participants of a virtual world learning environment will experience higher levels of engagement, presence, and group presence during the collaborative tasks and report higher levels of perceived individual presence and of group presence than participants in other learning environments.

Hypothesis 1: Participants in a virtual world learning environment will perform better than participants in other learning environments.

Hypothesis 2: Participants in a virtual world learning environment will experience higher levels of engagement, presence, and group presence than participants in other learning environments during a collaborative task.

Hypothesis 3: Participants in a virtual world learning environment will report higher levels of perceived presence and perceived group presence than participants in other learning environments during a collaborative task

Research Design and Methodology

The goal of the study is to compare the sense of presence of participants in three different learning environments during a collaborative task and their performance on the task. The three learning environments are a text-based virtual learning environment (Blackboard), a virtual world (Second Life), and traditional classroom setting. Participants were undergraduate students enrolled in the researcher's Introduction to Computerized Information Systems sections, a required course for all business students. Students made the enrollment decision freely without any influence from the researcher or knowledge of the research project. Participation was voluntary and students made the decision after the informative session on the first day of class. Participants were able to choose between a virtual or traditional learning experience. Students that opted for the virtual learning experience were randomly assigned to one of the two virtual learning environments used—Blackboard learning environment and Second Life virtual world—and did not have any classroom contact. After the participants were assigned to a learning environment, they were randomly assigned to teams of six members. There were two collaborative tasks assigned. Each team performed both tasks.

The experiment was divided into two phases: the pilot study to calibrate the instrument and the main study. These phases were conducted in different academic semesters. A total of 45 students (17 males and 28 females) participated in the pilot study—15 in each of the three learning environments (traditional, Blackboard, Second Life). The main study had a total of 72 participants—24 in each learning environment—with a gender distribution (24 males and 48 females) similar to that of the college population. The average age of the participants was 20 years (standard deviation [SD] = 1.648, age range 18–25).

Before starting the study, the participants were administered an immersive tendencies questionnaire (ITQ) based on the ITQ questionnaire developed by Witmer and Singer [53]. Each participant's ITQ score was calculated as the mean value of the answers provided by the participant. The ITQ score was used to calculate the immersive tendencies score of each group in order to evaluate if any group had a significantly higher predisposition to immersion. We found no significant difference in the average ITQ score in the three different learning environments ($p = 0.186$).

After the collaborative tasks, the participants were administered a questionnaire developed to measure their level of presence during the task, called the presence questionnaire (PQ). The PQ was based on a set of presence measures proposed by various researchers [3, 6, 8, 13, 17, 18, 25, 53], which we adapted. Our original questionnaire consisted of 34 items. The pilot study was conducted to validate the instrument, resulting in the elimination of one item and modification of another two. The PQ used to gather the data consisted of 33 five-point Likert scale items—21 items applied to

all three learning environments while the other 10 only applied to the virtual learning environments. Participants were asked to rate the importance each item had for their experience during the collaborative tasks on a five-point Likert scale. The questions asked in the various questionnaires used in this study can be found in Franceschi [16, appendices B, C].

Study Results

The two collaborative tasks consisted of a crossword puzzle of course-related concepts and a set of five review questions related to the course topic that needed to be completed and submitted by the team. The tasks were performed synchronously by all team members on two different occasions. Online teams were assigned a date and time when the instructor was available in the corresponding online learning environment to supervise and grade the team's effort. The teams were graded on correctness and time used. Participants were administered the PQ instrument—either the online or paper-based version according to the learning environment—immediately after completing the task.

The data obtained with the PQ surveys was screened for missing values, outliers, normality, and linearity. No missing values were found. The Mahalanobis distance statistic ($\chi^2 = 45.315$) confirmed that there are no outliers in the data set. Multivariate normality was assessed using linear regression for standardized residuals together with a residual plot for the variables. The residual plot indicates that the data meet the assumptions for normality, linearity, and homoskedasticity.

A factor analysis using maximum likelihood estimates (MLE) was conducted with the data set, after the Bartlett's test of sphericity (approximate $\chi^2 = 189.8$) and the Kaiser–Meyer–Olkin measure of sampling adequacy (0.917) indicated that factor analysis is appropriate for the data set. Three components were retained with eigenvalues greater than one, which explain 62.26 percent of the total variance, and satisfying the interpretability criteria, that is, each omitted component accounts for less than 5 percent of total variability, each retained component contains at least three variables each with a loading more than 0.50, and variables loading in a component share the same conceptual meaning—different from those in the other components. The three retained components are: Engagement (nine items), Group Presence (five items), and Presence (four items), which were subjected to reliability analysis.

Cronbach's alpha for all factors is greater than 0.70 (Engagement = 0.918, Group Presence = 0.843, and Presence = 0.762), indicating internal consistency of the items used to measure each factor. Furthermore, if the less-correlated items are omitted from the factor, there is no increase in consistency in the items used to measure Engagement and Presence—then, each factor measure of internal consistency, Cronbach's alpha, decreases, except for Group Presence, which has a nonsignificant increase of 0.002 percent. Accordingly, the correlations between the items in each factor are satisfactory. To estimate the items coefficients to be used in the calculation of factor scores, path analysis was used. The model was evaluated using path analysis including the MLE items for each factor (Engagement, Group Presence, and Presence—confirmed by reli-

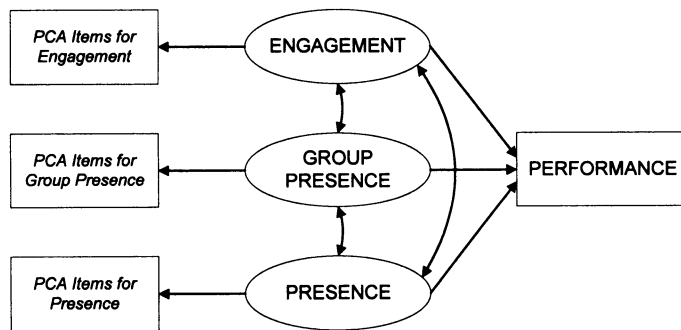


Figure 2. Path Analysis Model

ability analysis) and performance. The conceptual model is shown in Figure 2 and the path analysis results and diagram are presented in Figure 3 (with standardized estimates from Amos 16.0). They indicate a reasonably good fit (chi-square = 248.826, $p = 0.000$, goodness-of-fit index [GFI] = 0.856, adjusted goodness-of-fit index [AGFI] = 0.814, comparative fit index [CFI] = 0.927, parsimony ratio [PRATIO] = 0.86, root mean square error of approximation [RMSEA] = 0.07). All arc coefficients are significant at the 99 percent confidence level, except two: Performance with Engagement (0.07) and Performance with Group Presence (0.20). Four different scores per student were calculated for each component (factor), the unweighted average and three weighted averages of the question items. The first score (mean score; MS) consists of the unweighted average mean score of the answers provided by the participants for the components' items. The second, score weighted by relative importance (WS), uses the participants' responses rating each item and its relative importance for each item. The loadings generated by the principal components analysis (PCA)/MLE were used with the participant's rating response for each item to calculate the third score (MLE weighted score). Finally, the standardized estimates provided by the path analysis for each item and the participant's rating response for each item were used to compute the last score (path analysis weighted score; PAWS). The formulas used are presented in Table 2.

A multivariate analysis of variance (MANOVA) was conducted to determine the effect of the environment on six different dependent variables: Presence, Group Presence, Engagement, Performance, Perceived Presence, and Perceived Group Presence. The factors used were environment with three levels (1 = Blackboard, 2 = Second Life, and 3 = Classroom), gender with two levels (1 = female and 2 = male), and collaborative task exercise (1 = crossword puzzle and 2 = review questions). The participants were asked to rate rank (using a five-point Likert scale) their levels of presence and group presence during each collaborative task. These values correspond to the dependent variables Perceived Presence and Perceived Group Presence. The variables Engagement, Group Presence, and Presence were calculated using the participant's responses to rating the items that correspond to each MLE component. All four underlying assumptions of a MANOVA were checked before running the

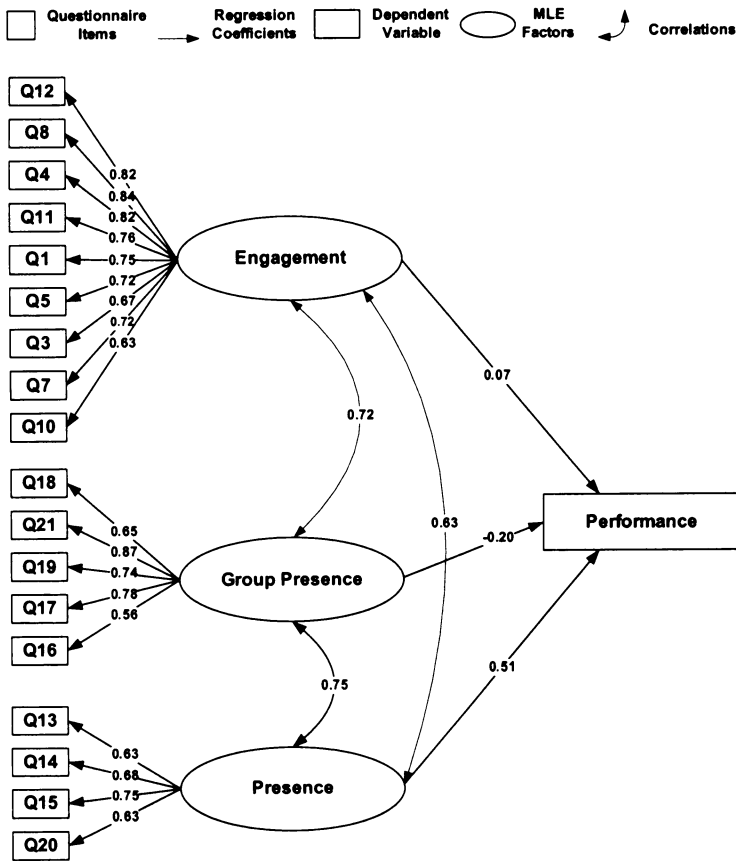


Figure 3. Path Analysis Diagram

analysis. Randomness and independence are met because participants were randomly assigned to the virtual learning environments. The Box's test of equality of covariances matrices shows that the homoskedasticity assumption is not met (significance 0.000). Therefore, the Pillai's trace test statistic was used to calculate and interpret the results of the MANOVA analysis.

We found that learning environment affects all the dependent variables while collaborative task and the cross effect between learning environments and type of collaborative task only affects Performance. Table 3 presents the results of Pillai's trace MANOVA tests. The results are consistent on all four dependent variable score measures (MS, WS, MLEWS, and PAWS), which is surprising. A further investigation during the paper revision of each of the three dependent variables (Engagement, Presence, or Group Presence) revealed that there is no significant difference among the four types of weighted scores in terms of means (confirmed also by analysis of variance [ANOVA]), standard deviation, coefficient of variation, or mean absolute deviation. Hence, the three different weighting schemes (WS, MLEWS, PAWS) did

Table 2. Formulas Used for Score Calculations for Student Engagement, Individual Presence, and Group Presence

Unweighted mean score (MS)

$$MS = \frac{\sum_{i=1}^n S_i}{n}$$

where S_i = score assigned by student for question i
 n = number of questions used to evaluate the factor

Weighted score by relative importance (WS)

$$WS = \sum_{j=1}^k (S_j * RQI_j)$$

where RQI_j = calculated relative importance for question j
 k = number of questions in the factor
 S_j = question j importance assigned by student

$$RQI = \frac{QI_j}{\sum_{j=1}^k QI_j}$$

where QI_j = question importance for question j
 k = number of questions in the factor; and

$$QI = \frac{\sum_{j=1}^n I_j}{n}$$

where I_j = score assigned for question j importance
 n = number of answers to the question

MLE weighted score (MLEWS)

$$MLEWS = \sum_{j=1}^k (S_j * PCA_j)$$

where PCA_j = PCA/MLE loading for question j
 k = number of questions in the factor
 S_j = question j importance assigned by student

Path analysis weighted score (PAWS)

$$PAWS = \sum_{j=1}^k (S_j * PAE_j)$$

where PAE_j = path analysis standardized regression weight for question j
 k = number of questions in the factor
 S_j = question j importance assigned by student

Table 3. MANOVA Test Results via Pillai's Trace

Factor	Unweighted mean score (MS)		Score weighted by relative importance (WS)		Score weighted by PCA/MLE factor loadings (MLEWS)		Score weighted by path factor estimates (PAWS)		Significance level (same for all four weighted methods)
	<i>p</i>	η^2	<i>p</i>	η^2	<i>p</i>	η^2	<i>p</i>	η^2	
Environment	0.000	0.544	0.000	0.547	0.000	0.544	0.000	0.545	All***
Gender	0.753	0.026	0.753	0.026	0.745	0.027	0.750	0.026	n.s.
Exercise	0.000	0.858	0.000	0.858	0.000	0.858	0.000	0.858	Performance***
Environment * Gender	0.180	0.060	0.174	0.061	0.196	0.059	0.202	0.059	n.s.
Environment * Exercise	0.000	0.146	0.000	0.146	0.000	0.146	0.000	0.145	Performance***
Gender * Exercise	0.787	0.024	0.775	0.025	0.784	0.024	0.787	0.027	n.s.
Environment * Gender * Exercise	0.931	0.022	0.937	0.021	0.942	0.021	0.928	0.022	n.s.

Notes: Significance (*p*) and variance accounted (η^2) by best linear combination of the dependent variables by independent variables and interactions. n.s. = not significant $p > 0.10$. *** Significant for variables specified $p < 0.01$.

not really differ from the simple mean unweighted score (MS) of the question items included in each of the three dependent variable factors.

Post hoc comparisons of the means (Dunnett's T3) reveal that Perceived Presence and Perceived Group Presence are higher for the participants in the virtual world (Second Life) learning environment than those in the text-based (Blackboard) virtual learning environment, but not significantly different from those in the traditional (Classroom) environment. There is no evidence of a significant difference on the dependent variables Presence and Performance between the participants in the Classroom environment and those in the Blackboard virtual learning environment. Both Presence and Performance are higher for participants in the virtual world learning environment than those in the other environments. Finally, participants in the virtual world learning environment experienced higher levels of Engagement and Group Presence than all other participants, while Classroom participants experienced higher levels of Engagement and Group Presence than those in the Blackboard virtual learning environment.

Discussion of Results

Support for Hypotheses

THE RESULTS OF THE STUDY SUPPORT the hypothesis that virtual world learning environments are better suited for effective e-learning collaboration than text-based virtual learning environments (e.g., Blackboard, Moodle). By contrast, the results show that the text-based virtual learning environment is the least effective in supporting the development of all the dependent variables (Engagement, Group Presence, Presence, Perceived Group Presence, Perceived Presence, and Performance).

The community-building features of virtual worlds that facilitate the rapid formation of collaborative groups for a wide number of purposes have been noted by various researchers [33, 34]. These features are also beneficial for the emergence of collaborative groups in an e-learning setting. In our study, the mean value for the performance of participants in the virtual world learning environment is significantly better than that of the other two environments.

The results do not provide full support for Hypothesis 3. The study shows that there is no significant difference between the means of the Perceived Presence and Perceived Group Presence variables in the virtual world learning environment and the classroom environment. At the same time, both environments have a significant positive difference with the Perceived Presence and Perceived Group Presence variable in the text-based virtual learning environment. Participants of the virtual world learning environment experienced higher levels of Presence and Group Presence than those in the other learning environments. This suggests that virtual world learning environments provide better support for the development of a sense of Presence and Group Presence even when the participants are not fully aware of it.

The development of all the dependent variables (Engagement, Group Presence, Presence, Perceived Group Presence, Perceived Presence, and Performance) is influenced

by the learning environment. Presence is also affected by the type of collaborative task, suggesting that virtual world learning environments are better suited for some kinds of collaborative tasks.

A surprising result of the research is that the participants in the virtual world learning environment experienced significantly higher levels of Engagement, Presence, and Group Presence than participants in the traditional learning environment. A possible explanation for this is that participants in the classroom environment not only share the same physical space, they also share the same sources of distractions, making it easier for all the team members to become simultaneously sidetracked. On the other hand, participants of virtual world learning environments share a virtual environment but not the possible distractions, and while any member can lose concentration at any given time, the others most likely will not and they will subsequently call the distracted member's attention back to the task at hand. In addition, students in virtual learning environments have to be organized and must manage their time in order to succeed in the online course, while students in the traditional learning environment rely heavily on the instructor for organization and time management, which affects their performance on collaborative tasks.

Engagement Results

A common criticism of current e-learning environments is the difficulty of achieving engagement levels similar to those achieved in face-to-face interactions [30]. The results of our study are persuasive that virtual world learning environments are a good proxy for classroom interactions regarding the level of engagement engendered during collaborative tasks. Even though the difference of the mean for the engagement variable of the virtual learning environment and the classroom environment is not significant, the fact that both have a significant positive difference with that of the text-based virtual environment reveal that both environments are better suited for developing student engagement.

Role of Individual Presence, Group Presence, and Engagement in Performance

Our study showed a high correlation between all three variables—Individual Presence, Group Presence, and Engagement. Rather surprisingly, however, the path analysis estimates of our study showed that Individual Presence had the highest direct influence on performance. This suggests that in order to achieve better performance on collaborative tasks in e-learning endeavors, it is not enough to simply address student engagement. Rather, individual presence appears to be a vital factor as well. The path analysis estimates indicate that Engagement's direct effect on performance is very small, but the high correlation with the other two variables (Individual Presence and Group Presence) makes it an important element to consider when developing virtual learning environments and e-learning initiatives.

Potential Biases

We recognize two potential kinds of bias that might have affected this study—novelty bias and expectation bias. By novelty bias, we mean that a certain technology, such as virtual worlds, attracts attention simply because it is new. This could potentially affect the students' measured engagement. We do not believe this was the case in this study because a high percentage (92 percent) of the participants were also new users to the other e-learning environment, Blackboard. However, admittedly, most of the students in our study were technology novices. Ideally, to avoid the potential novelty effect, the students would have been seasoned video game players and Internet surfers. This was not the case.

The other potential bias we considered is that the students were influenced by what they thought the instructor wanted. However, the student participants were not informed of the research claims; they were only told the purpose of the study: to compare effectiveness of three different learning environments. No suggestion was expressed to the audience regarding the goals of the research.

Broader Impact of the Results of This Study

Online learning education endeavors are primarily designed based on text-based virtual learning environments. Our research suggests that this type of learning environment is not the best approach to meet the education goal. Developers of e-learning initiatives need to consider the extra benefits that a virtual world learning environment can provide to a student's learning experience and design activities to incorporate their use.

Further Research Questions Raised by This Study

Future research should increase the sample size, time frame, and scope of the study to include a variety of courses, to determine if the environment effect holds for a variety of topics. Additional research should be targeted at identifying the characteristics of a virtual world learning environment that best support the development of engagement, group presence, and presence, since all affect the performance of the students. It is also necessary to investigate the characteristics of collaborative tasks that are better supported by a virtual world learning environment.

Conclusions: Classrooms Without Walls?

IMAGINE THAT A TIME MACHINE WERE TO BRING AN OBSERVER from the nineteenth century to our time. If this person would visit a hospital, things would be entirely different. However, a visit to the average university would probably be more familiar. The physical classroom has not changed much. However, the observer would no doubt be impressed by the new e-learning innovations, though text interactions still use the familiar keyboard from the nineteenth century. Although foreign students attend, college campuses are localized and quaint, much as two centuries ago.

Virtual worlds, however, offer something really new and different for education. They offer students simulated experiences in other roles, places, and times. One can participate in group discussions and projects with members from other cultures and locations around the world. This is all very promising. Will it really be as good as being physically together? The results of our study support that claim. Furthermore, our study was performed using a commercially available virtual world (Second Life). Intense competition among game developers, new technologies under development, and higher bandwidth infrastructures will further augment the sense of virtual presence and engagement. Educational applications will certainly benefit as well.

Finally, we would like to end with the observation that the technological aspects of this study, online virtual worlds, are a moving target. As we noted, the gaming kinds of virtual worlds have an intense competition to improve their sense of realism and presence. Further, these technologies are complemented by those of the set-top boxes, which are branching into new kinds of user interactivity, such as the Nintendo Wii. Most recently, these technologies are delving into recognition of users' facial expressions such as fear or anger, as well as headsets to track brain activity patterns in real time [46, 47]. These emerging technologies will certainly add to the sense of presence and engagement in virtual group interactions.

NOTES

1. Other funerals have also been held in virtual worlds. For instance, one may get an impression of the somber mood possible in this virtual church funeral in Second Life (www.youtube.com/watch?v=JaEgu8NnJn8). Indeed, even this aspect of virtual life is being commercialized; see <http://buziaulane.blogspot.com/2007/01/funeral-assistance-even-in-second-life.html>.

2. This is from an actual class, conducted by Lee.

3. See <http://secondlifegrid.net/slfe/education-use-virtual-world>.

4. Linden Labs, Second Life Web site, available at www.secondlife.com.

5. However, it may also soon become possible to put live videos of participants' faces onto their respective avatars. RealXtend (www.realxtend.org), for instance, already provides for putting photo snapshots of persons onto the avatar faces.

6. See also Spore (www.spore.com), where one can design artificial life forms.

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