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Co-creation and collaboration in a virtual world: A 3D visualization design project in Second Life

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RESEARCH COMMENTARY

Co-Creation and Collaboration in a Virtual World: A 3D Visualization Design Project in Second Life

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ABSTRACT

One of the most successful and useful implementations of 3D virtual worlds is in the area of education and training. This paper discusses the use of virtual worlds in education and describes an innovative 3D visualization design project using one of the most popular virtual worlds, Second Life. This ongoing project is a partnership between IBM and three universities in the United States: the University of Nebraska-Lincoln, Iowa State University, and Wright State University. More than 400 MBA students have participated in this project by completing a creative design project that involves co-creation and collaboration in Second Life. The MBA students from the three universities worked in pairs to create designs to represent concepts related to IBM Power Systems, a family of IBM servers. The paper discusses observations and reflections on the 3D visualization design project. The paper concludes with a discussion of future research directions in applying virtual worlds in education.

Keywords: Co-Creation, Collaboration, Education, IBM Power Systems, Second Life, Virtual Worlds

1.0 INTRODUCTION

With the advent of low cost networks, high speed computing infrastructures, and easy to use social media platforms, a growing number of educators and scholars have begun to attend to the opportunities presented by new media platforms for delivering high quality learning experiences (Erickson & Siau, 2003). 3D virtual world environments, which support a higher level of interactivity and richness for collaboration and communication than traditional media, have the potential to create engaging and meaning-

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ful experiences for learners (Eschenbrenner et al., 2008). Guru and Siau (2008) note that the possibilities surrounding these platforms are endless as the technology continues to advance and evolve. Similarly, Zhao et al. (2010) observe that the various types of virtual world platforms are now having major influences on businesses, communities, and society at large.

Most 3D virtual world environments offer various affordances for learning and education that make them attractive as platforms for supporting educational experiences (Dickey, 2005a; Park et al., 2008). These unique affordances enable pedagogical activities related to co-creation and collaboration that often extend well beyond those available to collaborators working with traditional technologies and media. In virtual worlds, users interact and form relationships with one another through their virtual representations called avatars. This embodied representation enables richer forms of interaction compared to traditional media such as chat rooms or web conferencing (Mennecke et al., forthcoming). Interactivity is a critical component of teaching and learning because enhanced interaction can increase the effectiveness of learning (Siau et al., 2006). Unfortunately, the lack of interactivity has been identified as one of the major issues facing many educational pedagogies and techniques (Siau et al., 2006). In this light, Dickey (2005a) points out that creating interactive learning environments is one of the prominent trends in the development of effective pedagogies. Furthermore, at a theoretical level, the focus on interactive learning is supported by an increasing paradigm shift towards constructivism in education, which emphasizes approaches such as learner-centered teaching (Schiller, 2009). This paradigm is premised on the notion that knowledge is constructed by learners and learners need to take an active role in the learning process in order to develop a rich understanding of the concepts and skills associated with their learning experience.

One of the unique features of many virtual worlds is the object affordance (Dickey, 2005a; Dickey, 2005b; Park et al., 2008; Chen et al., 2010). Objects can be created, manipulated, and positioned by users, thereby enabling the users to engage in truly creative endeavors (Osborne & Schiller, 2010). Such freedom in creation supports active learning because it allows users to learn not by simply 'watching', but by 'doing' and creating ideas and concepts in the virtual worlds that may closely resemble their real world counterparts. Additionally, users are able to collaboratively design and co-create objects in the 3D virtual world environment in ways that may not be feasible in the real world. This capability for collaboration is important because it fits with the requirements associated with constructivist learning that is increasingly emphasized in pedagogy (Barab et al., 2000). While it is not appropriate for all learning tasks, collaborative learning is increasing in importance because of its demonstrable effectiveness (Gokhale, 1995; Slavin, 1980, 1983; Unalan, 2008). Further, Nah et al. (2010) demonstrate that with the right balance of skills and challenges in a 3D virtual world, a user's flow experience or engagement increases. As one's flow experience increases, engagement in learning and outcomes of learning also increase (Shin, 2006; Skadberg & Kimmel, 2004).

In this paper, we focus on co-creation and collaboration in virtual worlds' learning activities designed to achieve educational objectives. The paper aims to provide actionable suggestions and findings that academics, instructors, and educational institutions can use in creating a more effective and efficient learning environment in virtual worlds. The paper also reports on a specific 3D visualization design project that was conducted in Second Life and describes our reflections on the use of this environment for learning. The 3D visualization design project is a co-creation and collaboration project that involves students from three universities: the University of Nebraska-Lincoln, Iowa State University, and Wright State University.

The remainder of the paper is organized as follows: In the next section, we review the literature on learning theories as well as provide examples on co-creation and collaboration in virtual worlds. We then describe and discuss a 3D

visualization project carried out in collaboration with IBM. Observations and general findings from the 3D visualization project are reported in the paper. The paper concludes with a discussion on potential future research directions.

2.0 LITERATURE REVIEW

While virtual worlds have been used for a variety of purposes for more than a decade, their applications in education are still limited (Eschenbrenner et al., 2008). In this section, we review learning theories and research works related to co-creation and collaborative learning in virtual worlds.

2.1 Learning Theories and Relationships with Co-Creation and Collaboration

Learning theories can be grouped into three categories: (i) behaviorism; (ii) cognitivism; (iii) constructivism (Ertmer & Newby, 1993; Leidner & Jarvenpaa, 1995; Sheng et al., 2010). Recently, the focus of learning has shifted from the behaviorism and cognitivism models to the constructivism model. The behaviorism model, based on the stimulus and response theory, suggests that learning takes place through reinforcement of behaviors that are triggered by specific environmental stimuli. Hence, the behaviorism model views the learner as a "black box" where the process of learning that takes place in the learner is unknown but is driven by deterministic processes. The cognitivism model, on the other hand, views learning as the active processing of new ideas or concepts and the transfer of these ideas or concepts to a meaningful form in one's knowledge structure. Hence, the learner is an active entity that can influence the learning outcome by active processing and encoding of knowledge into long-term memory. The constructivism model, which focuses on the active construction of knowledge by the learner, has recently garnered a significant following and stands as one of the prominent theories of learning (Steffe & Gale, 1995). One of the widely adopted constructivist learning theories in educational practices is the learner-centered teaching theory. Learner-centered teaching emphasizes students' intrinsic motivation to learn and the development of students' abilities to acquire appropriate techniques in problem solving, thus transforming learners from passive receivers of knowledge to active participants in learning and co-constructors of knowledge (Weimer, 2002; VanderMeer & Dutta, 2009). The learner-centered constructivism model, when properly applied, can maximize student learning (Tobin & Tippins, 1993). Learner-centered teaching methodologies have been further refined by IS educators into a systematic approach in instructional development to achieve successful learning outcomes. Empirical results from prior studies have demonstrated the effectiveness of learner-centered teaching in business and information systems education (Schiller, 2009; Wagner et al., 2008).

Collaborative approaches to learning and co-creation are based on the constructivist learning model. In this context, learning takes place through knowledge discovery and interaction during the process of co-creation of a concept, design, or product. Learners engage not only in knowledge discovery during the process but also through reflective thinking. Instruction is provided to support and engage learners in the learning process, and reflections are used to enhance the learning outcomes. Further, learners create their understanding of concepts through their comprehension and interpretation of information from diverse sources including the social construction of knowledge through interaction with other learners. Co-creation provides not only a conducive collaborative approach for learners to interact and gain knowledge from their peers, but also empowers the users (Fuller et al., 2010).

In the next section, we will present examples of how co-creation and collaboration have been applied in virtual worlds.

2.2 Learning through Co-Creation and Collaboration in Virtual Worlds

Visualization has been shown to enhance student learning (McGrath & Brown, 2005) and is a powerful feature of 3D virtual worlds (Ives & Junglas, 2008). Businesses have used visualization to communicate, discuss, and enhance designs and developments, and to obtain consumer feedback (Ives & Junglas, 2008) whereas educational institutions have used visualization to enhance learning in education (Eschenbrenner et al., 2008). Following the constructivist approach, we can incorporate co-creation and collaboration with visualization in virtual worlds to engage students and further enhance their learning.

There is a general consensus in the education literature that interaction, dialogue, and collaboration are essential for productive learning (Minocha & Roberts, 2008). Minocha and Roberts (2008) suggest that 3D virtual worlds provide a platform where pedagogy can be enhanced through socialization, synchronous communication, and collaboration. Citing Vygotsky (1978), Minocha and Roberts argue that knowledge construction is achieved by "the interaction that takes place within oneself through reflective thinking and by the interaction that occurs in communications and collaboration with other people" (p. 184).

Various applications of co-creation and collaboration have taken place in 3D virtual worlds such as multidisciplinary collaborative design as an alternative to CAD systems (Gu & Tsai, 2010; Rosenman et al., 2007), new product development by consumers (Fuller, 2010), and team problem solving in a virtual world environment that simulates the real world (Attasiriluk et al., 2009; Rousso et al., 1999).

In the following section, we report on a co-creation and collaboration 3D visualization design project in Second Life. The project is a partnership between IBM and three universities.

3.0 A 3D VISUALIZATION DESIGN PROJECT IN SECOND LIFE

Researchers from the University of Nebraska-Lincoln, Iowa State University, and Wright State University embarked on an innovative academic project using Second Life. An objective of the project is to educate the MBA students at these three universities, many of whom are working professionals, about concepts, applications, and products related to IBM's Power Systems, a family of IBM servers. Guided by the constructivist learning approach, students collaborated on a creative visualization design project in Second Life to represent concepts related to IBM Power Systems by creating a visualization of these concepts to inform and educate business managers and executives. The 3D virtual world environment was used to facilitate the creative thought processes and critical thinking involved in the co-creation and design processes as well as to promote a deeper understanding of the features and functions related to IBM Power Systems.

As of fall of 2010, more than four hundred MBA students have participated in the collaborative design visualization project in Second Life. The MBA students worked in dyadic teams to create visualization designs in Second Life that represent concepts related to the technology, applications, and/or products of IBM Power Systems. Some of these concepts include AIX, Linux, blade center, Websphere, virtualization, capacity on demand, on demand business, high availability, dynamic computing, green computing, smarter planet, and disaster recovery.

The design project has four stages. In the first stage, participants were guided through orientation activities to familiarize them with the Second Life environment. In addition, we provided training on skills related to building basic prims (i.e., primitive building objects), teleportation and movement, managing inventory objects, and communication in Second Life.

In the second stage, participants were introduced to concepts in IBM Power Systems through display boards in Second Life. The display boards were supplemented with web links to more detailed information on IBM products or applications. Each team conducted their own research on these concepts and the team was free to choose any one of the concepts for their design.

In the third stage, each team with two MBA students co-created their design in Second Life to represent and showcase their chosen concept on IBM Power Systems. The visualization design was to be completed on a virtual platform sized 10*10 meters in Second Life. Each participant collaborated with his/her partner using his/her own personalized avatar during the period of the design process. In general, depending on the class duration, the students would have 3-4 weeks to complete the project. Each participant received inventory folders containing pre-built objects, which included a diverse set of items such as computer equipment, pieces of furniture, decorations, and other miscellaneous items. Participants were free to use any given item, build their own items, or obtain items from other sources in Second Life. They could also upload images and other contents for use in their designs. Team members were instructed to log into Second Life and work on the project synchronously during the design phase.

In the final stage, upon completion of the design, each team was required to build a note card box and place it by the side of their design. The note card box included a script to display information describing their design. Each participant also submitted a reflection paper that explained the rationale underlying his/her team's design and the collaboration experience. The 400-plus MBA students have designed over 200 concepts in this 3D visualization project. Figures 1 and 2 depict some of the designs.

4.0 OBSERVATIONS AND FINDINGS

The Second Life project is innovative and novel in a number of ways. First, the interactive nature

Figure 1. A Female Avatar Working on a Design in Second Life

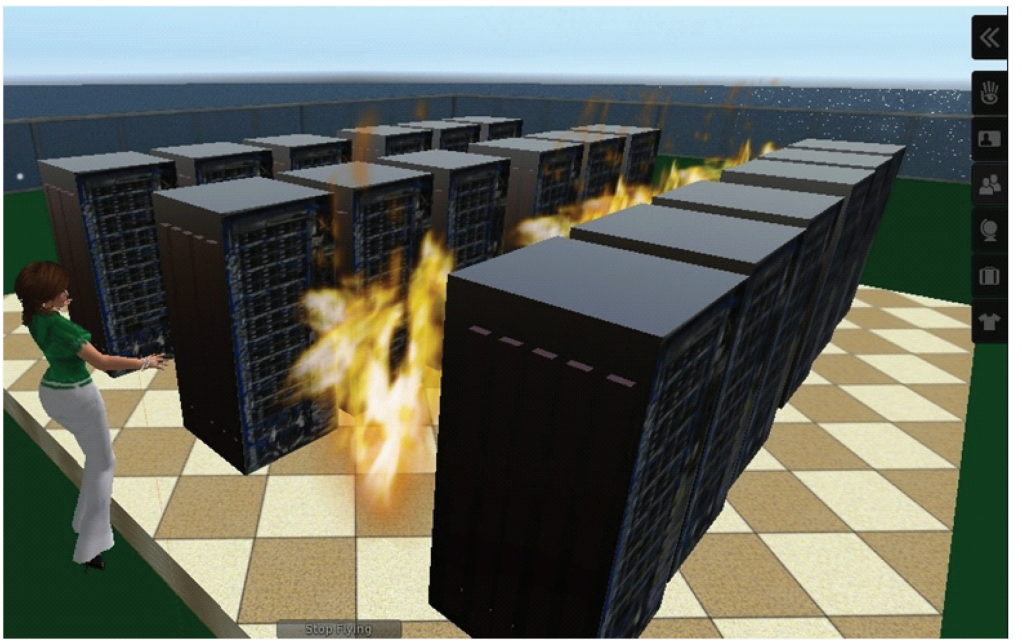

Figure 2. Avatars Working on their Platforms in Second Life

of Second Life promotes the constructivist learning approach, which is an approach to learning that has been shown to be highly effective in the education literature. Students reported that the interactive nature of the environment helped them to attend more intensely to the concepts associated with the design activity, and to actively participate in the learning and design activities when collaborating with a partner.

Second, the project is highly engaging and fun. We asked students to reflect on various aspects of the design experience; the large majority of the comments show that students thoroughly enjoyed creating their designs in Second Life and collaborating with their partners.

Third, working on a hands-on design project for an extended period of time helps to ingrain the IT concepts in the students' minds and to foster relationships between the team members. After spending an average of 4-5 hours a week for a few weeks on the project, the MBA students, most of whom are business managers and executives, would have gained a deep insight, understanding, and appreciation of IBM Power Systems.

Fourth, the Second Life project generated interest among female MBA students. Second Life is a very sophisticated environment but the impressive interface, the appealing visualizations, and the social content associated with the environment make it an aesthetic environment for users. We found the co-creation and collaborative opportunities afforded by the environment to be inviting for women to learn about IT and their applications. Attracting female students to enroll in technical courses and disciplines such as information systems and computer science has been a challenge of late. We have observed that virtual worlds such as Second Life are effective in engaging female students to learn about IT concepts and in increasing their interests in careers related to information systems and technology.

Fifth, the project is partly sponsored by IBM Power Systems. One of the aims of the Second Life project is to educate and inform business managers and executives about IT concepts and products that are related to IBM Power Systems. For IBM, the benefits derived from the project stretch beyond the boundaries of the three universities that participated in

this project. Specifically, more than 400 MBA students in three states – Nebraska, Iowa, and Ohio – have developed an increased awareness of the features associated with IBM Power Systems. Being current and/or future executives in organizations, their increased understanding of IBM Power Systems means that they will likely consider IBM Power Systems in their future IT procurement and investment decisions. The constructivist design experience of concepts in IBM Power Systems will have an important and long lasting influence on their knowledge and appreciation of these systems.

5.0 REFLECTIONS

Virtual worlds can provide unique educational experiences, with its potential only at the cusp of being explored. The project illustrates that 3D virtual worlds such as Second Life may be a good medium for distance education and learning. The students from the three universities participating in this project were geographically dispersed and they were able to collaborate online and co-create their designs in Second Life. From our observations and the students' feedback, the interactive nature of Second Life is one of its greatest strengths. The ability of Second Life to support co-creation and collaboration enables the instructors to design pedagogical tasks that are creative, innovative, and fun. Some of these pedagogical activities were not possible with traditional teaching methods and media (e.g., one team built an interactive kiosk with ornate sculptures and other objects that would be nearly impossible to replicate in other collaborative environments).

Despite their unique capabilities and strengths in supporting active learning, virtual worlds, such as Second Life, present a variety of challenges when used as a platform for education. These challenges can be summarized into (i) technical and (ii) behavioral issues.

5.1 Technical Issues

To run Second Life smoothly, the application requires a high-bandwidth Internet connection (i.e., cable or DSL at a minimum) and a computer with an acceptable graphic card. While "modern" computers generally meet the minimum specifications to enable their use for client applications, not all students have ready access to newer computers. Technological barriers related to bandwidth and older machines can be alleviated by offering students other alternatives for accessing Second Life (e.g., university computer labs).

One major constraint in Second Life is that each island has a maximum of 15000 prims (i.e., primitive objects). For our design project, students generate complex and ornate designs that need a substantial number of prims. We found that the number of prims used and remaining for use needed to be constantly monitored and that we needed to actively manage the prim status. Therefore, educators should be aware of the need to actively manage technical features of the project during its execution. One solution we developed was to split the project activities onto multiple Second Life islands to distribute the load and reduce these constraints.

Another limitation in Second Life is the number of avatars that each island can support at any time. While technically the upper limit stated by Linden Lab is 300 avatars per island, in practice only about 40-60 avatars could visit an island without significant system lag and communication problems occurring. Because of this limitation, small classes would be more appropriate for Second Life.

Although the 3D graphical environment has been effective in delivering experiences that create perceptions of social presence and a realistic sense of place, the Second Life virtual environment still falls short in creating a realistic simulation of true and real-time facial expressions and non-verbal cues. In other words, while some aspects of "body language" can be expressed (e.g., moving about or interacting with objects), the default settings for avatars do not convey rich and detailed forms of body language. Scripts can be purchased that create talking facial gestures, but these need to be acquired and activated and would likely not be appropriate for most educational applications.

5.2 Human-Factor Issues

Attention should also be paid to social and behavioral issues that can create challenges when using Second Life for educational applications. Because social virtual worlds allow users to "hide" behind their avatars, identity and trust issues may generate problems for educators and researchers (Galanxhi-Janaqi & Nah, 2005). An avatar's real identity may, in some circumstances, be difficult to verify, which can create concerns for educational applications. The fact that users can easily switch identities (e.g., switching gender, species, or general appearance) can cause difficulties in classroom discussions (e.g., keeping track of students' real names), problems with untoward behavior (e.g., uninhibited students may be disruptive), and concerns about attendance or participation (e.g., substitutions). This can also be an issue as students interact with each other in the virtual environment in classroom activities or research sessions as well as when students explore the environment on their own. As a result, some students may feel disconnected from other students, which might reduce their sense of trust with other students. Under the identity "cover" offered by their virtual representation, people may feel comfortable engaging in sexually explicit behaviors, displaying inappropriate content, disturbing others, and otherwise behaving badly (e.g., griefing, harassment, and sharing or executing malicious scripts). Fortunately, instructors are able to keep the island accessible only through invitation to authorized personnel and avatars, which can be used as a deterrent. Additionally, our experience is that most graduate students approach the experience professionally and refrain from negative behaviors. Plus, students quickly move past the mask and learn about their partners as "real" people. Once students develop these friendships, the trust they generally develop is supportive of constructive behaviors towards each other and other students in their classes. Nevertheless, "bad" things can happen in Second Life, particularly if an island is left open for visitors, so managing negative behaviors is something that needs to be considered in the use of Second Life for education.

Most students have to meet the challenges of the deep learning curves associated with using Second Life. The majority of the participants in our projects were not familiar with Second Life prior to the class. As a result, many experienced difficulties when they first started using the environment. It is important that sufficient guidance and assistance be made available to students. Effective and clear information and instructions should be provided and enough time should be allowed for the participants to finish the project in the virtual environment. Depending on the complexity and scale of the task and the skills of the participants, collaborative activities can sometimes take much more time to be completed than expected. Given these issues, we generally recommend that educators actively monitor their students' use of the Second Life environment, actively communicate supportive and encouraging messages to students to address questions, and support students in their exploration of the virtual environment.

6.0 FUTURE RESEARCH DIRECTIONS

In this paper, we have highlighted several opportunities and constraints in using Second Life. Of course, our observations are premised on our own anecdotal experiences with using Second Life for several educational and research activities. Given this, these opportunities and constraints represent areas where additional research is called for. While the spectrum of potential research topics associated with the use of Second Life is vast, we will briefly discuss a few of these areas that are most pertinent for IS researchers using Second Life for education and, by extension, for research.

One of the most important topics for research in Second Life is associated with the fit of the environment for educational activities. As is the case with any software product, the use of a technology like Second Life will be more successful for students and educators if

the technology fits the task (See Goodhue & Thompson, 1995). The fact is that many educational activities can be better completed in other venues. In debriefing students who have completed our courses, a consistent theme has emerged. Specifically, students note that Second Life is relevant and useful for some classroom activities but less so or, perhaps, not at all for other types of activities. For example, we used the Second Life environment to bring together students from two institutions to work together on an interactive design project. Most students reported that this was an effective use of Second Life because it fostered rich activity based interactions that allowed students to communicate with their partners in ways that would have been difficult with other media.

On the other hand, we have received mixed feedback regarding attitudes about using Second Life for conducting lectures. Students have noted that when lectures are performed online, it is better if there is some reason to do so in Second Life. For example, we have brought guest speakers who are content experts to our classes using Second Life. In some cases, these speakers took our students on tours or showed them tools or applications within the environment (e.g., touring a NASA platform or walking inside of a blood vessel simulation). Students recognized that these Second Life-centric sessions were best performed in Second Life rather than via some other medium. In addition, we have received feedback suggesting that several educational activities might be better undertaken using other media. Second Life does not seem to be useful to engage in activities like short meetings, as a means of coordinating or managing team activities (e.g., scheduling or "pinging" other team members for availability), or for working on tasks that feed into "real-world" projects (e.g., working on composing a paper or performing a financial analysis). Other tools such as instant messaging or shared workspaces like SharePoint were offered as preferred tools for many of these tasks. Therefore, a possible venue for future research will be on understanding where and how Second Life and other virtual worlds will be useful in education.

A second focus for research should look at issues related to the adoption and management of the Second Life platform. As a software product, Second Life is within the domain of expertise for IS researchers and much research examining the adoption or diffusion of software within organizations could and should be brought to bear on understanding whether, why, and how virtual worlds can be successfully adopted by educators and researchers (see Davis, 1989; Venkatesh et al., 2003). What factors impede its adoption? What impact do institutional constraints or resources play in influencing faculty decision making about using Second Life? How does Second Life align with educational institutional strategies and how does this influence the decision making process? Finally, what role do the characteristics of the Second Life adopter, such as a faculty member, have in the success or failure of Second Life initiatives? These are but a few of the many types of questions related to adoption and diffusion that could be applied to understand Second Life use in education.

A third stream of research relates to leadership, teamwork, and team composition. Teams lead by the right leader and staffed with the right people are more likely to be effective and efficient (Crowston & Scozzi, 2008; Long & Siau, 2007; Siau et al., 2010b, 2010c). Second Life may be a possible medium for leadership and teamwork training but these are simply hypotheses or conjectures at present. Are there differences between leadership in the real world and leadership in virtual worlds? If so, what are the additional dimensions of leadership that a leader needs to possess to be effective in the virtual environment? How about teamwork characteristics and team composition? What are the necessary skill sets that a team should possess when completing a task in a virtual world and how does this compare to the skills needed in other virtual team contexts?

Another venue for research is on knowledge acquisition, knowledge transfer, knowledge diffusion, and knowledge management in Second Life. The ability to effectively manage distributed knowledge is becoming an essential core competence of today's organizations, including

educational institutions (see King, 2006; Cai, 2006; Kwan & Cheung, 2006; Kwahk et al., 2007). Nevertheless, Siau et al. (2010a) emphasize that knowledge management sharing in virtual communities is an important area that remains largely understudied. What are the efficient ways to foster knowledge acquisition, transfer, and diffusion in virtual worlds? How to effectively manage knowledge in virtual worlds? Currently, most faculty members that use Second Life for teaching or research are storing the knowledge outside Second Life. What kind of features and functions should be provided in Second Life to effect management of knowledge?

Numerous research topics could be examined to better understand whether and how Second Life can be used as a platform for education. Those that we discussed above represent some of the more pertinent areas for IS researchers. Scholars in areas like law, sociology, cognitive psychology, and numerous other disciplines have already begun to study questions related to legal, social, psychological, and interpersonal behavioral issues as they apply to Second Life and other virtual world environments. It is time for IS researchers to examine the issues relevant to IS in the adoption and use of virtual worlds.

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