Using Computer Simulation to Teach a Standardized Instrument in an Online Course

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Abstract

The purpose of this study was to ascertain if using computer simulation, for teaching students how to administer and score a standardized instrument, was an effective instructional method in an online course. The process for implementing this study was based on the situated learning theory. Participants in this study were 52 graduate students enrolled in an online advanced assessment course in a special education master's program. Data were collected from a 12-item survey and from two student assessments. Concluded from the data is that computer simulations are an effective instructional method for teaching a standardized instrument in a course taught fully online. Findings also revealed that students found the situated learning process for acquiring knowledge and skills, relative to a standardized instrument, to promote high quality learning in an online course.

Keywords: simulations, online learning, teacher preparation, standardized instrument.

1. Introduction

In teacher preparation programs, one of the most prevalent pedagogical methods is teacher modeling. In face-to-face courses, the medium used for modeling skills and behaviors to be acquired by students is demonstration. Traditionally, the instructor disseminates knowledge about the skill's components and then proceeds to demonstrate how the skill should be implemented. As students progress from awareness and knowledge, they move toward skill acquisition. This higher level of learning is typically reserved for more advanced courses where a real-life working environment is often replicated to provide students with a setting for skill practice. When these advanced courses are taught online, how does an instructor maintain this pedagogical method of teacher modeling and performance feedback? The answer is through computer simulation.

This paper describes how computer simulations were utilized as a method to teach a standardized instrument to graduate students enrolled in an advanced assessment course that was fully online. To begin, a review of the literature is provided to define computer simulation and to report current research. Next, the research study is described and its connection to the situated learning theory delineated. To conclude, the findings are reported in conjunction with educational implications and areas for future research.

2. Literature Review

"Over the past decade, simulations have become increasingly popular for creating realistic digital environments that closely replicate the world and the workplace" (Ferry et al., 2004, p. 295). According to Lunce (2004), a computer simulation is a model of a real-life system or process represented in an "abstracted or scaled-down form" that can be "powerful tools for analyzing, designing, and interacting with complex systems or processes" (p. 30). Rude-Parkins, Miller, Ferguson, and Bauer (2005) supported this by stating that simulation may be one of the "most powerful tools" for online instruction because of how learners are engaged and challenged in personal ways (para. 1).

According to Gredler (2004) there are two classifications of simulations: symbolic and experiential. "Experiential simulations are social microcosms. Learners interact with real-world scenarios and experience the feelings, questions, and concerns associated with their particular role. That is, the learner is immersed in a complex, evolving situation in which he or she is one of the functional components" (Gredler, 2004, p. 573). Gredler separated experiential simulations into three types: a) social-process, diagnostic, and data management simulations. Social-process simulations are often developed to provide experiences in using language to communicate for various purposes.

Diagnostic simulations have learners take professional roles that involve problem-solving. Data management simulations typically involve competition among management teams as a major variable.

Gredler (2004) defined symbolic simulation as:

> A dynamic representation of the functioning or behavior of some universe, system, or set of processes or phenomena by another system, in this case, a computer. A key defining characteristic is the student functions as a researcher or investigator and tests his or her conceptual model of the relationships among the variables in the system. This feature is a major difference between symbolic and experiential simulations. That is, the role of the learner is not a functional component of the system. (Gredler, 2004, p. 574)

"Technology and pedagogy exist in a dialogic relationship with each other, embedded in a complex web of relationships and feedback mechanisms" (Koehler, Mishra, Hershey, & Peruski, 2004, p. 26). Consequently, appropriate context-specific strategies and representations must be developed (Koehler et al., 2004). In an online learning environment, computer simulations can play a crucial role because they can provide a vehicle for interactive practice (Berge, 2002) that enables students to respond to new information which closely approximates real-life situations (Lunce, 2004). After reviewing empirical studies, Hacker and Niederhauser (2000) identified five learning principles relative to effective online instruction and student learning outcomes. Two of the principles require students to become active participants in their learning and to ground learning by using examples.

"Simulations can provide authentic and relevant scenarios making use of pressure situations that tap users' emotions and force them to act, thus, providing a sense of unrestricted options which can be replayed" (Ferry et al., 2004, p. 295; Aldrich, 2004). Alessi and Trollip (2001) reported that students found educational simulations to be more "interesting, intrinsically motivating, and closer to real-world experiences than other learning modalities," which gives simulations an advantage over other instructional methodologies and media (Lunce, 2006, p. 38). Beyond this, simulations have resulted in improved performance in real-world settings due to providing a transfer of learning (Lunce, 2006).

The advantages of computer simulations are not exclusive to the online learning environment. Simulations can be made available to students in both traditional and online classrooms for multiple viewings. Lunce (2006) asserted that simulations can also benefit learners in the traditional classroom. In a study conducted by Smith, Smith, and Boone (2000), they found that ongoing access to online instructional materials offers potential advantages to student comprehension.

3. Purpose of the Study

Lunce (2004) asserted there is a need for reliable assessment instruments for evaluation of computer simulations. More specifically, limited research has been conducted on simulations in teacher preparation (Ferry et al., 2004). Responding to the aforementioned need, the purpose of this study was to ascertain if using computer simulation for teaching graduate students how to administer and score a standardized instrument was an effective instructional method in an online course.

4. Method

4.1 Setting and Participants

Participants in this study included 52 graduate students enrolled in a master's program in special education at a Midwestern university. Students were selected to participate in this study based on their enrollment in an advanced assessment course (i.e., SPED 551 Advanced Assessment) that was taught completely online. In this course students were taught how to administer and score a standardized instrument to assess academic achievement in order to help identify if a student has a disability, as well as his/her academic strengths and needs.

4.2 Instrumentation

The situated learning theory served as the theoretical framework for this study. This theory was most suitable because "simulations facilitate situated learning by providing interactive practice of real-world skills, focusing on the essential elements of a real problem or system" (Lunce, 2006, p. 40; Heinich, et.al., 1999). Situated learning is a general theory of knowledge acquisition developed by Jean Lave and Etienne Wenger in the late 1980s and early 1990s.

Collins (1988) defined situated learning as "the notion of learning knowledge and skills in contexts that reflect the way knowledge will be useful in real life" (p. 2). Herrington and Oliver (2000) delineated the nine elements of situated learning:

1. provide *authentic contexts* for the way the knowledge will be used in real life,
2. provide *authentic activities*,
3. provide access to *expert performances* and the *modeling processes*,
4. provide *multiple roles and perspectives*,
5. support *collaborative construction of knowledge*,
6. promote *reflection* to enable abstractions to be formed,
7. promote *articulation* to enable tacit knowledge to be made explicit,
8. provide *coaching* and *scaffolding* by the teacher at critical times, and
9. provide *authentic assessment* of learning within the tasks (pp. 25-6).

A 12-item survey was developed using the situated learning theory for construct validity. Because the overarching research question was to ascertain if using computer simulation was an effective teaching method for teaching a standardized instrument, the survey items were constructed for centralization on the overall *process* in learning the instrument (which focused on situated learning elements 1, 3, 4, 5, 7, and 8) and on the *effectiveness* of using computer simulation as an instructional method for learning to administer and score the instrument.

Students rated items using a Likert scale denoted as 5 = *Strongly Agree*, 4 = *Agree*, 3 = *Neutral*, 2 = *Disagree*, 1 = *Strongly Disagree*. The 12-item survey was found to be internally consistent with Cronbach's Coefficient Alpha at .90 and with the item-to-overall correlations being all positive. Thus, the instrument appeared to be reliable and valid in measuring simulations as an effective instructional strategy.

A formative assessment was developed as an *authentic activity* for assessing student learning (this addressed element 2 of the situated learning theory). This assessment, WJ-III Performance Assessment, evaluated students' skills at administering and scoring the Woodcock-Johnson® III Tests of Achievement (WJ-III). WJ-III's standard battery is comprised of 12 separate tests relative to reading, written language, mathematics, and oral language. Although there are 12 separate tests, there are four main methods for administering and scoring these tests. For the WJ-III Performance Assessment, 5 of the 12 tests were selected for students to administer and score based on the following criteria: a) at least one test was chosen from the four academic areas; and b) each test represented 1 of the 4 testing methods, so collectively, all methods were included. The WJ-III Performance Assessment included:

1. Test 1 Letter-Word Identification
2. Test 3 Story Recall
3. Test 8 Writing Fluency
4. Test 10 Applied Problems
5. Test 11 Writing Samples

Students were required to videotape their administering and scoring performance, which was then sent to the course instructor along with the completed scoring forms. The criteria used to assess students' administering and scoring skills for each of the five tests was called the *WJIII Tests of Achievement Examiner Training Checklist*, which was written by the authors' of the WJ-III and included in the training materials purchased by the University. Table 1 provides a sample of the criteria for this assessment.

A summative assessment, WJ-III Case Study, was also developed to provide an *authentic assessment* for the *integration of learning* (this addressed elements 6 and 9 of the situated learning theory). This assessment required students to administer and score all 12 tests of the WJ-III. This assessment was also videotaped and sent to the instructor. Criteria used to assess student learning was the *WJIII Tests of Achievement Examiner Training Checklist*, as described above. In addition to the administering and scoring criteria, a reflective question was in embedded for students to formulate abstractions regarding their performance on the WJ-IIII and how they would generalize their newly learned skills to other standardized instruments. For both the WJ-III Performance Assessment and WJ-III Case Study Assessment percentages correct were computed to evaluate student learning.

4.3 Procedures

Stated previously, the purpose of this study was to ascertain if using computer simulation for teaching students how to administer and score a standardized instrument was an effective instructional method in an online course. The standardized instrument taught in this advanced assessment course was the Woodcock-Johnson® III Tests of Achievement (WJ-III). The procedures used to teach the WJ-III were grounded in the concepts of the situated learning theory that provided students with an authentic context by providing them with computer simulations that were real-life situations to accomplish real-world objectives (Henning, 1998). Because the majority of graduate students enrolled in this advanced assessment course were in-service special education teachers, elements of situated learning also provided them with authentic assessments that integrated cognitive capacities learned in the classroom to real-world expectations they encountered as practitioners. Below are the procedures that were utilized for teaching the WJ-III; moreover, they are sequenced in the order they were implemented for students' developmental progression of newly acquired knowledge and skills:

1. To begin learning the WJ-III, students read the Woodcock-Johnson® III Tests of Achievement Examiner's Manual (Mather & Woodcock, 2001) while completing a study guide written by the instructor. This initial procedure allowed students to be apprised of the exact procedures for administering and scoring the WJ-III. The element of the situated learning theory this procedure addressed was to *promote articulation to enable tacit knowledge to be made explicit* (i.e., Element 7).
2. Next, students were provided with an *authentic context* that reflected how the WJ-III should be used in real-life (i.e., Element 1) through the participation in computer simulations that were classified as "experiential" (Gredler, 2004).
    a. Content: Simulations were made for each of the 12 tests that comprise the standard battery of the WJ-III. Because experiential simulations have begun to fulfill broader functions, such as diagnosing the learning problem of children (Gredler, 2004), this type of simulation was selected because the WJ-IIII is an assessment instrument commonly used when a comprehensive evaluation is conducted to determine if a student has a disability. A real-world testing environment was simulated by providing recordings of the instructor administering and scoring each test. In situated learning, this also *provided access to expert performance and the modeling of processes* (i.e., Element 3).
    b. Development: The simulations were recorded using Tegrity®. This technology is a self-contained streaming media production cart that facilitates the creation of online streaming media lectures, presentations, and demonstrations using Windows Media®. Recordings were streamed to students through a web-based course management system (i.e., Blackboard®), which afforded them the opportunity to engage in the computer simulations multiple times because they remained available throughout the semester.
    c. Engagement: The simulations immersed students in real-world scenarios (Gredle, 2004) where they assumed a decision-making role that is required of an evaluator. Although the testing scenarios were being modeling by the instructor, students were engaged throughout because they *experienced questions as part of their engagement* (Gredler, 2004). While simultaneously viewing each simulation, students were required to navigate through the testing administration booklet. After each page of administration, students paused the recording and had to make a choice based on the subject's performance: continue testing forward, begin testing backwards, or discontinue testing. After they made a choice, they continued with the recording to learn the consequence of their decision based on how the instructor navigated administration. Students were also engaged in the scoring process. They were provided with blank scoring forms to record the subject's responses as they were immersed in the testing scenario. For students to assess their accuracy in scoring the WJ-III, they were provided with instructor-completed forms. As a whole, an interactive learning environment was created to hone students' administering and scoring skills. Students were more than passive viewers of testing demonstrations; they were expected to make choices required by an evaluator. Following their decisions, they were provided with immediate feedback relative to the consequences of these choices by comparing their decisions to that of the instructors. Students were able to revise their choicse by changing the scoring form or by changing their placement in the administration booklet.

3. To provide *scaffolding* (i.e., Element 8) and to *support collaborative construction of knowledge* (i.e., Element 5), the instructor held three question and answer sessions. The instructor began each session by systematically going through each test to highlight the fine points of administering and scoring and then to answer students' specific questions. Next, a collective discussion ensued about general issues and perspectives specific to the WJ-III and relative to the assessment process in general, which addressed Element 4 (i.e., *providing multiple roles and perspectives)* in the situated learning theory.
4. The next procedure in this process was for students to complete a WJ-III Performance Assessment to provide them with an *authentic activity* (i.e., Element 2). Students administered and scored five instructor-selected tests from the WJ-III while videotaping their performances. The instructor evaluated students' administrating and scoring skills and provided them with written feedback.
5. The last procedure was for students to administer and score all 12 tests of the WJ-III to a school-age student to provide an *integrated assessment of learning* (i.e., Element 9). This was referred to as the WJ-III Case Study Assessment. A *reflective* component was embedded in this assignment for students to evaluate their current and continued learning and for *abstractions to be formed* about the assessment process and other standardized instruments (i.e., Element 6).

4.4 Data Collection and Analysis

A quantitative research design was implemented for this study. Participants anonymously completed the 12-item survey at midsemester during their advanced assessment course (i.e., SPED 551 Advanced Assessment). The survey was uploaded into Blackboard®, which is a web-based course management system. The survey took approximately 10 minutes to complete, with the overall response rate at 95%, which is well above the acceptable rate of 50% (Babbie, 1990). Data were also collected using two student assessments: a) WJ-III Performance Assessment, and b) WJ-III Case Study Assessment. Both these student assessments were completed during the first half of the semester. Survey and assessment data were collected across five semesters.

Survey data were analyzed using descriptive and reliability statistics. Data were disaggregated by item using mean, standard deviation, and reliability. WJ-III Performance Assessment and WJ-III Case Study Assessment data were also analyzed using descriptive statistics (i.e., mean and median). For both assessments, a score of 75% or higher was considered passing.

Survey data were triangulated with student assessment data. Items on the survey pertained to students' perceptions on the effectiveness of computer simulation for learning to accurately administer and score a standardized instrument; whereas the WJ-III Performance Assessment and WJ-III Case Study Assessment evaluated students' newly acquired skills at accurately administering and scoring the instrument. To triangulate, survey data related to administering the instrument were compared to how accurately students actually *administered* the instrument on the performance assessment and case study assessment. The same process was implemented for evaluating the effectiveness of *scoring* the instrument

5. Results

Are computer simulations for teaching graduate students how to administer and score a standardized instrument an effective instructional method in an online course? This overarching research question was addressed using a survey to measure students' perceptions on the effectiveness of computer simulation and two student assessments to evaluate acquired administering and scoring skills. The results obtained from the survey administered to 52 graduate students enrolled in a master's program in special education are represented in Table 2. Data are disaggregated by the 12-items comprising the survey. The mean, standard deviation, and reliability are reported for students' ratings of each item. The results of students' performance on the WJ-III Performance Assessment and on the WJ-IIII Case Study Assessment are represented in Table 3. Descriptive statistics are reported for each of these assessments.

According to results, computer simulations were an effective instructional method for teaching students how to administer the standardized instrument. Students perceived (M = 4.35) the computer simulations to be beneficial in learning to accurately administer the instrument. More specifically, students were in agreement (M = 3.98) that the computer simulations motivated learning due to the visual and auditory presence of the instructor. When triangulating this with student assessment data, students performed well above the passing criterion of 75%. On the WJ-III Performance Assessment, students administered the instrument with 90% accuracy and with 94% accuracy on the WJ-III Case Study.

Based on data, computer simulations were also effective at teaching students how to score the standardized instrument. Survey data revealed that students found the scoring protocols, that accompanied the simulations, to be helpful (M = 4.19). To compare students' perceptions to their actual scoring skill set, they were able to score the WJ-III with 94% accuracy on the performance assessment and with 96% accuracy on the case study.

Students agreed the computer simulations were convenient to access (M = 4.04). They also agreed the simulations gave them the opportunity to participate in administering and scoring procedures multiple times (M = 4.21). Beyond this, students' perceptions were that the computer simulations better promoted their learning when compared to face-to-face demonstrations because they could be accessed multiple times (M = 3.98).

Overall, students perceived this process for learning the standardized instrument to promote high quality learning (M = 4.27). Students were in agreement that the computer simulations provided an authentic learning experience (M = 4.35). Their perceptions were that the simulations gave them the opportunity to interact with the course content (M = 4.25), as well as provided a context for the information in the examiner's manual (M = 4.38). Lastly, students were in agreement that the follow-up question and answer sessions were helpful (M = 3.83).

6. Discussion

The main purpose of this study was to ascertain if using computer simulation for teaching students how to administer and score a standardized instrument was an effective instructional method in an online course. A second purpose was to expand the research for the use of computer simulations in teacher preparation. Using a 12-item survey and student assessment data, an evidence-base for the use of computer simulations in an online course was established.

The first overarching theme from this study is that students found the computer simulations to be *effective*. Students perceived the computer simulation to be effectual at teaching them to both administer and score the standardized instruments. When students' administering and scoring skills were actually assessed on two separate occasions, their scores surpassed the established criterion for proficiency. As a result, it can be concluded from this study that computer simulations are an *effective* instructional strategy for teaching standardized instruments in an online course. Perhaps the effectiveness of computer simulations was the result of the three advantages identified by Gredler (2004):

> First, they bridge the gap between the classroom and the real world by providing experiences with complex, evolving problems. Second, they reveal student misconceptions and understandings about the content. Third, and particularly important, they can provide information about students' problem solving strategies. (p. 573)

The experiential-type simulations allowed student to interact with the complex process of testing through experiencing the role of the evaluator by assuming both administering and scoring responsibilities. In this role, if students were errant in their decisions, the correct choice was modeled by the instructor. The students found this presence of the instructor in the simulation to be motivating.

Although the current literature does not contain findings relative to using computer simulation to teach a standardized instrument, there are studies that support computer simulation to teach skills for real-life application. In fact, computer simulations have been utilized in medical education since the late 1950s (Gredler, 2004). Reilly and Spratt (2007) studied the use of computer simulation with undergraduate student nurses as part of their preparation for clinical practice. The findings from their qualitative study were that "students believed the simulation is an innovative strategy that promotes active learning and has great potential for developing clinical competence and increasing confidence prior to practice" (p. 542). Burden, Tinnerman, Lunce, and Runshe (2010) used computer simulation to prepare pre-service teachers with the interpersonal skills necessary to participate in the development of Individualized Education Programs (IEPs) for students receiving special educations service. They found the simulations resulted in "richer and more in-depth discussion of what can be expected in actual IEP meetings" (p. 2).

The second overarching theme is that students found the *process* for learning the standardized instrument to promote high quality learning. The process for implementing this study was based on the situated learning theory, which is a general theory of knowledge acquisition by providing authentic experiences while providing scaffolding. Another conclusion that can be drawn from this study is that the overall process for teaching the standardized instrument provided an authentic learning experience that bridged research-to-practice.

According to Gredler (2004), "Simulation is an evolving case study of a particular social or physical reality in which the participants take on bona fide roles with well-defined responsibilities and constraints" (p. 571). In this study, the authenticity was achieved when students simulated the role of an evaluator by requiring them to make decisions of trained evaluators during the assessment process. In this role, students were required to make choices about what items to administer, how to score the subject's responses, and when to discontinue testing. Accuracy in these decisions is vital in order to collect reliable test results, which is why the federal special education law (i.e., Individuals with Disabilities Education Improvement Act) mandates that assessments be administered, scored, and interpreted by trained evaluators.

Based on current research, Lunce (2004) concluded that the efficacy of computer simulation is supported by data indicating that students recognize and value real-world learning experience facilitated by simulation. Dean and Webster (2000) captured the essence of simulations in how they are "providing a stimulus for insights in theory into practice and should enable students to transfer what they have learned to their work environments" (p. 347).

Interestingly, because students were able to conveniently access the computer simulations multiple times, they reported the simulations better promoted their learning when compared to a one time demonstration traditionally employed in a face-to-face-class. Smith, Smith, and Boone (2000) found that ongoing access to instruction in an accessible environment offers potential advantages to student comprehension and ongoing application across teacher preparation curricula. In light of this finding, the implication is that instructors using both online and face-to-face formats should consider using computer simulations, or an alternative, that will allow students to conveniently participate in the real-world process multiple times. Lunce (2006) supported this by stating, "It seems apparent that many benefits of situated learning can be provided to the learner in the traditional classroom through the use of educational simulations" (p. 40).

In the future, this study should be replicated. However, the computer simulations should be developed using a different standardized instrument related to academic achievement (e.g., Wechsler Independent Achievement Test®-II). This replication will not only offer comparative data but will strengthen the professional literature for the use of computer simulation in teacher preparation. Another recommended area for research is to use simulation for teaching a formalized process not related to assessment, such as the process for crisis de-escalation (e.g., Life Space Crisis Intervention®). In addition, this process should be constructed using the situated learning theory because all types of simulation-based learning environments need to include a pedagogical strategy (Granlund, Burglund, & Eriksson, 2000).

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Table 1: *Sample Criteria of WJ-III Performance Assessment*

Test 1 Letter-Word Identification (circle one)				
Y	N	N/O	1.	Knows exact pronunciation of each word.
Y	N	N/O	2.	Uses suggested starting points.
Y	N	N/O	3.	Asks subject to reread all the items on the page when a response was unclear.
Y	N	N/O	4.	Scores only the item in question when the subject rereads a page.
Y	N	N/O	5.	Does not tell the subject any letters or words during the test.
Y	N	N/O	6.	Gives reminder to pronounce word smoothly only once during a test.
Y	N	N/O	7.	Tests by complete pages
Y	N	N/O	8.	Counts items below the basal as correct

Note Y = yes; N = no; N/O = not observed. Adapted from "WJ-III Tests of Achievement Examiner Training Checklist," by B.J. Wendling and N. Mathers, 2001, *Woodcock-Johnson® Tests of Achievement Examiner Training Workbook*, p. 21. Copyright 2001 by Riverside Publishing Company.

Table 2: ***Survey Data***

Item	M	SD	r_p
1. The simulations provided an authentic learning experience for transferring assessment skills to my teaching practice (real-life application).	4.35	.52	.891
2. The simulations afforded me the opportunity for interaction with course content.	4.25	.653	.890
3. The simulations provided a context for the information presented in the Examiner's Manual.	4.38	.530	.892
4. The simulations were beneficial in learning to accurately administer the standardized instrument.	4.35	.623	.889
5. The scoring protocols that accompanied the simulations helped me learn to score the standardized instrument accurately.	4.19	.742	.889
6. The simulations taught me how behavioral observations helped me to understand my students as learners.	4.13	.595	.900
7. The simulations gave me the opportunity to view administering and scoring procedures multiples times.	4.21	.776	.886
8. When compared to face-to-face demonstrations, the simulations better promoted my learning because I could view them multiple times.	3.98	.960	.888
9. The simulations motivated my learning as a result of the visual and auditory presence of the instructor.	3.98	.727	.886
10. The simulations were convenient for me to access.	4.04	1.028	.909
11. The follow-up question and answer sessions with the instructor were helpful.	3.83	.857	.898
12. Overall, this process for learning the standardized instrument promoted high quality learning.	**4.27**	**.744**	**.885**

Table 3: ***WJ-III Performance Assessment and WJ-III Case Study Assessment Data***

Assessment	Mean	Median
WJ-III Performance Assessment	92%	93.5%
Administering	90%	
Scoring	94%	
WJ-III Case Study Assessment	95%	97%
Administering	94%	
Scoring	96%	