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Assessing the Value of Virtual Worlds for Post-Secondary Instructors: A Survey of Innovators, Early Adopters and the Early Majority in Second Life

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Abstract**—**The purpose of this study was to assess the value of Second Life among post-secondary instructors with experience using Second Life as an educational tool. Using Everett Rogers's diffusion of innovations theory, survey respondents (N = 162), were divided into three adopter categories: innovators, early adopters and the early majority. Respondents were from 15 countries and 25 academic disciplines, indicating the considerable potential this innovation has to be adopted across many different borders and in many areas of academe. Nearly 94% of respondents said they plan to use Second Life again as an educational tool. However, no significant differences were found in instructors' levels of satisfaction with Second Life as an educational tool or their perceived effect on student learning across adopter categories. On the other hand, instructors who conducted class fully in Second Life were significantly more satisfied than those who used Second Life as only a small supplement to a real-world class. Overall, personal interest factors, rather than interpersonal communication factors, most influenced respondents' decision to adopt Second Life as an educational tool. In light of these findings, theoretical implications are discussed and practical suggestions are provided.

Keywords**—**Second Life, Virtual Worlds, Educational Technology, Diffusion of Innovations

I. Introduction

WEB 2.0 technologies, such as social networking, blogs, wikis, podcasts, mash-ups and virtual worlds, hold the potential to transform higher education. These new Web 2.0 tools are built on encouraging interaction and collaboration, two concepts that are at the foundation of participatory learning, in which participants move from being passive consumers to active contributors [5]. For instructors, Web 2.0 tools, particularly virtual worlds, may help improve traditional distance learning, which is often rich in content, but low in interaction among instructor and learners [25]. In addition, having grown up playing video games, many of today's learners may be more comfortable in virtual worlds than sitting in a classroom [27]. Recent interest in experimenting with new participatory educational tools for the college classroom has thrust virtual world Second Life into the spotlight.

While Second Life wasn't developed specifically with education in mind, its open-ended possibilities have caught the attention of post-secondary educators across a wide array of disciplines. Second Life is now being used to teach classes in architecture, English as a second language, physics, engineering, law, science and space, computer science and engineering [6]. More than 150 academic institutions from at least 14 countries have a presence in Second Life [12]. In 2007, a virtual conference held in Second Life to discuss teaching in a virtual world attracted 1,300 unique avatars from around the world [7]. An e-mail list started by Second Life creator Linden Lab to discuss education and teaching in this virtual world has more than 2,300 active subscribers [18].

After an initial burst of enthusiasm by educators for using Second Life as an educational tool, criticism and skepticism about teaching in virtual worlds has emerged. Educational proponents of virtual worlds have cited their effectiveness for conducting group events and activities, role-playing scenarios and virtually exploring new places[7], [8], [10], while critics have argued that virtual worlds may be more playful than pedagogical [12], [13]. Other criticisms of Second Life have included the time it takes for instructors and learners to understand how to manage their avatar in the virtual world before they can even think about learning, as well as technical problems with the Second Life program [2]. Additionally, bad behavior, known as "griefing" in Second Life, has soured the program's reputation among some educators. One of the most notable examples of griefing occurred in May 2007, shortly after the tragic shootings on the real world Virginia Tech campus, when a virtual gunman began shooting other visitors on Ohio University's Second Life campus. While no avatar was hurt or killed, the university temporarily closed its island

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in Second Life [35].

This exploratory study represents one of the first efforts to evaluate the diffusion of virtual worlds as an educational tool for post-secondary instructors and uses the diffusion of innovations as a theoretical framework [30]. In addition to providing detailed descriptives on the institutions, instructors and courses being taught in Second Life, this study aims to assess the perceived value of virtual worlds as an educational tool specifically among the innovators, early adopters and the early majority of this technology. The findings will better inform higher education professionals about the potential value this technology has for teaching methods and enhancing student learning.

II. Literature Review

A. Origins of Second Life

Second Life was released to the public in 2003 by Linden Lab [32], a San-Francisco-based company [19] founded in 1999 by CEO Phillip Rosedale and currently comprised of 200 employees worldwide [21]. Before founding Linden Lab, Rosedale served as chief technology officer for RealNetworks where he pioneered streaming media technologies.

Second Life is an online 3-D virtual environment that is most akin to The Sims Online, although Second Life is not a game [3]. Second Life is a free 3-D browser-type software program that allows users to move about and create objects within a virtual world [9]. The environment of Second Life is created entirely by its 13 million registered "residents" [1], [33]. These residents are represented in the virtual world by customizable virtual personas called "avatars", which can walk and fly [3].

The "digital continent" of Second Life is made up of islands where parcels of land are bought and sold by its residents. When Second Life launched in 2003, it consisted of just 64 acres of land; it has since expanded to over 65,000 acres of virtual real estate [32]. Residents are able to explore, build, edit and create objects and services [35] such as skyscrapers, nightclubs, clothing, automobiles, and programming within the Second Life world. In 2007, Linden Lab released the software code for Second Life, effectively making it an open-source program that anyone can change at any time [35].

Perhaps most interesting for academic instructors, things that do not exist in the real world or are not easily accessible to learners can be created and experienced in Second Life. For example, students in Second Life can explore a recreation of the Sistine Chapel, visit a representation of Dante's Inferno, walk around a town made to look like Elizabethan England or virtually experience hurricane-like weather conditions [12], [14], [16].

B. Online Educational Technology and Adoption Factors

The use of Second Life for educational purposes represents the next step of instructors incorporating online technology into curricula. The concept of e-learning, a term once used to define teaching methodologies associated with the use of a variety of electronic aids, has in recent years become synonymous with distance education over the Internet [26]. E-Learning, as it is known today, allows students to participate in collaborative online environments where they interact with other students, tutors, and teachers. Most universities around the world now offer courses to students on and off campus by way of Internet-based distance education and online learning management systems, or LMS [31]. LMS programs like WebCt and Blackboard Vista allow teachers to use a variety of interactive technologies, commonly known as Web 2.0, to facilitate student learning.

Repman, Zinskie, and Carlson [28] point out that online learning can utilize either asynchronous or synchronous tools, or both. Asynchronous tools automate previously tedious tasks, and include technology like e-mail, discussion boards, listservs, and blogs. Synchronous tools, on the other hand, provide real-time interaction among users and include technologies like online chatting, instant messaging, and audio and video Web-based conferencing. While both types of tools can enhance an online learning environment, a meta-analysis of 132 conceptual and primary research journal articles conducted by Bannan-Ritland [4] revealed, among other findings, that:

1. Asynchronous and synchronous tools afford different instructional strategies;
2. High levels of interaction need to be modeled by the instructor for students;
3. Course structure, class size, feedback, and experience are perceived as factors influencing interactivity;
4. Cooperative or collaborative activities are perceived to foster interactivity; and
5. The instructor's role is significant in promoting interactivity and indicates a change in role from face-to-face instructional contexts (p. 172).

Roberts, Kelley, and Medlin [29] conducted a study examining the factors influencing the adoption of new technologies, such as online lectures, notes, syllabi, grades, forums and related technologies among accounting faculty in the classroom. Roberts et al. [29] found that the availability, reliability, and ease of use of physical resources are the most important organizational factors in the decision to adopt. In contrast, a university mandate on faculty members showed only marginal statistical significance. Personal motivation factors, such as personal satisfaction and a perceived improvement in teaching, are collectively the second most important factor, following physical resources, in influencing the decision to adopt. Social factors of peer support, shared departmental values, friends, and students also proved significant in an instructor's decision to adopt or not adopt new technology, while institutional rewards or recognition did not.

C. Diffusion of Virtual Worlds in Higher Education

Everett Rogers' diffusion of innovations theory has in recent years been applied specifically to the spread and

adoption of the Internet as an innovation. More than 5,000 studies have utilized the theory with about 250 new studies coming out each year [30]. "*Diffusion* is the process in which an innovation is communicated through certain channels over time among the members of a social system" (p. 5). Using this definition, one can examine Second Life and the larger concept of virtual worlds in terms of its adoption by society as a communication and educational tool. In order to do this, each piece of Rogers's definition and its application to virtual worlds should first be understood in detail.

Innovation

Rogers defines innovation as "an idea, practice, or object perceived as new by an individual or other unit of adoption" (p. 12) [30]. Second Life, having only been in existence since 2003 [33], represents a growing use of virtual identities to communicate across the Internet. These identities, used in conjunction with educational exercises, allow for an environment in which the student serves as an active participant in creating knowledge [6]. Other Web-based educational tools have come to signal a change in the way teaching and learning is done.

Tools such as blogs, wikis, social networks, tagging systems, mashups, and content-sharing sites are examples of a new user-centric information infrastructure that emphasizes participation (e.g., creating, re-mixing) over presentation, that encourages focused conversation and short briefs (often written in a less technical, public vernacular) rather than traditional publication, and that facilitates innovative explorations, experimentations, and purposeful tinkerings that often form the basis of a situated understanding emerging from action, not passivity (p. 30) [5].

Utilization of these tools, which now include Second Life, are moving away from the more passive lecture method to an active format where the user is in charge [7].

At this point, Second Life is still rife with the bugs that can plague a new technology growing at such an exponential rate. Figures suggest that "fewer than one in six who try [Second Life] are still online 30 days later" (¶11) [19]. As new technology issues like server crashes and the steep learning curve for new users are resolved in subsequent versions, the convenience and satisfaction expectations of the user should be better met. The degree of complexity to those without sophisticated computer skills is a concern that must be addressed in the near future to ensure wider acceptance by a large audience. This should, in turn, increase its prestige as a viable communication and education option and improve its rate of adoption [30].

The Second Life resident's ability to create virtual representations of real life objects, as well as objects that emerge from an individual's imagination, increases its compatibility to "the existing values, past experiences, and needs of potential adopters" (p. 15) [30]. This gives virtual world residents opportunities to exist in realities that may be adjusted to fit into their expectations. Individuals can take their time integrating Second Life and its flexible representations into their online experience. As more people learn of enjoyable Second Life experiences, the numbers of virtual residents should continue to grow [30].

Communication Channel

Successful adoption of an innovation by a mass audience requires a substantial communication channel through which to spread. As Fetscherin and Latteman [11] point out, Second Life provides an environment that promotes communication and collaboration. This coincides with Rogers' view of the Internet as an optimal communication tool. More traditional media, such as *Business Week*, *Wired*, *Popular Science*, CBS, and CNN, have recently begun to cover this growing technology, allowing for discovery by a wider audience. As virtual worlds become a more frequent part of popular media, this innovation will be more likely to spread through interpersonal channels. This is a particularly important way for an innovation to be adopted because people are more likely to adopt ideas and objects than those who are similar to them have already adopted [30].

Time

In terms of the individual, there must be proper time for a user to interact with the virtual world and make a decision on whether to adopt it based on experience. The ability of the individual to quickly figure out the innovation and effectively use it is important in cutting down on the time necessary to make a decision [30]. This may vary when considering the previous knowledge of the user. With respect to educators, some will adopt more quickly depending on their technology experience and enthusiasm level, as seen in the following five adopter categories:

1) Innovators ("techies"): These educators are truly interested in the technology itself, understand the hardware requirements and the software, and often form communities across disciplines and institutions based on a common interest of the technology.
2) Early Adopters ("visionaries"): Educators as early adopters explore technologies to expand on cutting-edge instructional methods for teaching effectiveness. They are risk-takers, and apply an interdisciplinary approach to teaching, learning, and research. They are often skilled in use of technology, although not to the same extent as the innovators.
3) Early Majority ("pragmatists"): These educators are looking for tools to solve the day-to-day problems of teaching and research. Based on success stories from colleagues in their department or field, they would consider implementing a technology. They tend to be more risk-averse, and their community tends to be less expansive across discipline boundaries than the two previous groups.
4) Late Majority ("skeptical"): Educators in the late majority are more likely to adopt a technology that comes as a complete package and is well established. They are not as technologically savvy as the previous groups and tend to stay close to home in their community groups.
5) Laggards: These educators are not likely to adopt technology as a pedagogical tool. They may even be

confrontational to those who do use instructional technology (pp. 7-8) [15].

Social System

Adoption by the masses should move through these categories in an S-curve whose actual shape will depend on the rate of adoption by the social system as a whole [30]. In the case of this study, the social system is made up of instructors in higher education. Diffusion should take place much more quickly if there is institutional support for the educational innovation [18]. Once adoption of new Web 2.0 technologies, including virtual worlds, becomes a priority, higher education should be improved by using all of the resources available to the modern student

D. Second Life Research

Scholarly research to date about using virtual worlds as an educational tool in higher education has primarily consisted of qualitative case studies and instructional essays [1], [6], [7], [8], [10], [22]. A review of the literature suggests that only a handful of quantitative research studies have been conducted regarding how post-secondary educators use Second Life. In a survey study comparing identical courses taught using traditional face-to-face methods versus Second Life, Lester and King [20] found that, overall, students in both courses reported that "they enjoyed the experience, and they appeared to learn the information on a comparable basis" (p. 22). A content analysis by Jennings and Collins [17], focusing on post-secondary institutions as the unit of analysis, provided descriptive insights into the population of Second Life by higher education institutions, as well as the various ways virtual land is used by these schools. It also provided the beginnings for applying Rogers's diffusion of innovations theory to the use of Second Life as an education tool. This study expands the application of diffusion theory by tying its theoretical constructs to specific survey measurements from individual respondents.

Finally, the most similar research that has been conducted on the uses of Second Life as an educational tool has come not from within academe, but from the New Media Consortium (NMC), an international 501(c)3 not-for-profit organization comprised of "over 260 learning-focused organizations dedicated to the exploration and use of new media and new technologies" (¶ 1) [24]. Completed in 2007, the most recent annual survey provides a great deal of raw data collected on demographics, experience levels using Second Life and other technologies, uses of Second Life, and personal and professional satisfaction with Second Life [24]. However, the NMC study provides no analysis or interpretation of its data, and it includes among its respondents students, administrators, librarians, and instructors. In contrast, the study concentrates only on post-secondary instructors as the unit of analysis, and moves beyond raw data to provide a detailed analysis of the findings based on Rogers's theory. Moreover, whereas the NMC survey is conducted by means of an open on-line questionnaire, this study's researchers have sought to control their findings with greater rigor by directly sending questionnaires to only those respondents who could be identified and confirmed as post-secondary instructors.

E. Research Questions

The existing literature suggests there is a great deal of room to explore how the capabilities of Second Life as a virtual world are being applied as an educational tool among post-secondary instructors and to what effect. Furthermore, the foundation of Rogers's diffusion theory provides an opportunity to examine individual, social, and logistical factors associated with the adoption of Second Life among higher-education instructors. The following research questions, derived from the literature review, provided the basis of inquiry for this study.

RQ1: Which instructors are most likely to use Second Life as an educational tool in terms of their gender, age, faculty rank, academic discipline, length of time teaching in higher education, the country in which they teach, and institution characteristics?

RQ2: How do post-secondary instructors in different adopter categories differ in their levels of satisfaction with Second Life as an educational tool? How do they differ with respect to their perceptions of how using Second Life affects student learning? Does course structure affect their levels of satisfaction and perceived student learning effect?

RQ3: Are there differences among instructors across adopter categories regarding the factors that influence their decisions to adopt Second Life as an educational tool?

III. Method

This study involved a survey that was conducted from May through August 2008 to gather quantitative data regarding the use of Second Life as an educational tool among post-secondary instructors.

A. Unit of Analysis

The unit of analysis for this study was the individual post-secondary instructor, as opposed to the institution, college, department or any other more collective unit of measurement. Individuals must have been using Second Life to teach post-secondary students either prior to, or concurrent with the time the questionnaire was administered.

B. Sample

A list of educational institutions was initially constructed following Jennings and Collins's method [17] of deriving a purposive sample of institutions with a virtual presence in Second Life. Specifically, a "quasi-official" list of institutions was found on the SimTeach.com wiki (http://simteach.com/wiki/index.php?title=Institutions_and_Organizations_in_SL), a page directly linked from the official Linden Lab education Web page (http://secondlife.com/businesseducation/education.php). Additionally, a list of community colleges in Second Life was found on a wiki located at http://ccsl.wetpaint.com/page/CC+Locations. Post-secondary educational institutions were operationally defined as any

institutions granting associate's degrees or higher with a real-world physical presence. From this initial list, the researchers e-mailed specific contact individuals for each institution and subsequently identified instructors using Second Life as an educational tool at those schools.

In addition, the researchers also contacted persons who had self-selected to be listed on the New Media Consortium's Campus Directory found on the Web site, http://sl.nmc.org. An in-world instant message explaining the nature of this study, the criteria for participation, and requesting participation when appropriate was sent to each of the 2,403 individuals listed on the directory. As a function of the Second Life Instant Message feature, messages sent to recipients who were not in-world at the time were automatically forwarded to the recipient's e-mail inbox. The researchers also sent a similar e-mail message to all members of the Second Life Educators listserv. Finally, a snowball sampling method was employed by asking each instructor who was contacted or completed the questionnaire to provide the names and e-mail addresses of other post-secondary instructors who were using Second Life as an educational tool. All referrals were checked to ensure that each participant was sent only one questionnaire.

The methods described above resulted in a total population of 257 instructors who use Second Life in higher education courses. This seemingly small population size was not surprising given the relative newness of Second Life and its application to higher education, as well as the narrowly defined participation criteria. The researchers attempted to contact all 257 individuals with an e-mail explaining the study and providing a link to the online questionnaire. Automated replies from six of these 257 individuals indicated that the instructors' emails were either undeliverable or the recipient was out of the office during the time the questionnaire was open, resulting in an initial sample of 251 individuals.

C. Research Instrument

The research instrument used in this study was an online questionnaire consisting of 23 closed-ended and open-ended questions. Closed-ended questions included single-answer and multiple-answer multiple-choice questions, as well as Likert-type scale questions. Open-ended responses were not analyzed for this study. One question asked respondents how long they had been using Second Life as an educational tool and was used to assign respondents into three adopter categories derived from Rogers's theory - innovators, early adopters, and early majority. This is consistent with the prior research of Sutherland [34] who assigned college and university administrators into adopter categories based on the length of time their academic programs had been incorporating Web course features in their curricula. Due to the relative newness of Second Life's usage as an educational tool, none of the respondents were categorized as late majority or laggards.

The remaining questions were used to assess how each respondent was using Second Life as an educational tool, the factors influencing their decision to adopt Second Life as an educational tool, their level of satisfaction with the technology, their intentions to use or not use Second Life as an educational tool in the future, and demographic information.

D. Pretesting

To pretest the survey, the researchers sent the questionnaire to four students participating in an interdisciplinary graduate research seminar focused on Second Life. The students provided feedback on the technical functionality, structure, and content of the survey.

E. Data Collection

The first wave of data collection consisted of e-mailing the questionnaire to 197 post-secondary instructors who were using Second Life in their curricula at the time the study was conducted, or who had used Second Life in their curricula at some point prior to the time the study was conducted. The second wave of data collection began nine days following the initial opening of the questionnaire. Based on the 113 instructors who did not respond to the first questionnaire e-mailed to them, as well as 36 new instructors identified by the snowball sampling method, the researchers resent the questionnaire via e-mail to 151 non-respondents. The third wave began seven days after the second wave, in which the questionnaire was sent via e-mail to 24 new and 78 non-responding instructors. All together, the questionnaire was sent via e-mail to 257 instructors. However, automated replies from six of these 257 individuals indicated that the instructors' e-mails were either undeliverable or the recipient was out of the office during the time the questionnaire was open, resulting in an initial sample of 251 individuals.

Of the initial sample of 251 instructors, 186 responded to the questionnaire. Of these 186 respondents, 17 were dismissed because they answered no to a criterion question asking if the individual had used Second Life as a tool to teach post-secondary students. Likewise, seven additional respondents were dismissed because they failed to complete any portion of the survey following this criterion question. Thus, the final response rate, based upon valid respondents, was 162 out of 227, or 71.4%.

F. Data Analysis

Mean scores regarding the use of and satisfaction with Second Life as an educational tool, as well as the factors influencing decisions to adopt the technology in their curricula, were compared across the adopter categories and class structure types using analysis of variance and Bonferroni's post-hoc tests for statistical difference. Demographic information was analyzed using basic frequencies and descriptive statistics.

IV. Results

Research Question 1 looked at the characteristics of instructors using Second Life as an educational tool. The male-to-female ratio was almost even, with 84 (51.9%) of the

TABLE I
INSTRUCTORS BY COUNTRY

Country Represented	Number of Instructors (% of N)
United States	110 (67.9)
United Kingdom	13 (8.0)
Australia	8 (4.9)
Germany	8 (4.9)
Spain	4 (2.5)
Sweden	4 (2.5)
Canada	3 (1.9)
France	2 (1.2)
Italy	2 (1.2)
Netherlands	2 (1.2)
Portugal	2 (1.2)
Austria	1 (.6)
Colombia	1 (.6)
Finland	1 (.6)
Norway	1 (.6)

Items: Subjects were asked "What country do you teach in?" with approximately 200 countries to select from in response.

TABLE II
INSTRUCTORS BY ACADEMIC DISCIPLINE

Discipline	Number of Instructors (% of N)
Education	40 (24.7)
Journalism/Media/Communications	20 (12.3)
Computer Sciences	19 (11.7)
English/Literature	11 (6.8)
Business	10 (6.2)
Visual Arts	9 (5.6)
Architecture/Design/ Applied Arts	7 (4.3)
Health Sciences	6 (3.7)
Performing Arts	5 (3.1)
Languages/Linguistics	3 (1.9)
Law	3 (1.9)
Life Sciences	3 (1.9)
Psychology	3 (1.9)
Religion	3 (1.9)
Social Work	3 (1.9)
Sociology	3 (1.9)
Chemistry	2 (1.2)
Engineering	2 (1.2)
History	2 (1.2)
Personal Service Professions	2 (1.2)
Political Science	2 (1.2)
Geography	1 (0.6)
Gender/Sexuality Studies	1 (0.6)
Physics	1 (0.6)
Space Sciences	1 (0.6)

Items: Subjects were asked "What academic discipline do you teach in?" with 37 disciplines to select from in response.

162 total respondents male. The average age of the respondent was 45 years old with a range from 24 to 71. The respondents had been teaching in higher education for an average of 12 years. The median time spent by respondents in Second Life in a typical week was five hours, with a minimum of zero and a maximum of 80 hours.

In terms of the student population size at respondents' institutions, 37.6% (N = 61) of respondents were from schools with less than 10,000 students, 25.3% (N =41) with 10,000 to 20,000 students and 37% (N = 60) with over 20,000 students. Close to 86% (N = 139) of respondents' institutions granted at least a master's degree, while just less than 10% (N = 16) stated that associate's degrees were the highest degrees offered.

Second Life's international influence can be seen in the fact that respondents from 15 countries participated in the survey (See Table 1). The largest number of respondents was from the United States (67.9%), followed by the United Kingdom (8.0%) and then Australia and Germany (each 4.9%). Other than Canada and Colombia, respondents from the other 10 countries were located either in Western Europe or Scandinavia.

Though many of the respondents were concentrated in three main areas of study, a variety of academic disciplines were identified as using Second Life for educational purposes. Education (24.7%), Journalism/Media/Communications (12.3%), and Computer Sciences (11.7%) made up nearly half (48.7%) of the respondents' disciplines, with the other 51.3% of respondents were divided among 22 other disciplines (See Table 2).

Respondents were also given a list of 11 other instructional technologies from which they were asked to select the technologies they had previously used. A large number of the respondents used an online syllabus (84%), and online lectures, notes, or tutorials (82.7%), and, to a lesser degree, online grades (64.8%), blogs (63%), and web video (57.4%). Newer technologies that were less frequently used included wikis (45.1%), online exams (42%), podcasts (41.4%) and social networking (37%).

To address research questions two and three, respondents were divided by the researchers into adopter categories based on the respondents' responses to a closed-ended question asking how long they had been using Second Life as an

educational tool. Respondents that had used Second Life as an educational tool for less than six months were classified as early majority, respondents with six months to two years of experience were classified as early adopters and respondents with more than two years of experience were classified as innovators. Based on these criteria, 17 respondents (10.5%) were innovators, 113 respondents (69.8%) were early adopters, and 32 respondents (19.8%) were in the early majority.

Media coverage of post-secondary instructors starting to use Second Life as an educational tool began in 2006 [3], [8]. Therefore, respondents that already had over two years of experience using this innovation were the most experienced and would logically qualify as innovators. By the same token, respondents with six months to two years of experience have had a considerable amount of time to become familiar with the technology in their classrooms and would fit the early adopter classification. Finally, respondents with six months or less of experience teaching using Second Life are still early to adopt this innovation, but were markedly less experienced than the prior two groups of respondents. Therefore, this last category is classified as the early majority.

Research Question 2 asked how instructors in the adopter categories differed in their levels of satisfaction with Second Life as an educational tool. With 93.8% of respondents reporting that they intended to use Second Life again in future classes, it would seem that nearly all respondents were very satisfied with the program as an educational tool. However, to measure satisfaction more specifically, a seven-point Likert-type scale ranging from very unsatisfied to very satisfied was used. Analysis of variance tests were run to compare mean satisfaction levels across adopter categories. A one-way ANOVA test found no significant differences among adopter categories for levels of satisfaction. Overall, respondents reported an above average satisfaction score (mean = 4.76, sd = 1.51) with early adopters having the highest scores (mean = 4.81, sd = 1.55) and innovators the lowest (mean = 4.53, sd = 1.07)

TABLE III
INSTRUCTORS' SATISFACTION LEVELS AND PERCEIVED EFFECT ON STUDENT LEARNING BY ADOPTER CATEGORY

	Innovators Mean (sd)	**Early Adopters** Mean (sd)	**Early Majority** Mean (sd)	**Total** Mean (sd)	**Fisher's F ratio** (p)
Instructors' Satisfaction Levels	4.53 (1.07)	4.81 (1.55)	4.72 (1.61)	4.76 (1.51)	0.26 (.773)
Perceived Effect on Student Learning	4.88 (.86)	4.88 (1.24)	4.75 (1.02)	4.86 (1.16)	0.17 (.844)

Items: DF = 2, 159. n = 17 to 113. sd = standard deviation. p = probability.

Instructors were also asked to indicate how using Second Life had affected students' learning, again using a seven-point Likert-type scale ranging from strongly hindered to strongly improved. A one-way ANOVA test was used to determine if there was an overall difference between the mean levels of perceived student learning effect. As was the case with the reported satisfaction levels, there were no significant differences found among the adopter categories. The mean student learning effect score for innovators and early adopters was exactly the same –(mean = 4.88) with early majority adopters reporting only a slightly lower mean score (4.75). The overall, above average respondent score of 4.86 for perceived student learning effect was very similar to the overall score of 4.76 for level of satisfaction (See Table 3).

Another component of the second research question asked whether instructors' satisfaction levels with Second Life as an educational tool differed depending on how the virtual world was used in their class structure. A one-way ANOVA test indicated there was a statistically significant overall difference in mean satisfaction levels across the four categories of Second Life use in the class structure (F (3,158) = 4.040, p = 0.008).

Instructors conducting class fully in Second Life reported the highest levels of satisfaction (mean = 5.48, sd = 1.418). Instructors whose class was split evenly between real-world class and Second Life reported the second highest satisfaction levels (mean = 5.00, sd = 1.614). Instructors who used Second Life only as a small supplement to real-world class reported

the third highest satisfaction levels (mean = 4.47, sd = 1.417). Finally, instructors who used real-world class only as a small supplement to Second Life reported the lowest levels of satisfaction (mean = 3.50, sd = 0.707). Bonferroni's post-hoc test indicated that the only significant difference in mean satisfaction levels was found between instructors who conducted class fully in Second Life and those who used Second Life only as a small supplement to real-world class (p = 0.017). Additionally, despite differences in their levels of satisfaction, most instructors reported an above average level of satisfaction with Second Life, with only two respondents who used real-world class as only a small supplement reporting an average level of satisfaction.

A one-way ANOVA test also indicated that there was a statistically significant overall difference in the perceived effect on student learning across the different uses of Second Life in class structure (F (3,158) = 4.341, p = 0.006). Instructors conducting class fully in Second Life reported the highest student learning effect scores (mean = 5.40, sd = 1.190). Instructors whose class was split evenly between real-world class and Second Life reported the second highest student learning effect scores (mean = 5.05, sd = 1.160). Instructors who used Second Life only as a small supplement to real-world class reported the third highest student learning effect scores (mean = 4.65, sd = 1.009). Finally, instructors who used real-world class only as a small supplement to Second Life reported the lowest student learning effect scores (mean = 3.50, sd = 0.707). Bonferroni's post-hoc test again revealed that the only significant difference in perceived student learning effect was between instructors who conducted class fully in Second Life and those who used Second Life only as a small supplement to real-world class (p = 0.022). Again, across all uses of Second Life in their curricula, most instructors reported an above average level of perceived enhancement in student learning, with only two respondents who used real-world class as only a small supplement reporting essentially no effect (See Table 4).

Research Question 3 examined differences across adopter categories regarding the factors that influenced their adoption of Second Life as an educational tool. To address this question, instructors were asked to indicate the levels of influence that each of 12 factors had on their decision to adopt Second Life as an educational tool. These factors ranged from personal interest in instructional technology and peer support from colleagues to student enthusiasm and access to computer hardware/software. Instructors evaluated each of these factors individually on a seven-point Likert-type scale ranging from not influential at all to very influential.

Running one-way ANOVAs for between-group differences in mean scores for the influential factors found a statistically significant difference for only one factor, "Linden Lab support for educators" (F (2, 159) = 4.84, p = 0.009). The factor, "Mass media," also showed a mean score approaching significance (F (2, 159) = 2.47, p = .088). For the factor "Linden Lab support for educators", Bonferroni's post-hoc tests revealed that the early majority (mean = 3.72, sd = 1.82) and innovators (mean = 3.59, sd = 1.77) found Linden Lab

TABLE IV
INSTRUCTORS' SATISFACTION LEVELS AND PERCEIVED EFFECT ON STUDENT LEARNING BY SECOND LIFE CLASS STRUCTURE

	Class conducted fully in Second Life Mean (sd)	**Class was split evenly between real-world class and Second Life** Mean (sd)	**Second Life used as small supplement** Mean (sd)	**Real world class used as small supplement** Mean (sd)	**Fisher's F ratio** (p)
Instructors' Satisfaction Levels	* 5.48 (1.42)	5.00 (1.61)	* 4.47 (1.42)	3.5 (.71)	4.04 (0.008)
Perceived Effect on Student Learning	** 5.40 (1.19)	5.05 (1.16)	** 4.65 (1.01)	3.5 (.71)	4.34 (0.006)

Items: DF = 3, 158. n = 2 to 91. sd = standard deviation. p = probability.
* Bonferroni's post-hoc test revealed a significant difference between these means (p = 0.017).
** Bonferroni's post-hoc test revealed a significant difference between these means (p = 0.022).

support to be significantly more influential (p = 0.018) than early adopters (mean = 2.73, sd = 1.78). The factor with the highest mean score by all respondents was "personal interest in enhancing my students' learning" (mean = 6.30, sd = 0.99), followed by "personal interest in instructional technology" (mean = 6.00, sd = 1.34) and "personal interest in improving my teaching" (mean = 5.77, sd = 1.45). The next two most influential factors in deciding to adopt Second Life as an educational tool was "access to computer hardware and software" (mean = 4.76, sd = 1.79) and "student enthusiasm" (mean = 4.07, sd = 1.97). The importance that respondents placed on personal interest factors in influencing their decision to adopt Second Life for education fits with diffusion of innovations theory. The earlier adopter categories generally adopt a new innovation for personal gain rather than the later adopter categories, which tend to be more influenced by interpersonal communication channels (See Table 5).

TABLE V
IMPORTANCE OF INFLUENTIAL FACTORS TO ADOPTION OF SECOND LIFE AS AN EDUCATIONAL TOOL

Influential Factors	**Mean (sd)**
Personal interest in instructional technology	6.00 (1.34)
Personal interest in improving my teaching	5.77 (1.45)
Personal interest in enhancing student learning	6.30 (0.99)
Success stories from colleagues	2.80 (1.83)
Well established use of Second Life for teaching	2.60 (1.57)
Administrative and departmental support	3.03 (1.99)
Peer support from colleagues	3.40 (2.04)
Academic journals and conferences	3.04 (1.86)
Mass media	3.30 (1.85)
Linden Lab support for educators	3.01 (1.83)
Student enthusiasm	4.07 (1.97)
Access to computer hardware and software	4.76 (1.79)

Items: Subjects were asked "How influential were each of the following factors …" with 7 = very influential and 1 = not influential at all.

V. DISCUSSION

The purpose of this study was to assess the value of the virtual world Second Life among post-secondary instructors with experience using Second Life as an educational tool. Using the diffusion of innovations as the theoretical framework, respondents to the survey were divided into three adopter categories (innovators, early adopters and the early majority) based on the time they had spent using Second Life as an educational tool. In addition to providing detailed descriptive statistics on the instructors, institutions and courses being taught in Second Life, this survey assessed the satisfaction level of instructors across adopter categories and different course structures, as well as the factors influencing the adoption of Second Life as an educational tool.

Based on the respondents to this survey, post-secondary instructors with experience using Second Life as an educational tool are split fairly evenly by gender and are 45 years old on average. These instructors generally have over a decade of higher education teaching experience with the vast majority (85.8%) teaching at institutions that grant at least a master's degree. Since this study revolved around Second Life as a computer-mediated form of communication being used for educational purposes, it was not surprising to find that almost half of the respondents were from academic disciplines such as Education, Journalism/Media/Communications and Computer Sciences. However, it was interesting to find that 22 other disciplines were represented. While the majority of respondents were from the U.S., a total of 15 countries were represented. The diversity of respondents by nationality and discipline suggests Second Life has the potential to be adopted across many borders and in many different areas of academe.

Research Question 2 examined the relationship between the length of time the instructor had used Second Life as an educational tool and the instructors' level of satisfaction with using Second Life for this purpose. This question also examined the instructors' perception of how using Second Life in their curricula affected students' learning. For both levels of satisfaction and perceived student learning effect, respondents in the different adopter categories indicated no significant differences. However, for both satisfaction levels and perceived student learning effect, respondents across all adopter categories reported above average overall mean scores. With 3.5 being the mid-point score on a seven-point Likert-type scale, the overall mean score for satisfaction was 4.76 and the overall mean score for perceived student learning effect was 4.86. Therefore, it appears that instructors, despite their adopter category, find using Second Life in their curricula to be both satisfying and as having a positive impact on student learning. This bodes well for further diffusion and adoption of Second Life or a similar kind of virtual world

program as an educational tool. This is consistent with the fact that a commanding 93.8% of respondents reported they intend to use Second Life as an educational tool again.

Respondents also indicated that the more Second Life was integrated into the class structure, the more satisfied they were with it. Specifically, instructors who conducted class fully in Second Life were significantly more satisfied than those who used Second Life as only a small supplement to a real-world class. For administrators and instructors considering using Second Life as an educational tool, these results indicate that a fully immersive Second Life experience, rather than isolated experimentation, could be the most rewarding. Considering the amount of time it takes to become comfortable with the Second Life user interface, students may have to wait until they have attained a sufficient working knowledge of the program to receive the most benefits from its use. Likewise, instructors may need to be fully engaged in using Second Life in their course structure to determine how the medium best suits their teaching needs and the needs of their students. More intensive exposure to Second Life's various tools and features may allow students to gain this familiarity in a shorter overall time span, and better enable instructors to find the best use of the virtual world medium for matching with their unique classroom goals.

The final research question looked into the differences among adopter categories regarding the factors that influenced their decision to adopt Second Life as an educational tool. According to diffusion theory [30], specifically as it is applied to an educational innovation [15], the earliest adopters of an innovation are typically motivated by personal interest factors, whereas later adopters tend to be motivated more by interpersonal communication factors. A significant difference among adopter categories was found for only one influential factor, "Linden Lab support for educators." The early majority and innovators both found support from Linden Lab, the owner of Second Life, to be significantly more influential than early adopters. The early majority may score Linden Lab support the highest among the adopter categories because they are the newest to Second Life and are the least likely to try an innovation on their own. Innovators may score Linden Lab support more highly than early adopters because these innovators may want to use the more advanced features in Second Life for their classes, such as using the Second Life prim system for building objects. Exploring and implementing these more advanced features may mean innovators likewise seek more advanced technical support than either of the other two adopter categories.

Overall, the most influential factors among the survey respondents were personal interest categories such as "personal interest in improving my students' learning", "personal interest in instructional technology", and "personal interest in improving my own teaching". These factors were followed by "access to computer hardware and software." Interestingly, these results indicate the reverse of the findings in Roberts, Kelley and Medlin's study [29] of the factors influencing the adoption of new technology by accounting faculty in accounting classes. Roberts et al. [29] found that availability, reliability and the ease of use of physical resources were the most important adoption factor, followed by personal motivation factors, such as personal satisfaction and a perceived improvement in teaching. Roberts et al. [29] also found that interpersonal communication factors, such as peer support, shared departmental values, friends and students, were significant in influencing faculty to adopt new technology.

Respondents in the current study scored interpersonal communications factors relatively low compared with the personal factors. These findings support the researchers' belief that Second Life's use as an educational tool is still in the early stages of the diffusion process, as personal motivation factors tend to be more important for educators in the earlier adopter categories. Networks through which evaluations of Second Life's educational abilities could aid in its diffusion are still being constructed. In a normal diffusion process, "most people depend mainly upon a subjective evaluation of an innovation that is conveyed to them from other individuals like themselves who have already adopted the innovation" (pp. 18-19) [30]. Early in the diffusion process, there are few individuals who can provide an appropriate evaluation. As the process approaches critical mass, more interpersonal communication channels should emerge and exert a stronger influence on the diffusion of the innovation [30]. With this in mind, assuming Second Life's usage as an educational tool follows a normal diffusion process, subsequent surveys should predictably reveal that interpersonal and institutional support factors are more influential for later adopters.

This study contributes to the literature on virtual worlds as educational tools in several ways. Most academic research into the usage of Second Life as an educational tool has consisted largely of discipline-specific qualitative case studies. This study provides one of the first comprehensive quantitative reviews of which post-secondary instructors, institutions and disciplines are using Second Life and to what effect. While the body of literature regarding diffusion of innovations theory is extensive, this study is also unique in that it builds on previous diffusion findings, yet examines an innovation that is new to the diffusion literature. Finally, this study answers Rogers's call [30] to "investigate the diffusion of an innovation while the diffusion process is still under way" (p. 112). Diffusion studies are often conducted after an innovation has already diffused completely to the members of a system, leading to research focused on successful innovations [30].

VI. Limitations and Future Research

The usage of purposive and snowball sampling techniques were necessary for this survey, given the lack of an existing, comprehensive sample frame of post-secondary instructors with experience using Second Life as an educational tool. In addition, as evidenced by garnering respondents from 15 countries, an effort was made for as much international

participation as possible. Even with this effort, the majority of respondents (67.9%) were instructors from U.S. institutions. Finally, given that this study focuses on an innovation that is still in its early stages of diffusing, the researchers were required to make a subjective judgment on how to divide the respondents into adopter categories. This study's division of respondents into adopter categories based on their time spent using the innovation was in keeping with Rogers's diffusion theory. This approach is also consistent with a previous survey-based diffusion study focused on a new media education innovation [34], and is further supported by the findings that personal motivation factors were most important to respondents in their decision to adopt Second Life as an educational tool.

As the adoption of Second Life as an educational tool moves further along the S-curve, future research should examine how this innovation diffuses compared with previous technological innovations. In keeping with previous diffusion findings, future studies should explore if later adopters to Second Life as an educational tool are indeed more influenced by interpersonal communication channels and institutional-support. In addition, a comprehensive survey of students' perceptions on using Second Life as an educational tool would serve as a valuable compliment to this study's survey of instructors' perceptions. Finally, moving beyond *which* and *to what effect* questions, future research should explore *how* instructors are specifically implementing Second Life into their curricula. Important questions include what features instructors are currently using in Second Life, what kind of activities work best in Second Life, and what features need to be improved or are yet to be designed.

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