Impact of an Asynchronous Activity on Academic Achievement of Abstract Leadership Concepts

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Abstract

Educators require a variety of delivery methods to maintain students' motivation and attention, and to address different learning styles (Born and Miller, 1999). Vehicles that can reinforce cognitive knowledge and provide students the opportunity to put theory into practice include simulations, role-play, and games. Alessi & Trollip (1991) provide five major types of computer-based instructional programs: tutorials, drills, simulations, instructional games, and tests. Computer-based multimedia gives instructional designers the tools of animation, video, and sound to provide learners with working models that convey complex concepts. The purpose of this study was to ascertain if the use of an asynchronously delivered simulation activity to teach leadership styles and ethics theory would improve learning. The study employed a quasi-experimental design with a non-equivalent control group. Comparison of student performance on selected examination questions revealed that the treatment group (N=83) answered nine percent more questions correctly than did the control group (N=113). In addition, students in the treatment group performed significantly better on examination questions written at the knowledge, comprehension, and analysis levels based on Bloom's Taxonomy of Learning Objectives: Cognitive Domain (Bloom, 1956). Students in the treatment group performed equally well, regardless of learning preference (visual, aural, kinesthetic or multi-modal). It was concluded that computer-based simulations have the ability to improve student learning of leadership concepts at higher cognitive levels while allowing students to apply theory to real world situations.

Introduction

Leadership skills are essential for everyone, both as members and leaders of groups (Gatchell, 1989). Madeleine F. Green (1992) observed that while many people learn leadership as they go, in an unplanned and serendipitous way, it is also possible not to learn from experience or by observing others. She concludes, "The central question, then, for developing effective leadership is how can these efforts be made deliberate and purposeful rather than accidental or serendipitous" (p. 59). It is widely agreed by leadership scholars that leadership can be taught (Bennis, 1989; Bass & Avolio, 1994; Kouzes & Posner, 1987). However, the most effective methods for teaching leadership to undergraduate students is not known.

Teaching in large lecture halls presents difficulties in challenging learners to higher cognitive levels. It is especially frustrating for instructors who are teaching abstract concepts such as ethics and leadership styles. Students lack the opportunity to practice the theory in real world applications. Instructional method selection may be able to address this dilemma.

Instructors need choices in instructional methods to maintain students' motivation and attention and to address different learning styles (Born & Miller, 1999). Vehicles that can reinforce cognitive knowledge and provide students the opportunity to put theory into practice include simulations, role-play, and games. Alessi & Trollip (1991) provide five major types of computer-based instruction programs: tutorials, drills, simulations, instructional games, and tests. Situational simulations deal with attitudes and behaviors in various situations and allow the student to learn by actually performing activities in a context similar to real life. Simulations often enhance motivation, encourage transfer of learning, and are efficient in regard to the length of time required by the student (Alessi & Trollip, 1991).

Computer-based multimedia provides instructional designers the tools of animation, video, and sound to provide learners with working models that convey complex concepts. Specifically, multimedia simulations provide stimuli to auditory, visual, and kinesthetic learners. "It is known that animation can increase learner interest and motivation, provide metacognitive scaffolding and mental models, and promote visual stimuli to establish connections between the abstract and the concrete" (Dooley, Stuessy & Magill, 2000, p. 29).

Learning modalities are the sensory channels or pathways through which individuals give, receive, and store information. Most students learn with all of their modalities, but have certain strengths and weaknesses in a specific modality (Reiff, 1992). These avenues of preferred perception include kinesthetic/tactual, auditory, and visual (Eiszler, 1983). Multimedia simulations that utilize varying colors and fonts, audio and video streaming, and animation have the ability to appeal to all types of learners.

Asynchronous simulations offer many advantages as a delivery strategy for leadership education. Simulations provide educators direct opportunities to include Gagne's nine levels of learning into instruction (Gagne, 1985) and allow the learner to explore a topic and receive feedback without public humiliation (Bill, 2001). "Computer simulation affords teachers and instructional designers a powerful tool for sustaining knowledge retention and transfer" (Bill, 2001, p. 5). "One of the most powerful uses of multimedia is to immerse the user in a learning environment" (Boyle, 1997, p. 35). Simulations encourage exploration and case-based learning while relating the abstract to the concrete. While it is believed that a simulation is a positive addition to the instructional design used in teaching "ethics and leadership styles," Boyle indicated the need to "fully evaluate their strengths and limitations" (p. 43).

Research supports the use of multimedia simulations and animations as effective delivery methods. Dooley, Stussey, and Magill (2000) found that the use of animations improved students' conceptual understanding of difficult material in an upper level biochemistry course, regardless of the level of complexity. A study of engineering students using a computer simulation in conjunction with classroom instruction indicated that a substantial gain in the retention of the subject matter was obtained compared to students using only conventional teaching methods (Firth, 1972). Herrington and Oliver (1999) found that multimedia programs that were based on a situated learning approach provided an environment where higher order thinking occurs.

Instructors often strive to teach higher order thinking skills. Lewis and Smith (1993) offer a comprehensive definition: "Higher order thinking occurs when a person takes new information and information stored in memory and interrelates and/or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations" (p.136). Encouraging students to participate in higher order thinking can be challenging, however utilizing the taxonomy of learning objectives devised by Benjamin Bloom and colleagues (1956) can facilitate the process. This taxonomy separates objectives into six hierarchical categories: knowledge, comprehension, application, analysis, synthesis, and evaluation.

Bloom's six categories represent unique elements. Knowledge includes recall of terminology, facts, and other previously learned material. Comprehension is defined as understanding the meaning of informational materials. Objectives that require the student to use previously learned information in new and concrete situations to solve problems fall into the application category. Analysis requires the breaking down of informational materials into their component parts and examining them to reach divergent conclusions. Synthesis objectives require students to creatively apply prior knowledge and skills to produce something new. Evaluation requires the judging of material, based on certain standards or values, to create an end product (Bloom, 1956).

Whittington (1995) showed that professors in the College of Agriculture at The Pennsylvania State University were teaching primarily at the knowledge (47%) and comprehension (33%) levels of Bloom's taxonomy most of the time. Given that simulations encourage students to think at higher than the knowledge level, it is believed that this approach may be effective in teaching leadership education.

Born and Miller noted that choices in instructional methods are needed to maintain students' motivation and attention and to address different learning styles (1999). Miller (1997) stated, "College teachers of agriculture should engage in action research to find practical ways of using learning styles data to improve instruction." The investigators sought to examine an asynchronously delivered simulation as an instructional method and determine its effectiveness and impact on learning.

Purpose and Objectives

The purpose of this study was to determine if an asynchronously delivered simulation activity to teach leadership styles and ethics theory would impact learning. The specific objectives of the study were as follows:

1. Compare the performance on selected examination questions of students who had completed an asynchronous simulation activity with students who had not completed the activity.
2. Determine if an asynchronously delivered simulation activity impacted performance depending on the level of cognitive learning as defined in Bloom's Taxonomy of Learning Objectives: Cognitive Domain.
3. Compare the performance of the treatment group on selected examination questions based on their individual learning preference.

Procedures

Design of study

This study utilized a quasi-experimental design with a non-equivalent control group (Fraenkel & Wallen, 1999). The treatment (a computer-based simulation activity) was administered to a group of students (N=83) taking an upper level undergraduate agricultural education course, *Professional Leadership Development*, during the spring semester of 2001. Treatment group performance was compared to a group of students who completed the class during the fall semester of 2000 (N=113) and who had not received the treatment.

Students, in both the treatment and control group, were taught using lecture, guided discussion of leadership case studies, small group discussion, and reflective activities. Material on ethics and leadership styles were taught utilizing the identical instructor and delivery methods both semesters. The only difference in instructional delivery was the use of the computer-based simulation for the treatment group.

Three leadership style theories were taught prior to the implementation of the simulation activity: Situational Leadership Theory, the Style Approach (Northhouse, 2001), and the Leadership Continuum Model (Tannenbaum & Schmidt, 1958). In addition, ethical leadership was discussed in relation to two theories: the Six Pillars of Character (Josephson Institute of Ethics, 2000) and the six value systems identified by Spranger (1929) that motivate people to think and act as they do.

The learning activity entitled, "Project Interaction," was designed based on findings from a previous study that indicated a preference for audio and graphics over video and text (Boyd & Murphrey, 2001). The activity covered one unit within the course that focused on "Ethics and Leadership Styles," which was designed during Fall 1999 and developed the following year. Design of the activity followed recommendations provided in *Computer-based Instruction: Methods and Development* (Alessi & Trollip, 1991). The asynchronous learning activity was designed using a simulation model and created with the computer program Macromedia Flash. The simulation includes the following components: objectives, directions, an opening, the body (presentations and student actions), and conclusions. The activity is comprised of narrated audio clips, sound effects, text, and graphics. Students are placed in the position of a human resources director with personal knowledge about a job applicant. The students must decide whether or not to tell the search committee what they know about the candidate. Students learn of the potential consequences of their decisions throughout the activity through the presentation of animated clips to which students are asked to respond by answering a question based on what they learned. The process continues for multiple levels. At the conclusion of the activity, the learner is presented with a unique summary of what should have been learned in the activity. There are eighteen possible routes within the program. At the end of each route, following the unique summary, students are provided an opportunity to go through the simulation again or to proceed to a self-test quiz. The self-test quiz combines both content and questions to create an interactive learning experience.

Creativity was used to generate a unique approach to the topic, "Ethics and Leadership Styles," in an attempt to match student preference for learning discovered in the previous study. The activity used colorful graphics, animations, and entertaining audio to maintain the students' interest while teaching a lesson about the implications of ethical decisions and leadership styles. The purpose of the learning activity was to encourage retention of the primary principles covered in the units. The asynchronous approach was selected to allow each student to learn at his/her own pace; however, the activity could be used in a traditional classroom setting.

All students in the treatment group received the computer-based simulation on a compact disc (CD-ROM), and were provided both written and oral instructions. Students were told that participating in the simulation was strictly voluntary, but that it was a self-paced activity designed to let them apply theories that had been discussed in class. Students were asked to report if they used the simulation activity and how many times they went through the scenario. Eighty-three students reported running the simulation at least once.

The performance of treatment group responses (N=83) on six examination questions relating to ethics and 16 questions relating to leadership styles were compared to the performance of the control group (N=113). Differences between the treatment and control group were determined using the t-test for independent samples.

The questions were categorized using Bloom's Taxonomy of Learning Objectives – Cognitive Domain (Bloom, 1956) by the authors and verified by a panel of two faculty members experienced in curriculum design and familiar with the taxonomy. T-tests were used to describe differences between treatment and control group performance on each taxonomic category.

Students also completed the Visual, Auditory, Read-write, and Kinesthetic (VARK) Learning Styles Inventory to ascertain their predominant learning preference (Active Learning Site, 2001). The inventory consists of thirteen questions designed to determine a student's preferences for taking in information. Analysis of variance was used to discriminate among mean scores of students with different learning styles.

Findings

Comparison of the control and treatment groups was based on four characteristics: overall class grade point average (GPA), percentage of class enrollment from each college, student classification, and gender. These data were collected from the Student Information Management System at Texas A&M University. Table 1 summarizes the differences between the two groups and reveals that they are similar. The average GPA for the control group and treatment group were 2.80 and 2.70, respectively. The class average GPA for the control group was not significantly higher than that of the treatment group. Males comprised 63% of the treatment group as compared to 53% for the control group. In contrast, the treatment group consisted of 37% females compared to 47% for the control group. The control group consisted of 4% sophomores, 22% juniors and 74% seniors, while the treatment group consisted of 11% sophomores, 31% juniors, 57% seniors.

Agriculture majors comprised slightly more than 88% of the control group and 80.5% of the treatment group. This is not unusual as *Professional Leadership Development* is a required class for all Agricultural Development and Agricultural Business majors at the university. The colleges of Engineering, Liberal Arts, and Science constitute the bulk of the remaining students enrolled during both semesters.

Objective 1

Objective one was to compare the performance on selected examination questions of students who had completed an asynchronous simulation activity with students who had not completed the activity. Chronbach's Coefficient Alpha revealed a moderate internal reliability (0.62) for the 22 test questions used to assess differences in learning between the two classes. While an alpha of .62 is normally not considered rigorous, the examination questions are considered inherently valid and reliable because they have proven effective in measuring knowledge and understanding through repeated use.

The control group (students who did not participate in the simulation activity) averaged 76% correct answers (16.79 out of a possible 22). The treatment group (students who utilized the simulation as a learning activity) answered 85% of the questions correctly (average of 18.68 out of a possible 22). T-tests revealed that the differences in total correct answers between the treatment and control groups were statistically significant at the .05 level. Table 2 describes the results of the t-test comparison.

Objective 2

Objective two was to determine if an asynchronously delivered simulation activity impacted student performance depending on the level of cognitive learning as defined in Bloom's Taxonomy of Learning Objectives: Cognitive Domain. The twenty-two examination questions were categorized according to Bloom's Taxonomy of Educational Objectives – Cognitive Level (Bloom, et al., 1956). The questions fell into four categories: knowledge, comprehension, application, and analysis. The mean number of correct answers between the treatment and control groups for each cognitive category was compared using the t-test for independent samples. Mean scores and t-values are reported in Table 3. T-values for the cognitive levels for Knowledge, Comprehension and Analysis revealed a statistically significant difference between the mean number of correct answers for the treatment group and the control group. While t-tests did not reveal a significant difference between mean scores at the application level for the two groups, it is significant to note that there were only three questions classified at the application level.

Objective 3

Objective three was to compare the performance of the treatment group on selected examination questions based on their individual learning preference. Analysis of variance (ANOVA) was conducted to determine whether differences in performance on selected test items existed between students with different learning preferences. ANOVA results are reported in Table 4, and reveal no significant difference between students with different learning preferences.

Table 1

Characteristics of Treatment and Control Group Students in an Agricultural Leadership Class, 2001

Characteristic	Control[a]	Treatment[b]
Grade Point Average (GPA)	2.80	2.70
Classification		
Sophomores	4.%	11%
Juniors	22%	31%
Seniors	74%	58%
Major		
Agriculture	88%	80%
Engineering	4%	7%
Liberal Arts	3%	5%
Education	<1%	3%
Business	<1%	2%
Science	3%	3%
Gender		
Male	53%	63%
Female	47%	37%

[a] N=124; [b] N=113.

Table 2

Comparison of Means of Students' Scores on Selected Test Questions in an Agricultural Leadership Class, 2001

Group/Semester	N	Mean[a]	SD	t-value [b]
Treatment	83	18.68	2.76	5.11
Control	113	16.79	2.40	

[a] Mean correct out of a possible 22 questions; [b] $p < .01$.

Table 3

Comparison of Mean Scores by Cognitive Level of Questions in an Agricultural Leadership Class, 2001

Cognitive Level	N	Mean[a]	SD	T
***Knowledge*[c]**				
Treatment Group	83	7.07	1.21	5.10[b]
Control Group	113	6.18	1.20	
***Comprehension*[d]**				
Treatment Group	83	4.21	0.90	2.42[b]
Control Group	113	3.88	0.93	
***Application*[e]**				
Treatment Group	83	2.71	0.53	1.29
Control Group	113	2.61	0.51	
***Analysis*[f]**				
Treatment Group	83	4.70	1.24	3.44[b]
Control Group	113	4.12	1.04	

[a] Average number of correct answers; [b] $p < .05$; [c] 8 total questions;
[d] 5 total questions; [e] 3 total questions; [f] 6 total questions.

Table 4

Differences in Mean Correct Answers by Student Learning Preference in an Agricultural Leadership Class, 2001

Cognitive Level	Visual N=4	Auditory N=3	Kinesthetic N=22	Read-Write N=7	Multi-Modal N=46	F[a]
Knowledge[b]	8.00	5.67	6.91	7.43	7.11	1.93
Comprehension[c]	4.00	3.67	4.14	4.29	4.28	0.44
Application[d]	3.00	2.67	2.64	2.71	2.72	0.40
Analysis[e]	5.50	5.00	4.77	4.71	4.57	0.60

[a] $p < .05$; [b] 8 total questions; [c] 5 total questions; [d] 3 total questions; [e] 6 total questions.

Conclusions

The treatment and control groups were compared on four characteristics, class GPA, gender, student classification, and percentage of students from each college in the university. While the treatment group contained 16% fewer seniors and 10% more males than did the control group, these differences did not affect the overall academic performance of the two groups. Thus, it can be concluded that the two groups were similar.

Objective one was to compare the performance of the treatment and control groups on selected examination questions. Students who participated in the simulation improved their performance on selected test items by 9%. There were no significant differences in the performance between males and females in the treatment group. Based on the finding that students who participated in the computer-based simulation activity scored significantly better than students who did not, it may be concluded that the simulation was an effective means of delivering instruction.

Objective two sought to determine if an asynchronous simulation activity impacted the performance of students at different cognitive levels, based on Bloom's Taxonomy (Bloom, 1956). While the treatment group performed better on questions written at the knowledge, comprehension, and analysis levels, no significant difference was found for questions written at the application level. It may be concluded that the simulation is an effective delivery strategy for the lower cognitive levels (knowledge and comprehension) as well as the higher level of analysis.

Objective three compared the performance of students based on their learning preferences. Based on the finding that no significant difference existed between students with different learning preferences, it may be concluded that the simulation facilitated learning regardless of student learning preference.

Implications

The use of simulations holds promise as instructors look for more effective methods for delivering instruction. Based on the design of the activity that included animations, this study supports the findings of Dooley, Stuessy, and Magill (1999) who found that the use of computer-based animations greatly enhanced the ability of students to answer questions of increasing difficulty. Instructors who seek to improve students' understanding of abstract concepts should consider using computer-based simulations that emulate the working environment. Based on the conclusion that the simulation assisted students in answering questions written at the higher cognitive levels (the analysis level), educators should consider the use of computer-based simulations to facilitate higher order cognitive skills.

It is clear that instructional design principles must be followed when creating computer-based simulations. The simulation combined multiple forms of media (text, audio, and animation), thus explaining the lack of significant difference between students with different learning preferences. It should also be noted that categorizing questions according to Bloom's taxonomy is a subjective process, and while the researchers used a panel of experts to confirm classification, it is possible that some of the questions would be categorized differently by others.

Recommendations for Further Study

This study was limited to those students who self-selected to complete the simulation activity. Future research should examine if students who participate in voluntary and extra credit activities differ from those who do not participate in such activities. This study should be replicated, using the simulation as a required instructional module in the class, eliminating the option of students self-selecting to complete the simulation.

Given the fact that there were only three items in the application category, one questions if there were enough test items to measure significant learning at this level. Given this fact and the findings related to objective two, it is recommended that further research be conducted to determine if simulations facilitate learning at all levels of Bloom's taxonomy of learning objectives.

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