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ABSTRACT

This document contains the following papers on simulations and case studies from the SITE (Society for Information Technology & Teacher Education) 2002 conference: "3-D Virtual Classroom Technology" (Kimberly Arseneau Miller, Angela Glod); "Simulated Lesson Design Studios" (Willis Copeland); "Lights, Camera, Integration: Presentation Programs and the Interactive Visual Experience" (Beverly J. Hagen,); "Web-Based Simulations on Chemistry and Physics Lab Activities" (Han-Chin Liu); "A Qualitative Examination of Student Responses to Test Questions after Simulation Software Use" (Kimberly Nyles-Roque); "Integrating Virtual Reality (VR) into Classroom Curriculum" (Kenny Ott); "Comparing Simulation-Based Lesson Planning in Experienced and Preservice Teachers" (Harold R. Strang); and "Nurturing Reflective Teaching in a Computer Simulation Program: An Investigation of Intervention Effects" (Y-Chu Yeh and Harold R. Strang). Some titles are brief summaries of conference presentations on 3-D virtual classroom technology, simulated lesson design studios, and presentation programs and the interactive visual experience. Most papers contain references. (MES)

Simulations & Case Studies (SITE 2002 Section)

Cathy R. Seymour. Ed.

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SECTION EDITOR:

Cathy R. Seymour, Northwestern State University of Louisiana

Though recognized as a legitimate and positive aspect of teaching and learning, simulations are being more widely used by authors for the 2001 SITE annual than in previous years. However, the wide variation in defining “simulation” in education has continued to contribute to the small number of studies in this area. The range in availability of hardware, courseware, and software in international locations where some of these investigations were done certainly has contributed to the variation in sophistication of data treatment. Additionally, though the global economy and international testing have moved countries closer in terms of educational goals, differences in educational philosophies have certainly contributed to the issues addressed and undertaken by this year’s contributors.

With only nine submissions, the variety of definition is again seen as a strength of this technology driven teaching strategy. The way educators have chosen to define and then implement technology in the classrooms of their districts and countries is as varied as the geographic locations of the schools. Regardless of the complexity or simplicity of the technology available or the cognitive entry level of the personnel proposed for using the innovation, readers can certainly find a situation or discipline that mirrors their own. Reports of technology use for teacher-preparation as well as use with the P-12 students also increase variation.

Papers submitted range from virtual classrooms in qualitative physics to reflective teaching and critical thinking simulations. Perhaps papers dealing with lesson planning and how simulations can serve as safe-havens for “practice” of skills learning in the pre-service teacher preparation classroom either individually or in groups show the technology version of “practice makes perfect.” Specific studies of how technology can be used to increase the “liveliness” in classrooms for today’s technology savvy students may say it best through the use of video, audio and animation.

Simulations have the ability to advance the experiential knowledge of the students using them regardless of age, stage, or location. For this, the studies promoting the use of technology in simulation should be commended.

3-D VIRTUAL CLASSROOM TECHNOLOGY

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Abstract: Travel to another country? Perform experiments without expense? All of this is now possible for the average student who has access to a computer in a virtual classroom. The implications for virtual 3-D technology in an online or traditional classroom are practically limitless. Online instructors consistently struggle with the task of creating a sense of community among students who often feel isolated or removed due to the lack of face-to-face interaction. Traditional classroom instructors often struggle with the task of creating real-life learning situations due to financial or distance barriers. Activeworlds is a software company that has developed 3-D technology that makes it possible for educators to create the virtual classroom that they desire. This presentation will be an overview of the 3-D virtual classroom as an emerging component of online and computer-assisted learning. Both an online class lesson and a real classroom activity using virtual 3-D technology will be demonstrated.

REFERENCES:

www.activeworlds.com

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Simulated Lesson Design Studios

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Teacher education programs have traditionally found it difficult to provide their credential students with the opportunity to practice complex skills such as lesson planning in ways that offer both detailed and constructive feedback and sufficient opportunity for student reflective response to practice. That is, it is easy to communicate to students the mechanics of lesson planning but much more difficult to engage students in repeated opportunities to plan lessons under conditions that allow them to examine closely the products of their planning with the benefit of focused feedback.

Preparing Credential Students to be Lesson Planners

The PT3 Program at UC Santa Barbara is working to develop an approach to provide our credential students with opportunities to practice, in controlled settings and with appropriate feedback, the designing of learning experiences (lessons and units) that make appropriate use of technology. We are designing what we call "Simulated Lesson Design Studios" into which our students could "enter" as individuals or as small working teams. Each SLDS will be specific to a grade level and content area and will contain the necessary tools and resources to allow our credential students to create a lesson or unit for a specified classroom of pupils. Each SLDS is contained on a CD-ROM and features a user interface built on the metaphor of a workshop with workbenches, tools and drawers of materials. "Tools", located on various "workbenches" in the SLDS, are used to create such things as learning objectives, assessments, needed materials lists, and lesson delivery sequences and to assemble these components into a printable "lesson/unit plan" file. Other "workbenches" contain electronic tools useful, for example, in creating computer-generated graphics and multimedia components.

Resources, found in "materials drawers" in the SLDS include background for the teacher concerning the lesson's content, a list of California Content Standards, a selection of available print materials for pupils that might be pertinent to the lesson, potentially helpful websites, computer applications that might be appropriate for pupils, videotape resources that might be used in the lesson, technology resources that are available in the school and thus could be planned for in the lesson, background information on pupils in the class for which the experience is being designed and even samples of activities that have been designed by other teachers and that might be incorporated into the complete lessons/units that the students are designing. Credential students would have to decide which tools and resources to use, and in what order. It would never be appropriate to use them all. There would not be "one best" way to proceed and different students working in the same workshop would very likely create discernibly different products.

We are in the process of creating a number of these Simulated Lesson Design Studios. Our students will then be assigned, outside of class time, to enter an SLDS and create learning experiences that make creative and appropriate uses of technology. Meeting in class sessions after such creative work is finished, the students' products can be presented, examined and compared. Because all students will have had access to the same tools and resources and will have designed for the same class of pupils, differences in the resulting products can be compared and, as is typical of all good design studio work, individual students' creative thinking and understanding of possibilities can be expanded.

Our development work has now turned to disciplined inquiry focused on both the process by which students engage in the task of lesson design, review and reflection and the results of engaging in this process in terms of students' planning ability.

Interactive Session

We propose to offer an interactive session at SITE 2002 in which attendees can 1) work with sample Simulated Lesson Design Studios as would credential students, 2) hear about the results of our observational studies of credential students at work in SLDS's, and 3) engage in a discussion of various pedagogical strategies that might be used with credential students and the possible advantages and disadvantages of these approaches. Attendees will be invited to explore questions such as the following: Would SLDS's be better used by individuals or by small working groups of credential students? What might be the expected characteristics of lesson plans that these students might produce from within a SLDS? How could students' reflection on and learning from an experience in an SLDS be best facilitated? At what stage in a credential student's professional development would work in SLDS's be most appropriate? How many separate sessions in an SLDS be necessary for real learning? How would a university faculty member most appropriately evaluate a credential student's work in an SLDS?

LIGHTS, CAMERA, INTERACTION: PRESENTATION PROGRAMS and the INTERACTIVE VISUAL EXPERIENCE

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Most college students have grown up with television and video games either as an enrichment of their lives or as a babysitter. After having been exposed to a myriad of visual stimulation experiences throughout the years, many students are dependent upon seeing, or interacting when involved in various learning opportunities.

Teacher education courses are particularly fertile ground for visual experiential opportunities in the field of practice. The synthesis of theory and experiences through presentations employing not only words, but videos or other images illustrating concepts has the potential to hold the students' interest as well as stimulate energy.

I will describe in this paper how to use a computer presentation program to increase the liveliness of learning experiences through video, audio, and animations. Group process, a major component of teacher education will be the focus of the video.

A digitalized video vignette portraying a situation in which both the teacher and the students in the classroom try to draw the non-responsive student into a discussion will be used as the demonstration. The teachers in training will be asked to share their interpretations of the class's interaction on the video, and their comments will be categorized and prioritized in a manner that will help them both understand and be a part of the process. Encouragement of critical thinking, along with sharing ideas with their peers in the class, increases the possibilities for both extension of knowledge and experiential learning. Seeing how others draw conclusions in vivo is, in itself, a valuable group experience.

The slide show is set up in the following manner:

1. A short verbal description (approximately 3 slides) of the goals of the slide presentation. This includes animations and photos.
2. A slide with 40 seconds of digitalized video with a vignette illustrating the behavior of a student reluctant to participate in class and the response of the class to her.
3. A succession of slides that stimulate the discussion process by introducing various questions to encourage students' synthesis of the situation. Suggestions provided by students re: teacher and student intervention will be displayed on the slides, prioritized and integrated into the broader learning goals of the course.

In my experience, using presentation programs that illustrate specific points through videos or photos along with encouraging students to become part of the presentation process is most effective in increasing student interest, sharing ideas as a class, and integrating theory and practice.

To avoid the pitfalls of irrelevance or lack of participation of students, the points illustrated should be clear and concise. The video or other media must illustrate the class or student problem well and provide opportunities for creativity in interpretation and critical thinking. The instructor, of course, should be experienced and well prepared, and the students must be equipped to participate through reading or other assignments or experiences pertaining to the material to be demonstrated.

Although problems taping and digitizing material may prove a barrier in some institutions, creative solutions are often available through University Television, cable TV stations that are required to do public service, or "home made" video vignettes subsequently digitized through campus media services. It may not be as slick as some day time soaps, but live action examples coupled with student participation and problem solving has the potential to combine theory and practice in an interesting and energizing manner.

Web-based Simulations on Chemistry and Physics Lab Activities

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Abstract: This demonstration presents online simulations built with Macromedia Flash 5.0. The simulations provide interactive interface for undergraduate students to change variables of an online chemistry lab to test theories and phenomena that are not easy to observe or accomplish precisely in real world lab environment. The simulations seek to provide students with conceptual understanding of scientific phenomena. Another advantage of using the simulations is that the online accessibility of the simulations breaks the limit of different platforms in different computer operation systems. Therefore, students can access the simulations with browsers in whatever system they are using.

Introduction

When learning scientific theories, students may lack experience in the phenomena that scientific theories seek to explain. Traditional lectures and textbooks typically present abstract symbolic representations of scientific concepts or principles without providing sufficient experience with the phenomena associated with the scientific concept and principles. In addition, some of the phenomena that scientific theories seek to explain are difficult for students to experience. According to Paivio's (1971, 1986) dual coding theory, information encoded in both visual and verbal formats is better remembered than information which is encoded in only one of these two formats. Today's computer technology can provide dynamic graphics, visuals, and simulation experiences. They can help students relate abstract contents such as mass, velocity, and acceleration to real experiences. Animated visuals can also provide explicit demonstrations that are not easy to be observed simply by naked eyes.

Tools for development

Macromedia Flash 5.0 is a powerful tool in building web-based animations and interactive simulations. Using web-based simulations in learning breaks the limits of time, locations, and computer platforms. Students can explore the content with internet-ready computers without the restrictions of time, locations, and operation systems. The small file size of the Flash simulations also reduces the time for downloading. The program provides features for building graphics and making simple animations. With the feature that allow developers to program for the characters in the simulation, it gives space for developers to manipulate their creativity.

Content of The Simulations

This proposed demonstration includes two projects. One is a series of web-based simulations of Newtonian mechanics. Users can test their knowledge of Newton's laws of motion by changing any of the variables such as friction, mass, and the direction of gravity. This series of simulations seek to help students explore the context that is not easy for them to experience in their daily life. By exploring the motion in the simulated contexts that allow students to change the magnitude and direction of friction, gravity, and the mass of an object, students' alternative conception could be changed by the simulations. Therefore, they can build their scientific understanding of Newton's laws of motion. The other is a series of on-line chemistry lab simulations used in the introductory chemistry courses for the APL (Active Learning Package) project at Iowa State University. The chemistry simulations are used to provide college students a chance to

experience lab situations by changing the variables such as volume of solutions, mass of compounds, and molarity of solutions on the interface of the web pages. The accompanied animations of microscopic level chemical reactions are aimed to make chemical phenomena explicit and to help improve student understanding.

Objectives

My objectives of building the above simulations is to develop a package to further investigate the effect of using computer simulations and also to help students learn science. While demonstrating the simulations, I would like to share with educators and instructional designers how to effectively use web-based simulations in instruction. I also expect to receive feedback from people who are interested in using simulations and animations in education. With insightful feedback, I will be able to modify existing projects and develop future projects for further research with deeper considerations.

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A Qualitative Examination of Student Responses to Test Questions After Simulation Software Use

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Abstract: In this study, student explanations for their answer choices on a Physics post-test dealing with motion were examined. During the qualitative examination of the data two trends emerged. First, students often fail to identify all forces involved in a problem. Second, students often fail to comprehend that multiple forces may act simultaneously.

Introduction

It is frequently observed that learning to apply Newton's 1st Law is a difficult task for beginning Physics students (Mahoney, 1994; Wanderee, Mintzes, & Novak, 1994). Andre and others (Andre, Hasselhuhn, Kreiter, Baldwin, Leo, Miller, Mroch, Duschon, Werner, & Akpan, 2000) have conducted two studies to examine the use of simulation software in addressing this learning gap. The first study used a more exploratory version of the software. It was found in this study that males who used the simulation software before reading the text benefit more from its use than did females (Andre, et al. 2000). The second study used a more directive piece of software and evidence was obtained that indicated that both males and females benefited from its use. Qualitative data was gathered during the first study in the form of student explanations of their choice of answer on the post-test. The present study examines the qualitative data set not previously analyzed during the first study.

This study was conducted to extend previous research concerning the use of physics simulation software to teach Newton's 1st Law of Motion to beginning physics students (Andre, et al, 2000). As part of Andre et al's first study, students were asked to explain their answers to conceptual questions dealing with motion. This study explores the nature of the reasoning and conceptions of motion displayed in student explanations of their answers. Specifically, the nature of errors in conception or reasoning were explored

The Study

The design of this study was primarily qualitative in nature. In the original 1993 study students were asked to explain their answer selection on a 46 question, multiple-choice Physics test. These explanations were entered into a spreadsheet program and then coded using the following categories: Correct Response, Explained Answer, Diagram Used, Formula Stated, and Use of Newton's 1st Law. It was possible for a single answer to be coded in multiple categories.

Research questions examined during the initial qualitative evaluation were as follows.

1. Did students express the application of Newton's 1st Law in their explanations?
2. If so, did they apply this law correctly?
3. If Newton's 1st Law was not applied correctly to the problem what mistakes did the students make?

It should be noted at this point that the qualitative results are somewhat limited in scope due to several factors. First, the qualitative examination of the data was not conducted until some eight years after the initial study took place. This made it impossible to triangulate results by interviewing subjects for clarification. Second, many students did not provide explanations of their answer selection for every test question or did not

provide explanations that indicated in any manner their thought processes. Third, no information was available to the researcher that indicated the student's previous Physics experience. Fourth, as in any qualitative analysis the science/teaching/software design background of the researcher did guide the direction of the research questions being examined.

Discussion

Two significant trends emerged when examining the explanations of students who answered questions incorrectly. First, these students frequently failed to identify all of the forces involved in the problem. Second, many students misinterpreted Newton's 1st Law in such a manner that they believed one force stops as soon as another starts. The concept of multiple forces at work simultaneously was not attained. It should be noted that the use of multiple forces was not required by every question on the posttest; consequently, these two trends were not observed in every question.

The first trend is perhaps the most significant as it indicates that an average of 56% of students who incorrectly answered a test question, failed to identify all the forces involved in the problem. The following two student quotes were in response to a problem that involved a bullet being fired at a target. At the exact moment the bullet is fired the target is dropped. Students are asked if the bullet will hit the target.

- ... the power and speed of the bullet will travel mostly straight while the target falls
- The target is lowered and the bullet will still be going straight

In these examples the students have failed to identify the force of gravity as it is applied to the bullet. Both the bullet and the target will fall at the same rate, so the bullet will hit the target.

The tendency of students to fail to recognize multiple forces at work simultaneously can be illustrated by the examination of their responses to a problem that involves a ball being kicked off the edge of a cliff. Students are asked to describe the path that the ball will take as it falls. The following are three quotes from students that typify this error.

- It must travel out a little before gravity takes it over
- The ball goes straight for awhile from the force then gravity overcomes and pulls it down
- After its inertia is gone it will fall. Thus the straight line and then the angled fall

In these examples students fail to realize that gravity is affecting the ball simultaneously to the kick. Although this trend was only present in an average of 41% of incorrectly answered questions, the trend remains significant in teaching.

Implications

The strength of the trends that emerged from this study indicates weaknesses in both the simulation software used and the instructional setting of the software use. Although students are acquiring a sense of Newton's 1st Law they are not developing the ancillary skills necessary to consistently apply it correctly. The concepts of identifying forces and simultaneous forces need to be more explicitly addressed either in the software or during classroom instruction.

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Integrating Virtual Reality (VR) into Classroom Curriculum

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Abstract: This paper discusses the potential use of Virtual Reality (VR) integration into classroom curriculum. Utilizing VR has been difficult for many educators because of resource and financial limitations. Although VR has been in existence for many years, recent technological advances have impacted its practicality and usability in the classroom environment. This paper provides an overview of VR and specifically how VR can be integrated into classroom curriculum. In addition, several Internet sites located on the World Wide Web are discussed that show the potential of VR integration. Virtual reality can be an exciting addition into educational curriculum.

Introduction

The term Virtual Reality can be defined in many ways. VR can be identified as a completely immersive environment or a simple three-dimensional (3-D) animated object. The development cost may start at hundred's of dollars and reach into the million's. Dunning (1998) identified that the cost can vary from very expensive computer-assisted virtual environments (CAVEs) to VR technology that are viewed inexpensively on a personal computer. CAVE products were originally developed by the military and other governmental agencies to provide realistic training. The cost and resource requirements for CAVE products have the potential to easily reach into the hundred's of thousand's or even million's of dollars. In addition, the video gaming industry has been creating CAVEs and immersive VR environments that provide realistic environments. Development of the games produced by this industry is very expensive. Thousands and thousands of dollars are sometimes spent to produce the simple graphics required for some of these virtual scenes.

VR in Classroom Curriculum

Unfortunately, developers of classroom curriculum have found it difficult to create immersive educational environments due to production cost limitations (Dunning, 1998). Advancements in VR techniques have rapidly developed over the last few years. Recent technological advancements have made it affordable and practical to implement new technologies in the classroom (Rodriguez, 2001). New software packages have lessened the cost limitation and increased the usability.

Briggs (1996) identified that VR has several applications in the educational environment. He defined VR as a computer-generated, 3-D simulation in which a student can interact and have the feel of immersion in another environment. Using VR students are able to see distant galaxies or explore complexities of the anatomy. History students can explore ancient historical sites and take a virtual tour of a present day site that would be too expensive and time consuming to visit. English students could take a virtual tour of an ancient Shakespearean playhouse. The possibilities are truly endless.

By experiencing a virtual environment, the experience may be more engaging than simply reading a text or sitting in a classroom listening to an instructor. Students can learn by experiencing an immersive environment that has already been built or discovered. A student may be able to experience something in a virtual environment before dealing with a real life situation (Dunning, 1998).

Winn and Jackson (1999) developed several propositions about VR in educational environments. Some of these propositions are: (1) Virtual Environments (VEs) are less expensive than costly simulators, (2) VEs can be safer than some real-world environments, (3) VEs allow quasi-natural interaction with environments or objects, (4) VEs provide environments where students can learn, (5) VEs are very useful

when they simulate concepts that are normally not assessable to the senses, (6) when changes in 3-D perspectives increase learning VEs are very effective, (7) VEs support constructivist concepts (8) participants in VEs actually experience a sense of presence, (9) VEs allows for situating education in a real world context, and (10) collaboration in VEs are an available option. The above propositions are important when considering integrating VR into classroom curriculum.

Immersive Imaging Technologies in VR

One form of VR is the interactive photographic process, sometimes termed “immersive imaging”. It is photographic immersive imaging technology that allows the student the opportunity to manipulate photorealistic images. These developments are beneficial because they articulate three-dimensional photographic imagery instead of three-dimensional computer generated imagery. These images allow students to view and manipulate environments or objects from many viewpoints. The VR images can be viewed in a linear and non-linear manner (Trelease, Nieder, Dorup, & Hansen, 2000). By manipulating the image, with the cursor, one may rotate on object and pan in or out, up and down or left to right. Two types of immersive imaging are panorama and object movies (Comer, 1999).

Taking multiple photographs of an object develops object movies. These overlapping photographs of the object are blended together and process using a software package. By moving the cursor a student can manipulate an object and examine it from several different angles. A panoramic movie allows the student to view an environment from 360 degrees horizontally and 180 degrees vertically.

The equipment needed to develop object and panoramic movies can be relatively minimal and inexpensive. Almost any camera can be used to accomplish the photographs. One may use an inexpensive disposable single use camera or a very expensive digital still camera. A tripod with a leveling device, for a panoramic movie a panoramic head is very beneficial. A major item in VR development is of course the software package for gathering, blending, stitching, compressing, and exporting the object or panoramic movie. For object movies a backdrop should be used, such as a piece of black material to provide consistent background color. In addition, a turntable will be used to place an object on to take the pictures. The object will be rotated and photographed from different angles to develop the image. This would be accomplished by rotating the object 12 times every 30 degrees to obtain a 360-degree image. There are numerous companies that have developed expensive turntables, but a turntable such as a Lazy Susan will accomplish the task.

Authoring Tools in VR

Several new software packages are presently available to develop VR. Some of the more popular programs are: Picture Works Technology (Spin Panorama, Spin PhotoObject and VRTour); Live Picture’s Reality Studio (Photo Vista and Object Modeler); Enroute Imaging’s QuickStitch 360; and QuickTime VR (QTVR) Worx (Panoworx, ObjectWorx, and SceneWorx). QTVR Worx is a comprehensive software package developed for photorealistic visualization of environments or objects. QTVR, developed by Apple, was one of the first authoring VR tools on the market for use on a personal computer. And has developed a complete package that includes everything needed to integrate QTVR into classroom curriculum.

QTVR Worx has been in existence for several years but has recently developed an educators’ special edition that includes the VR Worx 2.0 and the VR Toolbox QTVR Curriculum. This edition is specifically designed for educators. This unified set of programs and curriculum includes student handbooks and a teacher’s manual. A workbook, included in the package, describes everything a classroom teacher needs to know to integrate virtual reality into the classroom curriculum.

Examples of Immersive Imaging

Several examples of panoramas and object VR movies can be examined on the World Wide Web. The QuickTime VR gallery provided several unique examples of VR movies (www.qtvr.com). An interesting site that simply shows how VR could be used to explore a facility is at the Harvard University <http://www.news.harvard.edu/tour/main.html>. The site has approximately 75 QTVR movies and takes the visitor on a virtual tour of the Harvard campus. Students can examine a wide variety of anatomy resources at Wright State University (www.anatomy.wright.edu/QTVR/QTVR_menu) to get a full grasp on basic

anatomy. Architecture students can tour a building or house to fully understand constructional considerations and to develop a comprehensive understand of the interior makeup of a structure (http://www.qtvr.com/qtvrshock/index2_2.html). In addition to these sites there are numerous web sites that can be accessed to enhance the tradition classroom curriculum.

Conclusion

Virtual reality, if used in an appropriate manner, can be a wonderful element to add to the traditional classroom curriculum. It is no longer an expensive technology tool that is monopolized by governmental, corporate, or business agencies. VR is a practical tool that can be integrated into education. VR in educational environments is, for the most part, still in its infancy. In the foreseeable future resource limitations, financial constraints, and apprehension about using VR should decrease and educators will eventual use VR on a larger scale. VR integration can be an exciting new addition to the classroom curriculum.

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Comparing Simulation-based Lesson Planning in Experienced and Preservice Teachers

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Abstract: First, the four major features of the most recent LP II lesson-planning simulation are described. Next, major variables obtained during participation are defined. Finally, initial findings derived from data generated by collaborating clusters of preservice and inservice cohorts are discussed. The results suggest that, across cohorts, variables cluster to produce a single factor defined by the complexity of participant navigational movement during lesson planning. Furthermore, experienced teachers achieved significantly higher scores on this factor than did their inexperienced counterparts. Regarding planning outcomes, the increased open-ended nature of the simulation experience appears to have yielded results best defined by the interaction among a variety of qualitative variables rather than by unitary values of specific qualitative variables.

Introduction

Over the past several years, an ongoing research project in preservice and inservice teacher education at the Curry School has focused on developing and testing the educational efficacy of software-based lesson-planning simulations (Strang & Clark, 2001; Strang, 2000; Howard & Strang, 2000). The purpose of the current study is to compare the decision-making processes and planning outcomes of experienced and preservice teachers as they complete the most recent LPII simulation. This tool allows participants to create lessons for motivated and unmotivated software-defined students. The results obtained from this study will not only contribute to lesson-planning pedagogy, but when provided to future participants during simulation debriefings, will stimulate personal involvement in group discussions and ultimately help the participants to improve their lesson-planning decision-making skills. After describing the LPII simulation's interactive features and the empirical measures derived from its use, this paper will describe a preliminary study designed to assess the simulation-generated lesson-planning patterns for motivated and unmotivated students exhibited by preservice and experienced teachers representing two levels of teaching.

The LPII Simulation

Interactive Features

Using common keyboard and mouse functions, from 10 to 30 participants, seated in front of PCs in a computer lab, typically engage in the lesson-planning simulation alone or cooperatively in small clusters. As described by Strang and Clark (2001), the LPII simulation experience involves a decision-making sequence defined by the following four-phases.

1. A grade level is selected and the genders of hypothetical high- and low-motivation students are determined.
2. A three-step sequence is completed that defines the content of the simulated lesson. This sequence includes defining the lesson subject (language arts, social sciences, mathematics, or science), selecting a subject area from three appropriate Standard of Learning (SOL) goals (Virginia Department of Education, 1999), and finally, selecting one of three specific lesson goals related to the selected SOL.
3. A series of decisions is made that defines the nature of the lesson activity for each of the two hypothetical students. This major planning phase involves deciding for each student the number of distinct

activities, and, then within each activity, what the student will do, with whom the student will work, what learning aids will be used, what level of thinking will be encouraged, and how long this activity will last. Throughout this phase, decisions may be communicated via options defined by the software or via options authored by the participants themselves. Also, during this phase, participants may include an explanatory note accompanying any recorded lesson-activity decision.

4. The lesson's instructional effectiveness is evaluated for the hypothetical students during the final phase. Any combination of seven software-defined and two participant-defined evaluation options can be used to define how each of the two hypothetical students' lesson-related learning is to be evaluated. This phase also includes the preceding phase's note-taking option.

Navigation within the simulation is extremely flexible. After the high- and low-motivation students are defined, participants can quickly access previously completed phase screens to review and/or edit decisions and then quickly return to the current screen. Navigation within each of the phases also provides maximum flexibility.

Empirical Measures

Two types of variables are generated by participant keyboard and mouse activity during the lesson planning.

1. Process variables. Measures in this category focus on how participants plan the lessons for each of the two students. Specific variables include the length of time devoted to planning the lesson, the number of decision reviews and changes, the frequency of creative participant authoring, and, the frequency and length of participant note taking.

2. Outcome variables. Measures in this category focus on the results of participant planning for each of the two students. Specific variables include the length of student lessons, the number of lesson activities, the opportunity for independent student work, the cognitive demands placed on the student, the technology support integrated into the lesson, and the number of different forms of evaluation employed at the end of the lesson.

The Current Study

Samples of preservice and inservice teachers representing two grade level categories (grades 1-5 and grades 6-12) were drawn from students enrolled in both on-grounds and off-grounds teacher-education courses offered by Curry faculty members. All participants completed the simulation in collaborating dusters of from two to four teachers who, just prior to participating, had self-selectively formed clusters based on teaching level and teaching discipline. The cluster count for preservice and inservice teachers was 54 and 23, respectively.

The goal of the current study was to explore how the preservice and inservice teachers at each of the grade level spans planned lessons for their motivated and unmotivated pupils. A two-step analysis plan was implemented. First, two principal components factor analyses with varimax rotations were performed to ascertain the degree to which the six process and six outcome variables constituted mathematically as well as conceptually distinct factors for motivated and for unmotivated students. Next, a second level of analysis was performed to ascertain the influence of teaching experience, teaching level, and student motivation level on the mathematically defined factor scores. To achieve this outcome, factor scores were submitted to the appropriate number of 2(teaching experience) X 2(grade level category) X 2(pupil motivation level) ANOVAs.

Results

Mathematical Factor Validation

Neither of the two principal components factor analyses yielded viable two-factor solutions. Inspection of both numerical factor loadings and graphical scree plots suggested single-factor solutions. Factor structure

replication across the high-motivation and low-motivation data was assessed via the coefficient of congruence statistic (Gorsuch, 1974, pp. 253-254). The resulting coefficient of 0.924 further attested to the validity of the one-factor interpretation. Table 1 displays the factor loadings for the six process and six outcome variables for motivated and for unmotivated students, respectively.

	Factor Loadings	
	High-motivation Student	Low-motivation Student
Process Variables		
Total lesson-planning time	.83	.83
Number of lesson/evaluation reviews	.51	.53
Number of decision changes	.79	.62
Number of authoring entries	.58	.66
Number of notes	.73	.58
Average note length	.33	.57
Outcome Variables		
Lesson time	.45	.41
Number of lesson activities	.60	.33
% time student worked alone	-.05	.14
% time student created/judged	-.11	.39
% time computer was used	-.02	-.01
Number of different evaluators	.02	-.07

Table 1: Factor Loadings for the Six Process and the Six Outcome Variables

An inspection of the loadings revealed that the single factor was primarily defined by complexity of participants' navigational movements during their lesson planning. The most prominent variable was participant completion time, a measure that embraced the reviewing of previous decisions, the changing of previous decisions, the authoring of personal options, and the inclusion of personal notes variables. Interestingly, the results of the navigational complexity seemed also to yield student lessons that were longer and more likely to include more activities.

ANOVA Results

The results of the split-plot ANOVA applied to the factor scores yielded one significant main effect and no significant interaction effects. Experienced teachers scored significantly higher on the navigational complexity factor ($F(1,73) = 6.75, p = .011$). Neither the teaching level main effect ($F(1,73) = .204, p = .653$) nor the pupil motivation level main effect ($F(1,73) = .200, p = .656$) approached significance.

Conclusions and Implications

Two important observations can be drawn from the findings of the present study. First and most clearly, the quantitative variables generated during participants' completion of the simulation collectively define a dimension anchored on one end by fast, linear planning movements, and on the other end, by slow, nonlinear planning movement. Furthermore, the ANOVA results suggest that teaching expertise is a major definer of a participant's movement pattern. It appears that with their rich collective histories of professional classroom instruction, experienced teachers, in collaborating clusters, were able to use the simulation's movement and authoring freedom to create more complex and perhaps more integrated and more individualized lessons for their simulated students than were their preservice counterparts. Of course, support for the later two planning outcome assumptions requires validation via a qualitative analysis of the records of individual participant clusters. To further support the necessity for such analyses, let's briefly review the second important observation linked to the findings.

No meaningful outcome factor emerged from either of the factor analyses. A comparison of the key attributes of the current simulation and its predecessors may help to explain why a clear lesson-planning outcome factor structure, found in earlier simulation results (e.g., Strang, 1998), did not appear in the current LPII simulation findings. The present simulation was deliberately constructed to offer participants more opportunities both to navigate option screens freely and to do more than point and click when they made planning decisions within these screens. It is apparent that the increased freedom offered in the LPII has yielded a powerful quantitatively defined navigation factor. But variability attributable to an increased number of lesson-planning options, coupled with the opportunity to circumvent preprogrammed options with personally authored alternatives, has yielded lesson-planning outcomes that are highly individualized yet fail to fit clear factor structures. Of course further qualitative analyses of the current data and both quantitative and qualitative analyses of future participant datasets must be performed both to validate the current results and to define more completely the importance of the navigation and outcome variables.

A confirmation of the current findings will result in several practical changes in the LPII simulation's use in teacher training, particularly relating to the content and procedures that define the group-debriefing sessions that follow the creation of the lesson plans. Content shifts may include changing the Compare Profile. This printout, which presently allows participants to compare quantitatively their individual (or cluster) navigation and planning decisions with group averages, may be redesigned to present solely quantitative information on navigation patterns. Two additional post-training feedback instruments may be employed to provide participants the opportunity to compare their individual (or cluster) planning decisions with those of classmates or mentors (e.g., experienced teachers). The Event Record presents a decision-by-decision printout with an accompanying timeline, and the Lesson Plan printout creates an integrated picture of content, activity, and evaluation decisions with accompanying self-authored options and notes.

Procedurally, the debriefing session may be reframed to focus on the sharing of planning decisions via group discussions or one-on-one dialogue exchanges. Such a debriefing restructuring redirects the activity's focus from an information-providing session to one that promotes dialogue exchange tied to personal planning commitments. Finally, with its emphasis on exploration and discovery and de-emphasis on specific pedagogical absolutes, the restructured debriefing will offer more universal appeal as a dialogue tool in teacher education methods courses.

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Nurturing Reflective Teaching in a Computer Simulation Program: An Investigation of Intervention Effects

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Abstract: Nurturing reflective teaching and improving critical-thinking instruction are achievable only when teachers-in-training are provided with opportunities to build professional knowledge and practice reflective teaching skills. The CSTGCTS computer simulation was developed to provide such opportunities. A pretest-posttest control group design was defined by four preservice teacher groups and two treatments. The findings suggest that the employed treatments contributed to reflective teaching and helped enhance professional knowledge and teacher behaviors on the part of preservice teachers during the teaching of critical thinking.

Introduction

Many recent studies have addressed the importance of nurturing reflective teaching in teacher education (Rodriguez & Sjoström, 1998; Abell, et al., 1998). Recently, the principal author developed the Computer Simulation for Teaching General Critical Thinking Skills (CS-TGCTS) program, a software tool designed not only to cultivate reflective teaching in participants, but also to bring about improvements in their effectiveness in the teaching of critical thinking.

Definitions of reflective teaching suggest that performance with regard to professional knowledge and teacher behaviors are two indices for understanding a preservice teacher's degree of reflective thought in his or her teaching practices (Abell, et al., 1998). Two types of knowledge and three categories of teacher behaviors were identified and incorporated in the CSTGCTS program. Knowledge was divided into content knowledge and pedagogical content knowledge of critical thinking while teacher behaviors were classified into those that contribute to enhancing students' prior knowledge, their critical-thinking dispositions, and thirdly, their critical-thinking skills. Moreover, since increasing self-awareness and provoking mindful learning are crucial for breeding reflective teaching (Collier, 1998), interventions designed to improve these two mechanisms were central in the CSTGCTS program. With the focus on nurturing reflective teaching, this study tested the following hypothesis: Providing immediate feedback concerning teacher behaviors as well as literature related to professional knowledge would increase self-awareness of teacher behaviors and increase mindful learning in professional knowledge, which in turn, would provoke reflection in teaching practices, and, further, result in improved teacher behaviors.

Method and Results

Participants were 50 male and 99 female preservice teachers enrolled in a two-year teacher program at National Sun Yat-sen University, Taiwan. The interactive experience was achieved via the CS-TGCTS's two serial simulations, each of which takes about two hours to complete. The software also provided records of professional knowledge and teacher behaviors that denote critical thinking. Professional knowledge was measured by the *Questionnaire of Professional Knowledge for Critical-thinking Instruction* (Yeh, 1999), whereas teacher behaviors were measured by teachers' actual usage of 12 teacher behaviors in the CS-TGCTS program.

The study employed a pretest-posttest control group design. Participants were randomly assigned to one of the three experimental groups or to a control group. Two treatments were employed. Treatment I included five text files of research-based literature concerning professional knowledge for teaching critical thinking; Treatment II included a bar chart which indicated the usage rate of twelve teaching behaviors during the first simulation. The treatments were administered at the completion of the first simulation. Group A (the control group) received neither of the treatments; Group B received only Treatment I; Group C received only Treatment II; and Group D received both treatments.

The first MANCOVA yielded a significant group effect for professional knowledge, Wilks' $\lambda = .88$, p

< .01. The ANCOVA results also indicated a significant group effect for content knowledge, $F(3, 143) = 4.10$, $p < .01$, but not for pedagogical content knowledge, $F(3, 143) = .38$, *ns*. Comparisons of the least-square means revealed that participants in Group B and Group D, who received the treatment of professional knowledge, acquired more content knowledge than did the control group, $p < .05$.

The second MANCOVA yielded a significant group effect on teacher behaviors, Wilks' $\lambda = .82$, $p < .001$. Follow-up ANCOVAs, similarly, showed significant group effects for all aspects of teacher behaviors, $p < .01$. Comparisons of the least-square means revealed that Group D outperformed the other groups on teaching behaviors for increasing prior knowledge ($p < .05$); Group C and Group D outperformed the control group, and Group D outperformed Group B on teacher behaviors for enhancing critical-thinking dispositions ($p < .05$); Group C and Group D outperformed the control group on teacher behaviors for improving critical-thinking skills ($p < .01$). Moreover, based on the total mean scores on the posttest, Group D outperformed the other groups, $p < .001$. The mean scores for the four groups were 48.77, 53.59, 56.50, and 60.99, respectively. Group D, which received both types of treatments, achieved the greatest improvement in teacher behaviors among the four groups.

Discussion and Conclusions

The hypothesis proposed in this study was fully supported. More specifically, the data confirm that preservice teachers who received interventions for increasing self-awareness and mindful learning benefited the most from the computer-simulated training: their teacher behaviors improved significantly, and they outperformed their counterparts in the control group on all teacher behavior measures. These findings also support earlier conclusions that appropriate feedback increases self-awareness (Yeh, 1999); mindfulness and self-awareness contribute to nurturing reflective practice (Titone et al, 1998); and reflective teaching requires background knowledge (Rodriguez & Sjoström, 1998).

The data also show that computer-simulated training leads to greater improvements in preservice teachers' content knowledge than pedagogical content knowledge. The insignificant improvement in pedagogical content knowledge most likely reflects the fact that this type of knowledge addresses a much broader scope of understanding than simple content knowledge—a scope that involves teachers' responses to students with differing needs in a specific domain. An alternative explanation is that the CSTGCTS's instructional components focus more on the acquisition of content knowledge than on pedagogical content knowledge.

In conclusion, nurturing reflective teaching is crucial to successful teacher education. The ultimate goal of emphasizing reflective teaching is to help the preservice teachers gain a deeper understanding of their teaching practices so that they can improve them. The findings provide evidence that the CS-TGCTS simulation is an effective tool for improving preservice teachers' reflective teaching in critical-thinking instruction. Finally, the simulation's educational benefits are strongly related to its capacity to improve professional knowledge coupled with its capability to provide an analytical yet supportive environment for practicing teaching skills.

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