7-1-2009

MUVEs and Experiential Learning: Some Examples

Baba Kofi Weusijana

Vanessa Svihla

Drue Gawel

John Bansford

Follow this and additional works at: https://nsuworks.nova.edu/innovate

Part of the Education Commons

This Article has supplementary content. View the full record on NSUWorks here:
https://nsuworks.nova.edu/innovate/vol5/iss5/4

MUVEs and Experiential Learning: Some Examples

All exhibits, tables and figures that have remained available have been included as additional content with their respective articles to be downloaded separately. Click here to return to the article page on NSUWorks and view the supplemental files.

Unfortunately, not all the supplemental files have survived until 2015 and some will be missing from the article pages. If you are an author in Innovate and would like to have your supplemental content included, please email the NSUWorks repository administrator at nsuworks@nova.edu.

MUVEs and Experiential Learning: Some Examples

by Baba Kofi Weusijana, Vanessa Svihla, Drue Gawel, and John Bransford

Digitally based courses and their online delivery are rapidly expanding access to learning opportunities (Duffy and Kirkley 2004; NRC 2000; Visser and Visser-Valfrey 2008). It is important to ask however: access to what kind of learning opportunities? Weigel (2000) argues that most current attempts to create online learning environments suffer from a "port the classroom to the Web" model. Researchers have noted a similar phenomenon in multiuser virtual environments (MUVEs):

Look, for example, at the pioneering work taking place in . . . MUVEs such as Second Life. You'll see some beautifully rendered virtual buildings and even campuses, quite like regular classrooms and universities. You'll see student-created avatars attending classes and learning from their teachers, asking questions and interacting. . . . But essentially, these virtual classroom experiences are close imitations of familiar 'first life' classroom experiences. (Bransford et al. 2008, 39)

To some extent, this tendency is driven by common expectations about what education should look like; educators writing on the Second Life EDucators (SLED) listserv note that their students, administrators, and funders *expect* education to look a certain way—namely, teachers presenting information to students (Bransford et al. 2008). These expectations constrain the degree to which educators can innovate.

Some researchers have described attempts to use MUVE environments to go beyond typical models of instruction (e.g., Barab et al. 2007; Nelson et al. 2005). We are particularly interested by the potential of MUVEs to help students connect knowledge by description to knowledge by experience; in a MUVE, students can experience phenomena rather than only reading about them. To facilitate these kinds of connections, we constructed a maze in Second Life (SL) that allowed students in a class on learning theories to experience a key phenomenon, the aha effect, that plays a role in a number of concepts in educational psychology. We introduced students to the maze by having them watch others traverse it; we then encouraged them to navigate the maze themselves without explaining the underlying principles governing the maze's navigation. The procedural learning that students engaged in when they first navigated the maze solely on their observations set the stage for them to experience the reorganization of knowledge that characterizes the aha effect when they were given a clue to the underlying structure of the maze. Thus, our MUVE maze let students reliably experience key phenomena described by the theories they were studying.

The SL Environment

Because creating experiential learning opportunities is no easy task, students usually read about studies without experiencing the effects for themselves. We wanted to allow students to experience the benefits of the aha effect (Bransford and Johnson 1973; Auble, Franks, and Soraci 1979; Bransford and Stein 1993; Wills et al. 2000; Luo, Niki, and Phillips 2004; Mai et al. 2004) and to be able to connect their experience in the MUVE with a number of theoretical works and classic studies in learning theory, including behaviorism (Exhibit 1), functional fixity (Exhibit 2), positive and negative transfer (Exhibit 3), learning with understanding (Exhibit 4), and adaptive expertise (Exhibit 5) among others.

The major purpose of our SL environment was to allow students to experience a phenomenon—the rapid changes in conceptual understanding that characterize the aha effect—that is central to many classic studies

of learning. The environment was a virtual maze consisting of eight interconnected rooms; in each room, the task was to find a way to open the door to the next room. Moving from one room to another required a specific set of behaviors that was indicated by clues present in the room. Traversing the maze required students to solve problems conceptually similar to those presented by Thorndike's (1913) puzzle boxes for cats (he saw no evidence of "aha" in cats) and in other key studies of rewards, learning, and transfer. There was a partial overlap in clues across different rooms to guide behavior. Getting through rooms one and two required pushing a red square among a set of four colored buttons; in rooms three and four, the correct button was a blue square; in rooms five and six, pressing any button resulted in a virtual shock that stunned the avatar for several seconds. Participants could avoid the shock by using a wooden stick lying on the floor to press the buttons. Other artifacts in the rooms included a chair, rope, pictures, and temperature and humidity gauges.

The maze could be navigated in a fairly obvious way, relying on procedural knowledge acquired through trial-and-error learning. However, there was also a deep structure to the maze that once discovered explained why particular behaviors were effective in particular rooms and allowed the user to perform flexibly rather than simply following the surface rules.

Preliminary Studies

To explore the effectiveness of the maze at creating the effect we sought, we conducted two exploratory studies to test students' reactions to the maze followed by an experiment involving a full class.

Study I: Exploratory Case Study

Study I, originally presented in Gawel et al. (2007), involved an education graduate student with a well-honed set of concept mapping skills that allowed her to provide diagrams of her conceptualizations. She was told to complete the maze as quickly as possible and that she was competing against others. She was shown a video of two individual avatars going through the maze (Exhibit 6) and told to watch for clues to how to navigate the maze. The student then navigated her own avatar through the maze.

After she finished, one of us told her that there were faster ways to complete the maze. We asked her to use concept maps to represent her current conceptions of the maze and how to get through it. We saw this as an opportunity to coordinate her visual representations with her oral descriptions of her experiences. She produced an initial map in which room numbers provided the structure for organizing her understanding (Figure 1). After drawing the initial map, the student returned to the maze and began what she believed was an exhaustive exploration of all possible variables. For example, she tried pushing different combinations of buttons, she clicked on pictures on the wall—including the gauges for temperature and humidity—and she clicked on a rope lying on the floor. Her exploration led her to discover that she did not need to use a stick to avoid being stunned in the last two rooms. In a second and more complex concept map (Figure 2), the student included the key conditions of the rooms (temperature and humidity) but did not indicate that they were consequentially related to the behavior of objects in the room. At this point, the student had tried all the combinations of buttons and she had touched every object. She felt that she had exhausted all possibilities. The discovery that she did not need to use the stick to open the last two doors without being stunned gave her confidence that she had found something unexpected and that her inquiry was complete.

We then asked her to consider what might happen to wooden doors under high-temperature and high-humidity conditions. The effect on the student was noticeable; her eyes widened and she put her hands to her head in surprise. She then repeated her search through the maze and described the gestalt-like changes in her thinking (Exhibit 7). Her reference here was to classic gestalt theory that, unlike the theories of connectionists such as Thorndike, emphasized the importance of sudden reorganizations of complex

information into new forms (Wertheimer and Wertheimer 1959). The student then created a new concept map that reflected this reorganization in her thinking; this new map showed three types of rooms based on humidity and temperature conditions and the effects conferred by these conditions. Whereas before they had no functionality, temperature and humidity played a consequential role in this final representation ([Figure 3]).

The student experienced a variety of aha moments in the maze, first about the last two doors that opened without a shock when no stick was used, later after receiving a hint that humidity mattered, and finally when discovering the doors in the last two rooms could be opened by touching them directly. Further discussions with the student also revealed that she could see an advantage to her new level of understanding. If the experiment had been continued by randomizing the order of all eight rooms and taking away all the room numbers, she felt prepared to progress through such a maze in record time.

Study II: A Partial Replication and Extension

Based on the initial study, we designed a larger study involving four math and science education graduate students who worked individually and followed the same procedures used by the student in Study I. However, since these students did not use concept maps as part of their daily practice, we did not ask them to map their changes in understanding the maze. Their searches and comments were captured via audio and video. Once the participants were invited to engage in inquiry, their searches were quite systematic, but not all participants were as thorough as the student in the first study. Nevertheless, none of them ever tried to open a door in any of the rooms simply by touching it. Every student needed a hint to recognize the relationship between the wooden doors, humidity levels, and being stunned. All who mentioned changing their understanding with regard to the wood/humidity relationship described the change as abrupt as opposed to gradual, indicative of the aha effect.

After the MUVE experiences were over, the participants were asked to relate their experience to educational practice. These interactions were audio recorded, and the resulting transcripts were qualitatively analyzed; a detailed analysis has been published elsewhere (Weusijana et al. 2007). All participants were able to make a meaningful connection to educational practice, including problems with jumping right into a learning process, for instance, by imitating the actions of other avatars rather than exploring other options and the trade-offs between efficiency and exploration modes.

The MUVE Experience in the Classroom

The preliminary findings satisfied us that the phenomena of the aha effect was invoked reliably enough for us to use the SL maze in a class on learning. We introduced the experience in a teacher preparation course for 38 masters of education students in the fall quarter of 2007. All were first-year graduate students taking a required introductory class on human learning and education practice, including technology practices. The maze was used to introduce the students to MUVEs and to allow them to experience phenomena described in class readings—especially functional fixedness and aha effects and their relationship to adaptive expertise (Hatano and Inagaki 1986).

It was not convenient for each student to use a computer, and we did not want to use class time to have each student learn how to make and control an avatar. Therefore, we modified the learn-by-watching and inquiry parts of the experiment. On a large screen from a single classroom computer, we projected a video of three avatars consecutively finding their way through the maze. After watching the video, individual students traversed the maze by giving directions to a teaching assistant using a live version of the MUVE on the large screen; the assistant controlled the avatar according to each student's verbal commands. After these individuals successfully completed the maze, the entire class was told that there was a quicker way to get through the maze. Students worked in small groups to generate ideas that they wanted to explore in the live maze. For example, some wanted to push all four buttons in a room to see if doing so would cause

something magical, like the opening all of the doors in all the other rooms, that would allow them to walk through the rest of the maze instantaneously. Student groups checked their conjectures by asking the teaching assistant to try them out with his avatar.

Students were very engaged in hypothesis generation and testing, and they generated a number of creative hypotheses, including exploring whether they could simply fly over the maze. The avatar was indeed able to do this, but students concluded that flying was out of bounds since the contest required traveling *through* the maze. Another innovative thought was to have the first avatar in the group of three use the rope or chair to prop open the doors, which would allow the other two avatars to get through very quickly. Interestingly, the designers of the maze had never thought about this option.

Just like in other earlier experiments, none of the groups in the class tried to touch any of the doors directly. After several rounds of observing the students' conjectures, the instructor told the assistant to move the avatar to the last room and touch the door. When the door opened, the gasps of surprise from the class were clearly audible (Exhibit 8). Class discussions following the MUVE experience and readings were very animated, convincing us to use more MUVE experiences in future courses.

We also gathered evidence that the students were able to associate their experiences in the maze to educational psychology theories studied in the class. When asked in a questionnaire if they found the law of effects theory (Thorndike 1913) or the routine and adaptive expertise theories (Hatano and Inagaki 1986) relevant to their MUVE experiences, most students responded positively, more so in the first case than the second. For the law of effects, 88% of the students were able to see the relevance of the connection. The ability to relate the experience to Hatano and Inagaki's adaptive versus routine expertise was a bit more challenging—only 63% of the students felt confident in making that link. This was not unexpected. Learners often need opportunities for action, feedback, and revision in order to work optimally (NRC 2000; Black and William 1998). In any case, the MUVE experience clearly gave students a personal experience on which to build understanding of the theoretical concepts discussed in the class.

Conclusion

Because students in our study were able to associate their MUVE experiences to course-relevant concepts, we believe that classroom practice can be enhanced with the use of MUVEs. MUVE experiences can provide opportunities for teachers to observe and assess students' understanding of concepts based on their performance. The experience may then be the subject of reflective writing and discussion, allowing more opportunities to assess student learning. In the context of theoretical or abstract concepts, like those covered in the courses we teach, a virtual environment can provide a more reliable and instructive learning experience than may be available in a real-life context.

The procedures we used to introduce the MUVE experience to an entire class also indicate that MUVEs can be powerful learning tools even when only a single computer is available in the classroom and where students are novice users of MUVEs. One part of the approach is to film enactments of scenarios by avatars that have been created by educators or students and recorded for later use in class. We followed the movie by permitting students to engage in active exploration by having an assistant control an avatar according to verbal directions from the students. We have now successfully used this arrangement in a number of classrooms. Without it, we would have been unable able to introduce students to MUVEs and some of the rich sets of experiences that they can afford.

It may be possible to adapt our approach to use a movie of a MUVE experience without providing access to the MUVE itself. While using only movies precludes the interactivity of a true MUVE experience, such an approach may be useful if access to computers or the substantial Internet bandwidth required for many MUVEs is scarce. This approach could also serve a different function, perhaps as an engaging presentation to launch a unit or as a demonstration of a key concept. Although this was not our specific focus here, there

is much potential for supplementing teaching with such movies as they allow affordable access to some of the tremendous possibilities of MUVEs.

Our experiments helped us realize that there are affordances available in everyday environments that are missing in MUVEs. For example, the ability to feel temperature and humidity as physical phenomena may have helped students to perceive the underlying structure of the maze without the need for prompts. In our experience, pointing this out is a powerful way to help people realize the importance of direct perception in our everyday lives. It is also a consideration for MUVE design; many kinds of perceptions may still have to remain symbolic in MUVEs, but perhaps there are visual and other ways to make these factors increasingly clear.

We have shared our MUVE videos and findings in the hope of helping researchers in teaching and learning build a suite of simple but powerful MUVE learning environments that can be shared to allow interactive inquiry. Ultimately, one might imagine a collaborative collection of MUVE resources that can be used in a variety of settings. One use is to allow students, teachers, and researchers to experience and then read about phenomena rather than only read about them without ever having experienced them. Another use is to share resources that make it possible to conduct additional research on MUVE-enabled experiences in order to explore more deeply their learning and motivational effects. We suggest that educators take advantage of ways to share such resources (using services such as YouTube and Salamander/MERLOT). Having others use materials or environments for additional experiments or reprogram them in ways that provide even more compelling learning experiences could be a great help for the field.

References

Auble, P. M., J. J. Franks, and S. A. Soraci, Jr. 1979. Effort toward comprehension: Elaboration of "aha!"? *Memory and Cognition* 7:426-434.

Barab, S., B. Scott, A. Ingram-Goble, R. Goldstone, S. Zuiker, and S. Warren. 2007. Situative embodiment as a curricular scaffold: Using videogames to support science education. Paper presented at the annual meeting of the American Education Research Association, Chicago, IL, April.

Black, P., and D. William. 1998. Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan* 80 (2): 139-148. http://www.pdkintl.org/kappan/kbla9810.htm (accessed December 26, 2008). Archived at http://www.webcitation.org/5XrOWYjPn.

Bransford, J. D., and M. K. Johnson. 1973. Considerations of some problems of comprehension. In *Visual information processing*, ed. W. G. Chase, 383-438. New York: Academic Press.

Bransford, J. D., M. Slowinski, N. Vye, and S. Mosborg. 2008. The learning sciences, technology and designs for educational systems: Some thoughts about change. In *Learners in a changing learning landscape: Reflections from a dialogue on new roles and expectations*, eds. J. Visser and M. Visser-Valfrey, 37-67. Dordrecht, The Netherlands: Springer.

Bransford, J. D., and B. S. Stein. 1993. *The ideal problem solver* (2nd Ed). New York: W. H. Freeman.

Duffy, T. M., and J. R. Kirkley. 2004. *Learner-centered theory and practice in distance education: Cases from higher education*. Mahwah, NJ: Lawrence Erlbaum.

Gawel, D., V. Svihla, B. K. A. Weusijana, and J. D. Bransford. 2007. Exploring adaptive expertise virtual environments: Blending and flipping. Poster presented at the annual meeting of the American Education Research Association, Chicago, IL, April. http://life-slc.org/wp-content/up/2007/05/AESLver6.1.pdf (accessed December 24, 2008). Archived at http://www.webcitation.org/5dJoAZxMc.

Hatano, G., and K. Inagaki. 1986. Two courses of expertise. In *Child development and education in Japan,* eds. H. Stevenson, J. Azuma, and K. Hakuta, 262–272. New York: W. H. Freeman.

Luo, J., K. Niki, and S. Phillips. 2004. Neural correlates of the "Aha! reaction." *NeuroReport* 15 (13): 2013.

Mai, X.-Q., J. Luo, J. H. Wu, and Y. J. Luo. 2004. "Aha!" effects in a guessing riddle task: An event-related potential study. *Human Brain Mapping* 22 (4): 261-270.

National Research Council (NRC). 2000. *How people learn: Brain, mind, experience, and school.* Expanded ed. Eds. J. D. Bransford, A. L. Brown, and R. R. Cocking. Washington, DC: National Academy Press. http://books.nap.edu/openbook.php?record_id=9853 (accessed December 26, 2008).

Nelson, B., D. J. Ketelhut, J. Clarke, C. Bowman, and C. Dede. 2005. Design-based research strategies for developing a scientific inquiry curriculum in a multi-user virtual environment. *Educational Technology* 45 (1): 21-27.

Thorndike, E. L. 1913. *Educational psychology.* The psychology of learning, vol. 2. New York: Teachers College, Columbia University.

Visser, J., and M. Visser-Valfrey. 2008. *Learners in a changing learning landscape: Reflections from a dialogue on new roles and expectations.* Lifelong learning book series 12. Dordrecht, The Netherlands: Springer.

Weigel, V. 2000. E-learning: The tradeoff between richness and reach in higher education. *Change* 33 (5): 10-15.

Wertheimer, M., and M. Wertheimer. 1959. *Productive thinking.* New York: Harper and Brothers.

Weusijana, B. K. A., D. J. Gawel, V. Svihla, and J. D. Bransford. 2007. Learning about adaptive expertise in a multi-user virtual environment. Paper presented at the Second Life Community Convention, Education Track, Chicago, IL, April. http://www.simteach.com/slccedu07proceedings.pdf (accessed December 24, 2008). Archived at http://www.webcitation.org/5dJnmYZKs.

Wills, T. W., S. A. Soraci, R. A. Chechile, and H. A. Taylor. 2000. "Aha" effects in the generation of pictures. *Memory & Cognition* 28 (6): 939-948. http://www.psychonomic.org/search/view.cgi?id=2839 (accessed March 13, 2009). Archived at http://www.webcitation.org/5fFryGd5M.