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**Digital Literacies
in Multiuser
Virtual
Environments
Among
College-Level
Developmental
Readers**

As the rate of developmental reading students continues to climb, so does the surge in digital platforms as a means to deliver postsecondary instruction. Students enrolled in developmental reading courses should not be assumed to have digital literacy skills simply because they have been termed a “digitally literate generation.” In this study, one digital technology—multiuser virtual environments (MUVEs)—provided a platform that allowed students to engage in learning opportunities congruent with digital literacy. Examined in this study were (a) the digital literacy skills of developmental readers, (b) the differences in digital literacies between developmental reading students who used a MUVE and those who did not, and (c) the behaviors exhibited by students indicating their degree of digital nativeness. Participants in the experimental group demonstrated digital literacy through reading activities and observations in the MUVE, Second Life, and made higher reading achievement gains over the control group.

Across the nation, estimates show that only one third of students entering U.S. colleges and universities are prepared for college coursework (Greene & Forster, 2003). Unfortunately, these numbers are continuing to rise (Education Commission

of the States, 2008) and stemming from these rising numbers are complex and multi-faceted issues that, if not addressed with alacrity, could eventually widen the gap within a competitive global economy between a workforce with postsecondary credentials and a workforce without postsecondary credentials (Greene & Forster, 2003).

One option for college and university administrators to consider in addressing these burgeoning numbers is to expand instructional delivery options for incoming postsecondary freshman who are in need of college-readiness skills. However, a prerequisite to this potential solution must include an understanding and assessment of the digital skills that entry-level college freshmen may or may not bring with them.

Digital Natives

Researchers have shown that traditional college-age students use, understand, and master a wide range of social technologies (Caruso & Kvavik, 2005; Center for the Digital Future, 2007; Horrigan & Smith, 2007; Junco & Mastrodicasa, 2007). Dubbing many of these individuals as “digital natives,” Van Eck (2006) has asserted that this unique generation was brought up with a myriad of rapidly evolving technologies, and, therefore, many are very skilled at quickly learning and using them. In a report by Junco and Mastrodicasa (2007) this pervasiveness of technology use was illustrated by surveying 7,705 college students about their social technology use; they discovered that (a) 97% owned a computer; (b) 94% owned a cell phone; (c) 76% used instant messaging (IM); (d) 15% of IM users logged on 24 hours a day/7 days a week; (e) 34% used websites as their primary source of news; (f) 28% owned a blog and 44% read blogs; (g) 49% downloaded music using peer-to-peer file sharing; (h) 75% of students had a Facebook account; and (i) 60% owned some type of portable music and/or video device such as an iPod. Similarly, highlighting media use in the lives of 8- to 18-year-olds, the Kaiser Family Foundation Study (2010) documented “which media they use, which they own, how much time they spend with each medium, which activities they engage in, how often they multitask, and how they differ from one another in the patterns of the media use” (Kaiser Family Foundation Study, 2010, p. 1). One of the overarching findings in this report was the increase in the amount of time per day that media was consumed by youth in this age bracket (8:33 hours in 2004 to 10:45 in 2012). With much of the day spent using digital technologies—technologies that continue to change along with societal needs—it comes as no surprise that many students enrolling in postsecondary education for the first time are quite adept at using them.

Understanding and responding to the role that digital technologies play in students' everyday lives will serve as an important first step in

order to meet their academic needs and will, in turn, have important implications for educators. This generation of students is entering colleges and universities with unique challenges for learning. Collaborative learning using social technologies continues to be of interest to educators as students are quickly becoming disengaged with traditional instruction and are in need of instruction that appeals to the social technology knowledge and skills to which their generation has been accustomed. Social technology tools such as instant messaging, blogging, and Facebook, to name a few, are part of the everyday lives of these socially networked students—many of these technologies having common tools and functionalities for synchronous and asynchronous communication.

Developmental Readers as Digital Natives

Boylan (2002) has suggested that colleges should provide college-level developmental students a variety of course experiences and not limit their learning to one mode of delivery. Other researchers have expanded on this suggestion with the contention that students today must have computer knowledge to succeed in college and beyond. Leu, Kinzer, Coiro, and Commack (2004) stressed the importance in the global economy to equip students with literacies that support social communication and use of communication technologies since possessing these skills in our world today is vital. Altogether, the knowledge and skills needed for the aforementioned falls under the term “digital literacy.” One of the most important aspects of being digitally literate does not rely completely on the ability to use technology, rather on how a person is able to discern and critically analyze content in digital form. Those who are digitally literate are able to (a) determine the extent of digital information needed; (b) access the needed digital information effectively and efficiently; (c) evaluate digital information sources and services critically; (d) incorporate selected digital information into their knowledge base; (e) use digital information effectively to accomplish a specific purpose; and (f) understand the economic, legal, and social issues surrounding the use of digital information access (Holler, 2009). Another widely used term to describe digital literacies is *new literacies*. Leu et al., (2004) developed a conceptual definition of new literacies:

The new literacies of the Internet and other Information Computer Technologies (ICTs) include the skills, strategies, and dispositions necessary to successfully use and adapt to the rapidly changing information and communication technologies and contexts that continuously emerge in our world and influence all areas of our personal and professional lives. These new literacies allow us to use the Internet and other ICTs to identify important

questions, locate information, critically evaluate the usefulness of that information, synthesize information to answer those questions, and then communicate the answers to others. (p. 1575)

Not surprisingly, many colleges and universities are finding that incoming freshmen are already equipped with these social technological skills—including those students who have tested into developmental reading (Burgess, 2009; Hui-Yin & Shiangkwei, 2011; Loveless & Griffith, 2012).

Therefore, one digital technology rising in popularity holds great promise for developmental students—multiuser virtual environments (MUVES).

MUVES: Second Life

As previously mentioned, inherent to social technologies is the ability to communicate digitally with others. In a digital learning environment, this capability allows for both asynchronous and synchronous communication among users. There are, however, several platforms available for instructional purposes allowing virtual representation of oneself, thus adding a dimension of telepresence—or the “almost-like-being-there” experience that affords students the “feeling” that they are actually in a virtual space with their peers. Second Life (SL) is a synchronous and immersive MUVE where residents, or avatars, have the ability to build, communicate, interact, and share knowledge within this virtual environment, thereby making this platform suitable for online learning. Avatars are able to communicate via text chat or voice-enabled chat. In education, SL promotes socially constructed, exploratory, and creative learning activities that require practice in collaboration, self-regulation, time management skills, and critical thinking—all with the social technology tools that students are accustomed to using (Burgess & Caverly, 2009).

Steinkuehler (2008) posited that given the time spent in such environments and their importance for socialization, enculturation, and learning, situated spaces such as virtual environments should be part of the educational research agenda. Prensky (2005) added to this view by explaining that today’s students need to be engaged in learning that suits their lifestyles and that experimentation in digital game-based learning and virtual environments is imperative. The tools that can be used to navigate and communicate within this unique environment are very similar to the tools and components in other widely used digital learning platforms, thereby serving as a familiar springboard for those students having a desire to explore such environments. Harnessing and utilizing the potential this particular learning environment possesses could significantly and positively affect the world of education.

As education continues to underutilize these digital technologies, our speculation is that high school students are becoming more and more disengaged and unmotivated to read. They need instruction with relevance and purpose to their lives that utilizes the digital technologies they grew up with and are accustomed to (Burgess & Caverly, 2009). Researchers have suggested that high school and developmental reading educators must gradually “come to the understanding that it is no longer a question of if technology should be used but rather, which technology and how much technology” (McCabe & Day, 1998, p. 153).

Contrary to the previously mentioned reports and studies highlighting the affordances of online learning platforms, the learning environments continue to be underutilized in developmental education courses. The National Center for Educational Statistics (2003) reported that only 13% of higher education institutions offered developmental education courses using advanced technology as a mode of delivery for both distance education and face-to-face class instruction. The research on using online learning platforms specifically in developmental reading has been limited; however, it has increased in recent years, especially with the upward trend in online distance education (Burgess & Caverly, 2009). Some perspectives in developmental education reflect a hesitation to promote online developmental reading courses, citing high attrition rates and a lack of confidence as reasons that developmental readers cannot handle the independent nature of this delivery mode (Petrides, Kerglani, & Nguyen, 2006). Further, other researchers have argued that developmental students need instant feedback and teacher presence to learn effectively; therefore, online learning may place them at risk for dropout or feeling isolated (Boylan, 2002; Maxwell, 1997). Conversely, emerging studies document academic achievement gains from developmental education students in online developmental education programs. For example, in their longitudinal study of online remedial education effects, Rienties, Templelaar, Dijkstra, Rehm, and Gijsselaers (2008) found that participants who took developmental education courses online outperformed their face-to-face counterparts in terms of course exams, course GPA, and course completion.

Statement of Purpose

The purpose of this study was to determine (a) the digital literacy skills of developmental readers, (b) the differences in digital literacies between developmental reading students who used SL and developmental reading students who did not use SL, and (c) the behaviors exhibited by students that indicated the degree to which they were digitally literate.

Research Questions

The following research questions were addressed in this study:

1. What are the web-oriented digital literacy skills of developmental readers? In particular, what are the differences in web-oriented digital literacy skills between developmental reading students who use SL (experimental group) and developmental reading students who do not use SL (control group)?
2. What is the difference in reading achievement between developmental reading students who use SL (experimental group) and developmental reading students who do not use SL (control group)?
3. What are the behaviors exhibited by students who report themselves to be digitally literate?

Method

Participants

The completed research study included 80 college-level students enrolled in four sections of a developmental reading course taught at a rural southeast Texas university. During the data collection phase of this study, approximately 16,795 students were enrolled in the university. The sample of developmental reading students included a control group ($n = 38$) and an experimental group ($n = 42$). College-level developmental reading students often need to strengthen their cognitive and affective skills and/or strategies in the areas of (a) self-regulation, (b) effective reading strategies, (c) reading comprehension skills, (d) analytical thinking skills, (e) time management skills, (f) interest in reading, and (g) motivation (Boylan, 2002). The senior researcher served as a participant-observer in this study, whereby activities such as observing navigational abilities and social technology skills of participants within SL and conducting an orientation on basic navigational skills within SL were implemented.

Instrumentation

Both quantitative and qualitative instruments were used to collect data for this study. The instruments included the Survey of Web-Oriented Digital Literacy (SWODL) and a pre- and post-Developmental Reading Common Final (DRCF). Qualitative data were collected from observations within SL and used to triangulate quantitative outcomes from the SWODL assessment.

Survey of Web-Oriented Digital Literacy. The SWODL (Hargittai, 2009) was designed to measure understanding of computer and Internet-related terminologies. Using a 5-point Likert-item scale

requesting participants to self-rate their knowledge of specific computer terms “is a stronger predictor of how well they are able to navigate online content compared with asking people how they think they can use the internet” (Hargittai, 2009, p. 131). The survey includes two varying measures regarding digital literacy levels: (a) yes or no self-report questions on digital literacy and (b) Likert-item self-report ratings of the degree of understanding of digital literacy-related items.

Instrument Validity and Reliability

Scoring for the SWODL involved analysis of the Likert-item responses through descriptive statistics. Internal consistency was also analyzed through the use of Cronbach's coefficient alpha. The means and standard deviations for each category on the survey reported by the participants in the study were also compared. Following Hargittai's (2009) study, one way to minimize the potential for participants to misrepresent their knowledge and perceptions is to insert bogus items. Therefore, three bogus items were included to discover how the made-up entries would perform compared to the real ones. Per Hargittai's study, three bogus items were utilized. One made-up item resembled the name of actual computer and Internet-related concepts (proxy and pod) and a term that in its entirety does not mean anything (proxypod). Another made up item, DPEG, was developed to serve as an acronym (given the prevalence of acronyms in the online world and among real terms). A third term served as a made up noun (filtibility). For the majority of variables, the self-reported knowledge measure was a good indication of the participant's actual knowledge of the terms. The Cronbach coefficient alpha reliability for the study sample scores was .89. The instrument scores were validated in a previous study (Hargittai, 2005) by correlating the measures with actual skill.

Developmental Reading Common Final. The Developmental Reading Common Final (DRCF) is a 22-item, researcher-created, outcomes-based assessment measuring basic reading skills such as locating main ideas and supporting details, inferencing, comprehending point of view, and employing critical thinking. A time limit of 80 minutes was allotted for the pretest and posttest and a standard rubric was used for all graders of both the pretest and posttest to ensure consistency.

Procedures

The study lasted one semester in duration, which was ample time for predicted outcomes from the SL intervention to be observed. Both experimental and control groups received identical instruction; however, the control group experienced face-to-face lecture and instruction whereas

the experimental group experienced both face-to-face and supplemental instruction within the SL virtual environment.

Participants were also observed in this environment by the triangulation and confirmation of data with the results of the SWODL. This exploration required third-party observers to document behaviors that aligned (or did not align) with the results gleaned from the SWODL. Observations took place during the reading activities in SL (on a designated university island) whereby three third-party observers looked for behaviors including, but not limited to, ease of navigation within SL, utilizing social communication tools within SL (voice and chat), locating reading activity stations, reading instructions from the SL reading activities document and implementing them in SL, exploration, using various tools within SL (i.e., gestures, sending notecards, flying, mini-map, preference settings, interacting with objects on the designated university island), and uploading and downloading documents required for the reading activities.

Prior to the reading activities, the senior researcher provided an orientation for students in the experimental group to acclimate them to this unique learning environment. Participants were given the opportunity to create their own avatars and then to begin exploring a particular island in SL. Specific functions and tools were introduced and modeled, thereby strengthening the comfort level within this immersive environment. The experimental group met on the island from their own respective locations (e.g., home, dorm room, library, reading center) at the regularly scheduled class time. Participants were asked to meet in the center of the island in front of the island's identifiable university marker.

Experimental participants were divided into groups of four or five and asked to meet at their group's designated starting station, where they were asked to click on the station, read the directions, and then complete the activity by recording their answers within a Word document. In the event a participant in the group had difficulties with a question, it was allowable for another group member to assist the participant with the appropriate reading strategy; however, outright answers were not to be shared among others in the group. Observers at each station verified participant integrity through recording the chat logs for each group. Upon completion of each activity, each group proceeded to the next designated station, until all reading activities at each of the four stations were completed by each group. Two out of the four groups completed all of the activities. The two groups that did not complete the activities were asked to complete them outside of class and then email the senior researcher a document that indicated they had completed the activities.

Results

This section is organized sequentially by research question.

RQ1: What are the differences in web-oriented digital literacy skills between developmental reading students who use SL (experimental group) and developmental reading students who do not use SL (control group)?

The SWODL was given to all participants in this study to examine the extent to which college-level developmental readers were digitally literate. The means for each construct for both experimental and control groups indicated an overall “good” to “full understanding” knowledge level. For use of technology, participants responded “often” to “very often” and overall responded “yes” to the self-report of digital literacy items. Finally, participants believed their level of technology skills ranged from “somewhat” to “very skilled.”

Participants overwhelmingly indicated a “good understanding” of technology items including newsgroups, refresh/reload, advanced search, bookmarks, spyware, cc (email), blogs, and wikis (Questions 4, 6, 7, 9, 10, 11, 12, and 13). For the technology item, PDF (Question 5), the control group reported “some understanding” whereas the experimental group reported “good understanding.” Finally, participants in both experimental and control groups reported having “no understanding” of the bogus item, *proxypod*. Overall, participants perceived themselves to have a good knowledge base of specific technology items.

Under the technology-use construct, control participants responded that they “never” used the bogus item *flitibility*, whereas the experimental group responded that they “rarely” used the bogus item *flitibility*. Both experimental and control groups reported that they use social networking sites “often” (Question 15). Participants reported that they “rarely” used podcasting, firewalls, and virtual environments (Questions 16, 17, and 19).

Participants in both experimental and control groups “sometimes” used favorites, search engines, and chat features (Questions 18, 20, and 22). The control group reported that they “sometimes” used message threads, and the experimental group reported that they “rarely” used message threads (Question 21).

Participants in this research study were also asked to self-report on specific digital literacy skills. Experimental and control groups responded positively “yes” that they could download and send a file, attach a document in email, and use search engines to locate information.

Finally, means and standard deviations were reported on participants’ skill level with particular technologies. Both experimental and control groups reported that they, overall, had “some skills” in virtual

environments, gaming/simulations, webcams, smart phones, video conferencing, digital pictures, presentation software, discussion boards/forums, document sharing, and file conversions (Questions 27, 28, 31, 32, 35, 36, 37, 38, 39, and 40). All participants felt they were “skilled” with instant/text messaging and using computer headphones and microphones (Questions 29, 33, and 34). Participants reported that they had “no skills” with DPEG, which was the bogus item inserted into the technology skills section of the survey.

Descriptive statistics for the total SWODL for responses to individual constructs are presented in Table 10. Means and standard deviations for the control group ranged from 1.15 to 3.81 and 0.36 to 0.91, respectively. The means and standard deviations for the experimental group ranged from 1.17–4.26 and 0.37–0.90, respectively.

Table 1

Descriptive Statistics for the Total Web-Oriented Digital Literacy Survey for Responses in Individual Constructs (Experimental Group vs. Control Group)

Constructs	Control Group <i>n</i> = 38		Experimental Group <i>n</i> = 42	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Technology knowledge	3.50	0.70	3.47	0.70
Technology use	3.19	0.91	3.26	0.90
Self-report on digital literacies	1.15	0.36	1.17	0.37
Technology skills	3.81	0.81	4.26	0.88

Although the SL experimental group means were higher in digital literacy skills per the descriptive statistical analysis as hypothesized, the implementation or nonimplementation of SL did not statistically significantly influence the levels of web-oriented digital literacy skills as the SWODL was administered at the beginning of the semester prior to the commencement of this study. The sole purpose of this survey was to measure college-level developmental reading students' perceptions of their knowledge, use, and skill level using digital technologies.

RQ2: What is the difference in reading achievement between developmental reading students who use SL (experimental group) and developmental reading students who do not use SL (control group)?

Research question 2 looked specifically at what differences exist, if any, in reading achievement between college-level developmental reading students who used SL (i.e., experimental group) and college-level developmental reading students who did not use SL (i.e., control group).

Upon examination of the histograms, the data appeared normal. Additionally, the standardized skewness coefficients (i.e., the skewness value divided by the standard error of skewness) and the standardized kurtosis coefficients (i.e., the kurtosis value divided by the standard error of kurtosis) for the pretest and posttest for both experimental and control groups revealed that all four coefficients fell within the normal $+3$ limits (Onwuegbuzie & Daniel, 2002), justifying the use of a parametric independent samples t test. Results showed a statistically significant difference in achievement gains between the experimental and control groups, $t(80) = 2.74, p < .05$. The gain score for the experimental group ($M = 81.90$) was statistically significantly higher than the gain score for the control group ($M = 78.41$). Specifically, the control group experienced a 19.4% increase in reading achievement, whereas the experimental group experienced nearly a 28.2% increase in reading achievement. The effect size, measured using Cohen's d (Cohen, 1988), was a large effect size of 0.87.

RQ3: What are the behaviors exhibited by students who report themselves to be digitally literate?

For research question 3, third-party observers took extensive notes during the reading activities, documenting behaviors that demonstrated digital literacy skills—many of which were represented on the SWODL. Observers were given a checklist that comprised the digital literacy skills from the SWODL as well as some additional skills exclusive to virtual environments. If an observer observed a particular digital literacy skill, he/she was to check off the skill(s) from the checklist and then document how it was demonstrated by participants during the activity. After the reading activities were completed, the observers shared notes and agreement was reached among all three observers. If a difference of opinion was present on the classification of a digital literacy skill, discussion among the three observers regarding the item in question was used to reach an agreement. The debriefing process among the observers aided in the overall identification and compilation of observations. Table 2 displays digital skills that were evidenced at least once, if not more than once, by the observers during the reading activities from experimental

participants in sections 1 and 2. Although many of the observed skills were exclusive to SL, many of the digital skills were also used in other computer applications associated with the activity and were successfully demonstrated by a majority of the participants.

Table 2

Digital Skills Observed During Reading Activities

Digital Skill Observed	Description of Digital Skill	Digital Skills Noted by Observers
Preference settings	Setting controls that alter various features about a program.	Students wanted to change the environment settings from nighttime to daytime. Students were able to adjust the volume settings to hear and speak through the headset and/or microphone.
Document sharing	Being able to upload, download, or both, a document via email attachment to another person.	Saved, uploaded, and sent reading activity answers to researcher via email.
Instant messaging	Being able to hold a private conversation with another person.	Students used the private messaging instant message tool to have private conversations.
Chat (text and voice)	Being able to communicate with others using either digital text or voice to communicate.	The chat feature was used by students to communicate during the reading activities. Some students used the voice chat to communicate.
Digital pictures	Being able to take, upload, and send digital pictures.	Some participants used the snapshot function within Second Life to take pictures of themselves and others during the reading activities.

Virtual environment		<p>Student/Avatar observed flying, walking, running, navigating, and teleporting.</p> <p>Camera controls were used by students to zoom in and out.</p> <p>Changing appearance functions (i.e., clothes, hair, body shape, eye color) were utilized by students.</p> <p>Students used avatar gestures (i.e., laughing, smiling, dancing).</p> <p>Interaction with objects (i.e., golf cart, reading station).</p>
Open attachment	Being able to open an attachment that has been sent to you by another person.	<p>Students were able to open successfully the instructions for the reading activities and the Optimal Experience Questionnaire sent to them by the researcher.</p>
Computer headphone	Being able to use a computer headphone to hear digital sound through a computer.	<p>Students who tried the voice chat used headphones to hear other participants who were using the voice chat tool.</p>
Computer microphone	Being able to speak through either a built-in or external computer microphone to another person.	<p>Students who used voice chat were also successful at using either their computer's built-in microphone, or their external computer microphone.</p>

Limitations

This section outlines some of the limitations of this study.

Population validity. One of the main limitations of this research was in terms of population validity. In this study, the sample was fairly small (80 participants); therefore, the results of the study were not generalizable to the entire population of college-level developmental reading students.

Ecological validity. Additionally, ecological validity was an external threat because the setting, SL, was only one of several virtual environments available; therefore, generalizability regarding this setting was not possible.

Temporal validity. Further, temporal validity posed a threat in terms of the rapid evolution of technologies. Therefore, it is important to consider that SL as a learning platform may be obsolete in 5–10 years.

Discussion

Regarding the first research question (“What are the differences in the web-oriented digital literacy skills of developmental readers between developmental readers who use SL and developmental reading students who do not use SL?”), the statistical findings supported that the participants in the experimental group and the control groups were indeed digitally literate. The extensive use of digital technologies calls for major transitions in educational curricula, and as specifically focused on in this study, developmental reading curricula. First and foremost, as developmental reading instructors routinely measure learning styles, multiple intelligences, and prior knowledge of reading concepts, they should also examine and develop ways in which they can measure their students’ digital literacy—especially in a global society and workforce that demands knowledge of digital technologies.

Concerning the second research question (“What is the difference in reading achievement between developmental reading students who use SL [experimental group] and developmental reading students who do not use SL [control group]?”), a statistically significant difference was revealed whereby the experimental group achieved more of a reading achievement gain in DRCF scores than did the control group. As with any study whereby technology use in the classroom is compared to a classroom with no technology use, interpretations of data and deductions were not destined to be a balanced comparison. The “added value” of technology will likely produce better results—whichever technology the researcher wishes to use; however, this study did not involve a comparison. Accordingly, the goal for this research was not to compare SL integration to no SL integration. Rather, the goal was to examine digital literacy skills in SL among college-level developmental readers. What the researchers were particularly interested in was the existence of reading gains for both the control group and experimental group. Using SL—not as a substitute to traditional face-to-face classroom learning, but as a supplement for face-to-face learning—may allow developmental readers to experience learning more attuned to their needs as 21st-century

learners. The results of this study supported the effectiveness of incorporating SL in developmental reading classes; more specifically, the results of the pretest DRCF and the posttest DRCF scores indicated gains in reading achievement among students in the experimental group.

The gains in reading achievement for the experimental group were statistically significantly higher (28.2%) than for the control group and were interpreted to be the result of the development and implementation of reading activities that were intuitive and relevant to the participants' needs in terms of learning and utilizing innovation to support learning. Comments made by participants, including "I wish all of my other classes used SL" and "I really felt I was learning in SL because I got to talk with other people in class about questions I had and sometimes they had the same questions as I did," supported the initial assumptions in this study.

For the third research question ("What are the behaviors exhibited by students who report themselves as digitally literate in the SL learning environment?"), participants demonstrated several behaviors that matched their self-reported digital literacy capabilities from the SWODL. Although there were many instruments considered for use in this study to measure digital literacy, the actual demonstrations and applications of these digital literacy skills by the students were deemed as most insightful.

Through the results for this research question, according to the specific skills listed on the SWODL, the third-party observers in this study were able to note over 50 indicators that related to a digital literacy skill. Additionally, other digital literacies exclusive to virtual environments were also demonstrated. When participants experienced difficulties with technology skills, they consulted with their peers or instructors for answers. As the instructors of the experimental group were also virtually present during the reading activities for help and guidance, participants had immediate feedback to aid them in completing the activities.

One distinct advantage SL offers is its telepresence. As avatars, participants were able to feel as if they were in the same room as their classmates. As one participant stated, "It felt like everyone was all together in the same room." The telepresence experience has positive implications for distance education teaching and learning. Educators can provide instruction, answer questions, and give feedback in real time. Students can equally receive instruction, ask questions, and receive feedback—all in real time. Compared to other online-learning management systems (which are typically asynchronous in nature), MUVES such as SL have the potential to bridge the gap between face-to-face instruction and asynchronous distance education.

Conclusions

Through the execution of this study, digital literacy and reading achievement were examined in virtual environments among college-level developmental readers. Specifically, participants in this study were, for the most part, digitally literate. This digital literacy was demonstrated through reading activities in SL, in which the experimental group had increased reading achievement gains over the control group who did not use SL. We are undoubtedly facing a sharp change in education where it is apparent that online learning platforms are conducive to strengthening both academic and digital literacy skills. As more and more incoming freshmen require college-level developmental reading classes, the need to support these skills with instruction that reflects intuitiveness and responsiveness to how they think, live, and learn using online learning environments will be very important.

Digital technologies provide engagement that crosses borders and time zones; therefore, using virtual environments such as SL as a distance delivery platform for college-level developmental students across the globe has great potential. Developing instruction within these online environments, however, also requires instructors to possess digital literacy skills; therefore, instructors are encouraged to reflect upon their own individual skill level, and either proceed by seeking professional development opportunities to hone these skills, or if already attained, use them toward the development of engaging online environments.

The information learned from this study will hopefully pave the way for fresh ideas on ways to incorporate teaching and learning opportunities in virtual environments among developmental reading educators and developmental readers, respectively, and to help generate professional conversations for development and implementation.

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