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Immersive, Interactive, Web-enabled Computer Simulation as a Trigger for Learning: The Next Generation of Problem-based Learning in Educational Leadership

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This paper describes the use of advanced computer technology in an innovative educational leadership program. This program integrates full-motion video scenarios that simulate the leadership challenges typically faced by principals over the course of a full school year. These scenarios require decisions that are then coupled to consequences and scored in the background to create a profile of learner strengths and needs. Because the content has been filmed in an operating school and because of the unique choice-consequence sequences, the immersive and interactive simulation triggers more potent learning than is possible with either previous paper-and-pencil or discussion-based techniques. The scenarios are embedded in a Web-enabled framework that facilitates the provision of individualized feedback tailored to the specific choices made by the learner, and supports the collection of multiple metrics that relate to the performance of the learner and the learning framework itself. Project Authentic Learning for Leaders (ALL) demonstrates the future of teaching and learning in either hybrid (face-to-face instruction plus digital teaching and learning) or in individual anywhere, anytime learning.

> *Similar to the economic recession, there are always opportunities if we are willing to seize them. The key is do we have the "will" to recognize the need for change in the field and make the necessary shifts in our thinking and habits? The time for change is not when your back is against the wall, but rather when you don't have to change to survive. (Shoho, 2011, p. 3)*

The quote above is from Alan Shoho's presidential address at the 2010 annual conference of the University Council on Educational Administration (UCEA). The address was titled "Rise? Or Demise?" and served as a call to the educational leadership professoriate about their potential demise. Christensen and his colleagues have addressed the possible demise of schooling as we know it at the K-12 level (Christensen, Horn, & Johnson, 2008), and more recently at the college level (Christensen, Horn, Caldera, & Soares, 2011) through the lens of the theory of disruptive innovation. This theory describes processes

> by which a sector that has previously served only a limited few because its products and services were complicated, expensive, and inaccessible, is transformed into one whose products and services are simple, affordable, and convenient and serves many no matter their wealth or expertise. (Christensen et al., 2011, p. 2)

In other words, the sector is disrupted when the sector leaders focus too much on sustaining innovations (making small adjustments to existing products and services) and, thereby, "unwittingly open the door to entrants that can offer simpler, more convenient and lower-cost products to those customers who have no need to keep up with the accelerated pace of innovative change" (Innosight, 2005, p. 1).

Higher education possesses the characteristics of a sector ripe for disruption: historically complicated by burdensome admission requirements and pre-requisites, labor-intensive, expensive, unaccountable, and inaccessible to the large segments of the population. University-based colleges of education, and especially their school leadership preparation programs, are, in fact, facing a set of disruptive forces. Hawley (2010) lists a few. For one, the "performance pay" systems being tested and implemented in school districts across the country decrease incentives for educators to take university-based courses to earn salary bumps. Also, in tight budget times, local education agencies are decreasing and even eliminating subsidies for graduate course work for employees. Finally, alternative licensure programs are proliferating, and programs like New Leaders for New Schools threaten the existence of university-based preparation programs.

Hawley (2010) notably excluded distance learning, especially how the growth of online learning is impacting traditional university-based preparation programs. Baker, Orr, and Young (2007) documented the change in the landscape of master's programs in educational leadership between 1990 and 2005. They demonstrated how the creation of master's degrees in educational leadership mushroomed over that time period, led by the growth of programs like Nova Southeastern University, a fully online program. Nova Southeastern did not even have a program in 1990, but by 2005, they were producing the second highest number of graduates with master's degrees in educational leadership in the United States. At the doctoral level, by 2005, the two largest doctoral granting institutions for educational leadership were Nova Southeastern and Argosy University – Sarasota, both online.

There is nothing inherently wrong with distance learning, and the forces about which Hawley (2010) wrote are not negative per se. In fact, the growth in distance learning naturally begs a series of questions about the affordances of technology. As Shoho stated in the opening quote, there are always opportunities if we are willing to seize them. In that vein, Christensen et al. (2011) suggested that university administrators should consider "next-generation learning models…such as competency-based learning with actionable assessments, [and] not just make the traditional model of education more convenient" (p. 5).

Competency-based learning has been greatly facilitated by the affordances of the digital age. In particular, digital technology has facilitated the implementation of simulated learning environments. Of course, learning through simulations is not novel. In 1932, John Dewey wrote, "We practically never teach anything by direct instruction but rather, by the creation of settings" (p. 1032). Apprenticeships and internships were the only "settings" Dewey had available. However, now, we can use digital technology to create microworlds that teach. For practicing and aspiring school leaders, the ability to learn to make good decisions in an immersive environment that is entirely virtual, and, therefore, where the stakes are minimal is potentially game-changing. This article describes the development and early implementation of a simulation about school leadership that integrates full-motion video scenarios–taken directly from the world of practice—as triggers for a problem-based learning (PBL) exploration of educational leadership.

Design Concepts

Problem-based Learning (PBL)

Caldwell (1908) succinctly designated the characteristics of problem-based learning:

> The problems attacked must be real to the pupils and must be worthwhile. They must be the pupils own problems, or must be so presented to them that the pupils feel interest in them. The best problems are those that come out of the daily life and associations of the pupils, the solutions of which bring a fuller significance to phenomena constantly observed. (p. 346)

The legacy tenets of PBL enunciated by Caldwell (1908) are as appropriate today in the context of graduate education as they were over 100 years ago in elementary education. They would lead one to expect that graduates emerging from a PBL-focused educational leadership program would be more likely than graduates from traditional programs to: "(a) retain their knowledge, and know how to apply it appropriately, (b) demonstrate mastery of leadership skills, (c) put forth more effort while learning, (d) view their preparation as more meaningful and enjoyable" (Bridges & Hallinger, 1997, p. 136). In the longer term, Bridges and Hallinger suggested a graduate of a PBL-focused programs would be expected to make more informed decisions about being a school leader and be more satisfied if he or she became one.

These expectations constitute a strong endorsement of taking a PBL approach to educational leadership programs.

Hmelo-Silver (2004) suggested that the additional value added to learning in a PBL approach came as a result of the participant learning both content and thinking strategies. Hmelo-Silver envisaged the mental activities of the learner in a PBL environment as a cycle. As Figure 1 illustrates, the initial iteration of this cycle (which is prompted by a problem scenario) culminates in the learner developing an abstraction from his or her application of the new knowledge acquired. This abstraction helps to identify new facts and generate new hypotheses in the subsequent iteration of the cycle. The ideal juncture for the introduction of a new problem scenario is when this process reaches saturation (i.e., when no new abstractions are being generated).

We note that Hmelo-Silver's (2004) cycle stops short of the two things that characterize school leadership in practice–there is no decision, no choice, no commitment, and, even more critically, there are no consequences from those decisions and choices. That shortfall is the chronic gap between theory and practice, between the university classroom and the principal's desk, and between the repertoire of conventional professors and school leaders desirous of teaching and learning that replicates the complexity and significance of their work.

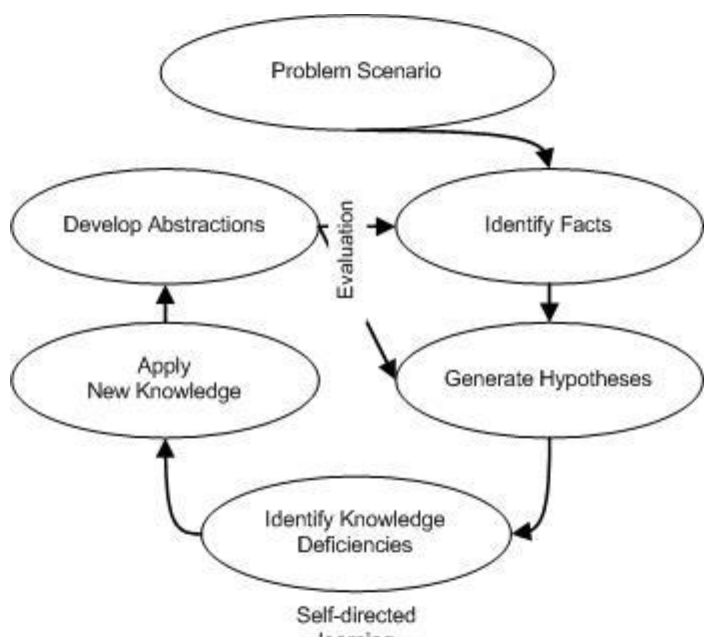

Figure 1. A depiction of the PBL learning cycle. Adapted from "Problem-Based Learning: What and How Do Students Learn?" by C. E. Hmelo-Silver, 2004, *Educational Psychology Review*, *16* (3), p. 237. Copyright 2004 by Educational Psychology Review.

Simulation and Learning

As McGaghie (1999) noted, a simulation is "a person, device, or set of conditions which attempts to present [educational and] evaluation problems authentically. The student or trainee is required to respond to the problems as he or she would under natural circumstances" (p. 9). The simulation in this instance is triggered by video plus computer algorithms to score and evaluate decisions, trigger associated consequences, and control subsequent problems and opportunities through scenarios supported and managed in a cutting-edge, web-enabled framework. These simulations measure each learner's multifunction capabilities in the critical areas of instructional leadership, teacher supervision, planning, assessing student performance, managing the common core standards, professional development, safety, budget and business management, communications and community relations, college and career readiness, pay-for-performance, and accountability.

As with PBL, simulations as educational tools are strongly supported among medical educators. Issenberg, McGaghie, Petrusa, Gordon, and Scalese (2005) reviewed the medical literature from 1969 to 2003, and extracted 10 features that "facilitate learning under the right conditions" (p. 10): (a) feedback, (b) repetitive practice, (c) curriculum integration, (d) range of difficulty level, (e) multiple learning strategies, (f) capture clinical variation, (g) controlled environment, (h) individualized learning, (i) defined outcomes, and (j) simulator validity. These features provide a useful range of comparisons for simulations in other disciplines. The provision of feedback was the most supported feature, with 51 supportive studies. While each of the above 10 features has its counterpart in these simulations, feedback is the most prominent of them. This is in keeping with the Issenberg et al. finding that each of the last six of these features—(e) through to (j)—was supported by 10 or fewer studies. Of these six features, simulator validity (j), while important, was supported by only four studies.

Bligh and Bleakley (2006) explored the relationships among classroom-based learning, work-based learning and simulation-based learning. They discussed a number of conceptual arrangements. For example, a particular implementation might closely ally simulation-based learning with the classroom-based learning space. Such an implementation might engage participants in the simulation in order to enrich the classroom experience, but would arguably reinforce the separation between the learning environment and the work environment. The ideal situation, they suggested, is as re-drawn in Figure 2. In an implementation along these lines, the classroom-based learning and the work-based learning extensively overlap (as shown by the overlapping vertical ellipses), with the simulation-based learning occupying the common ground between the other two. This conceptual arrangement among class-, work-, and simulation-based learning maps was the understanding that permeated this project.

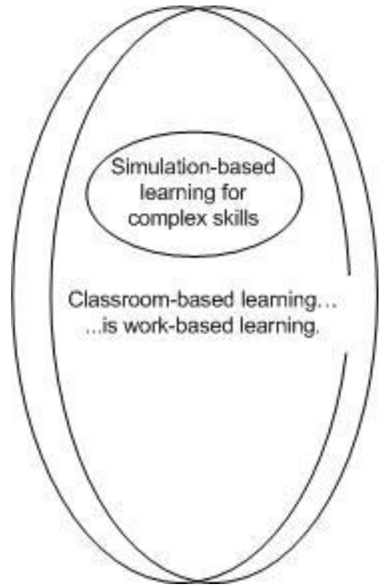

Figure 2. A depiction of the optimal relationship among classroom-, work-, and simulation-based learning adopted by this project. Adapted from "Distributing Menus to Hungry Learners: Can Learning by Simulation Become Simulation of Learning?, by J. Bligh, and A. Bleakley, 2006, *Medical Teacher*, *28*(7), p. 611. Copyright 2004 by Educational Psychology Review.

The approach described in this paper represents a considerable step in complexity and immediacy beyond earlier PBL-based simulation approaches that also took advantage of the affordances of the web environment, but in which learning was triggered by static webpages (e.g., Dexter, Tucker & Stuit, 2009). Additionally, these full-motion video simulations capture data that relate to diverse levels of assessment. For example, at the program level, they capture diagnostic information that directly addresses the key question: "How effective are the learners *and* the simulations?" At the level of the individual learner, the simulations can be used pre/post to provide evidence of each candidate's learning. The simulations also enable comparisons across users and sites (since the simulation holds the stimulus constant).

Simulation Description

The simulation described herein was created and funded as part of a grant to establish an innovative administrative leadership certification program. An urban school district joined in a collaborative venture with a research university in a mid-Atlantic state to design and implement a state-of-the-art administrative licensure program. The learners in the program were selected in collaboration between the university and the district. Members of the first cohort of this program will graduate at the end of Spring, 2011 and begin their mentored school leadership experiences in Fall, 2011. All the cohort members are practicing classroom teachers who are considering becoming administrators.

Within Project ALL, the lead author focused his efforts on the creation of the simulation. He conceptualized the overall design and scripted the scenarios with input from a number of other contributors who were at least partially funded by the grant.

The videos and the web programming were made possible by the grant, and were developed in accord with the lead author's concept. In the context of the Project ALL preparation program, the simulation represents a backbone of continuity among 12 learning modules—which were tailored to the leadership standards required of school leaders in Virginia—in addition to 320 hours of field experience (120 hours of which are integrated with the modules) spread across school placements in elementary through high school and at the central office level.

In creating the simulation, we began with an appreciation of the multiple performance demands of practicing school principals. Those were decomposed and scripted into hundreds of vignettes which have been in turn video-recorded on school locations or presented through computer graphics or other means. The dramatic material requires the participant's attention, but not necessarily his or her executive action. The participant sees the prototypical demands of school administration in a sequence that parallels the recurrent annual realities of a typical school building, that is, class scheduling and assignments take up the early months of the academic year, the budget demands start in the early spring, test season is in the spring.

Since each decision is scored and each choice triggers a pre-determined visual consequence, the scoring algorithms and the sequence-editor control programming are both demanding and time-consuming. One outcome of the problem vignette-to-choice-to-consequence sequence is immediate feedback on decisions. A second and more profound outcome is the cumulative creation of a personal profile of each user.

The Project ALL simulation gives participants a risk-free yet authentic opportunity to test whether or not, in fact, they want to leave the classroom, leave student-centered work, and move into administration and adult-centered work. After the completion of the simulation, participants should be able to make more informed decisions about being a school leaders and possibly perform more satisfactorily as they begin to enact the new roles of administration and leadership (Bridges & Hallinger, 1997).

The Logic of Project ALL's "Charles Thomson Middle School" Simulation

The design phase of the total program began with careful consideration of a new set of state performance standards. The new state standards were integrated into the overall program, but nowhere more clearly than in the role-playing simulations using point-of-view camera work and full-motion video—both of which added immediacy to the participants' learning experiences. In the simulation, visual and audio materials make the problems that confront the learner vivid and authentic. Further, each decision a participant makes is attended by consequences exactly tailored to each choice. The simulation is grounded in data from a prototypical field-of-practice setting, and is anchored to the evidentiary base of how high-performing school leaders turn around low-performing schools. This evidentiary base has been firmly established by the Council of Chief State School Officers (1996, 2008), and underpins the educational leadership standards and guidelines developed by states and professional organizations (e.g., the National Board for Professional Teaching Standards, see http://www.nbpts.org/products_and_services/national_board_certifica).

The simulation creates a virtual middle school (Charles Thompson Middle School), populated with data derived from a real urban school district and informed by the research on urban school improvement. The simulated school has been crafted to display a range of challenges, dysfunctions, and opportunities characteristic of a chronically low-performing school. Figure 3 shows the virtual office of the simulated school leader; the base from which many of the decision points emanate.

The challenges and performance domains have been weighted to reflect priorities of the principal working with teachers and with curriculum issues. The simulation content is presented in one of three modes: vignettes, decision points, or events.

Vignettes. Vignettes begin with a problem requiring a choice. The learner next sees video showing the consequences of the learner's choice and the simulation then branches (again and again) along a dramatic decision tree with the trajectory dictated by prior choices. There are 15 vignettes across the simulated school year (instructional leadership has six vignettes; student discipline, four; safety, three; and communications, two).

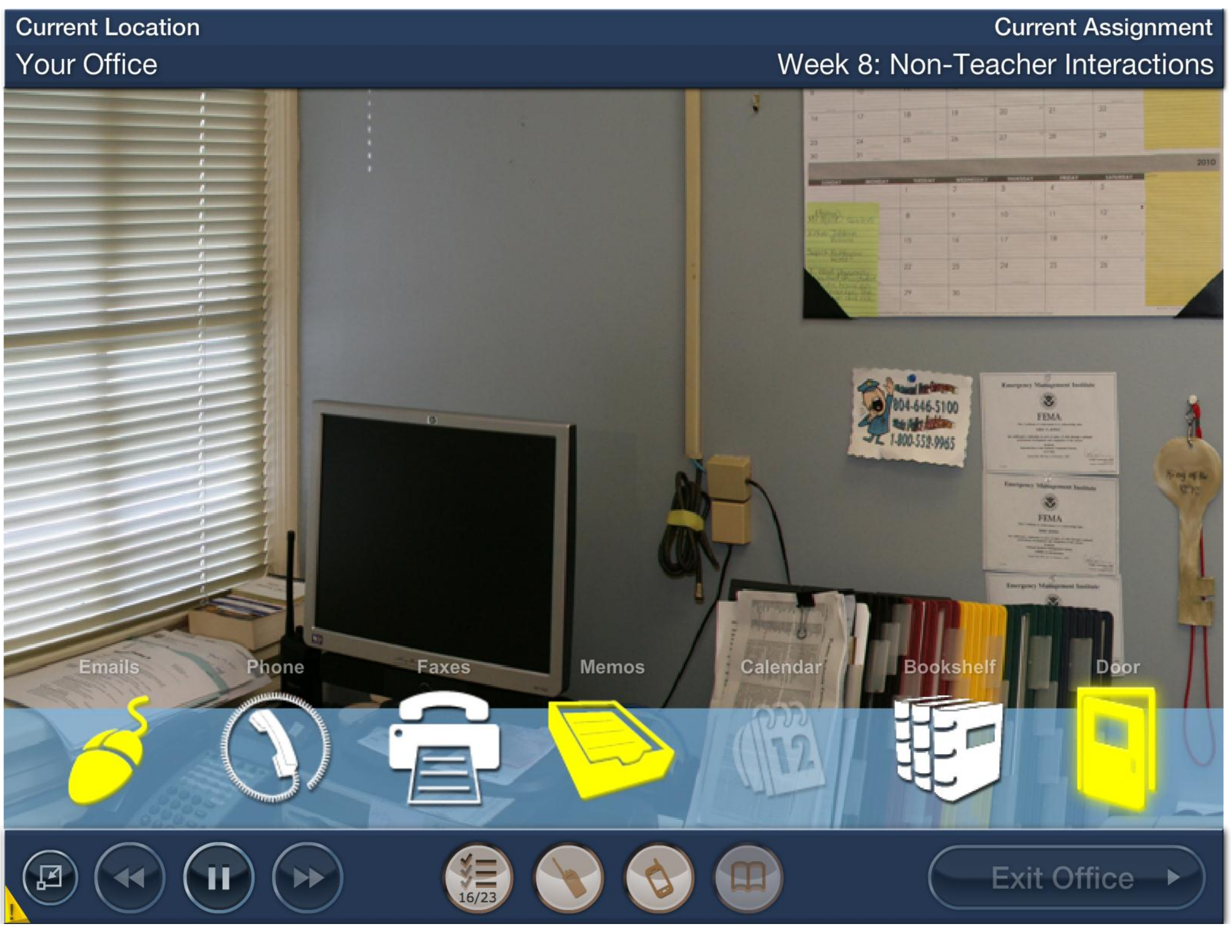

Figure 3. Still image of the virtual office of the simulated school leader in the Project ALL simulation.

Decision points. Decision points follow the same problem-choice-consequence dynamic but are self-contained and deal with a single issue. There are currently 167 decision points in the simulation (instructional leadership, 69; teacher supervision and professional development, 26; student assessment, 26; planning, 16; safety, 16; budget, 10; and professionalism, six). Figure 4 shows a screenshot of one of the many decision points facing the simulated school leader.

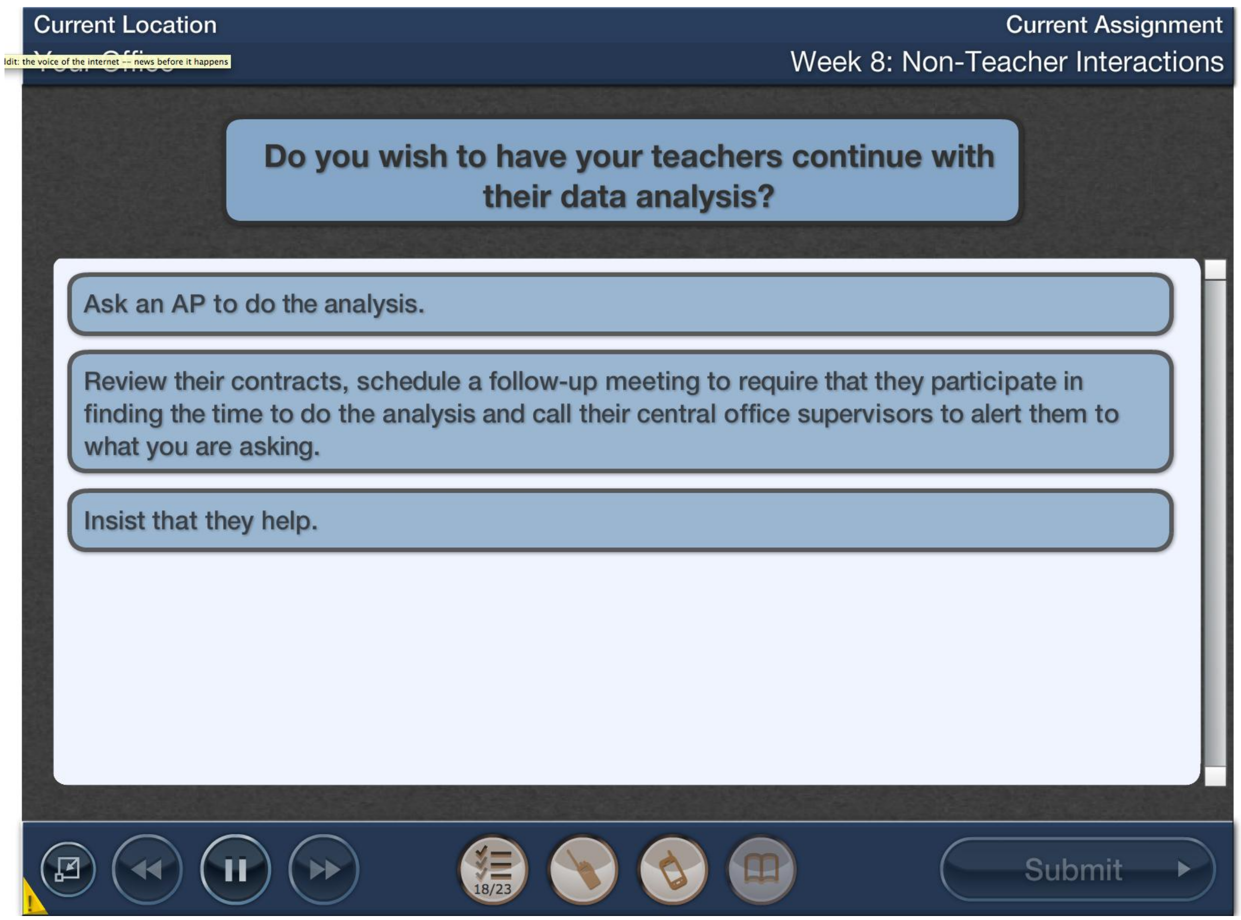

Figure 4. Screenshot of a decision point within the Project ALL simulation.

Events. Events are quick occurrences that pop-up in the middle of the learner's work on the simulated school. The 38 events do not require choices, but they do provide context or create distractions characteristic of school administration. As in the world of practice, some of the randomly occurring events accurately display Charles Thomson Middle School circumstances, others are rumors, others are distortions or are simply untrue. Knowing how to discern the reality and utility of the events (as with the decision points and the vignette choices) is part of the intentional pedagogy of the simulation. Figure 5 shows what the participant sees when deciding to check an email, a common "event" in the day-to-day lives of modern school leaders.

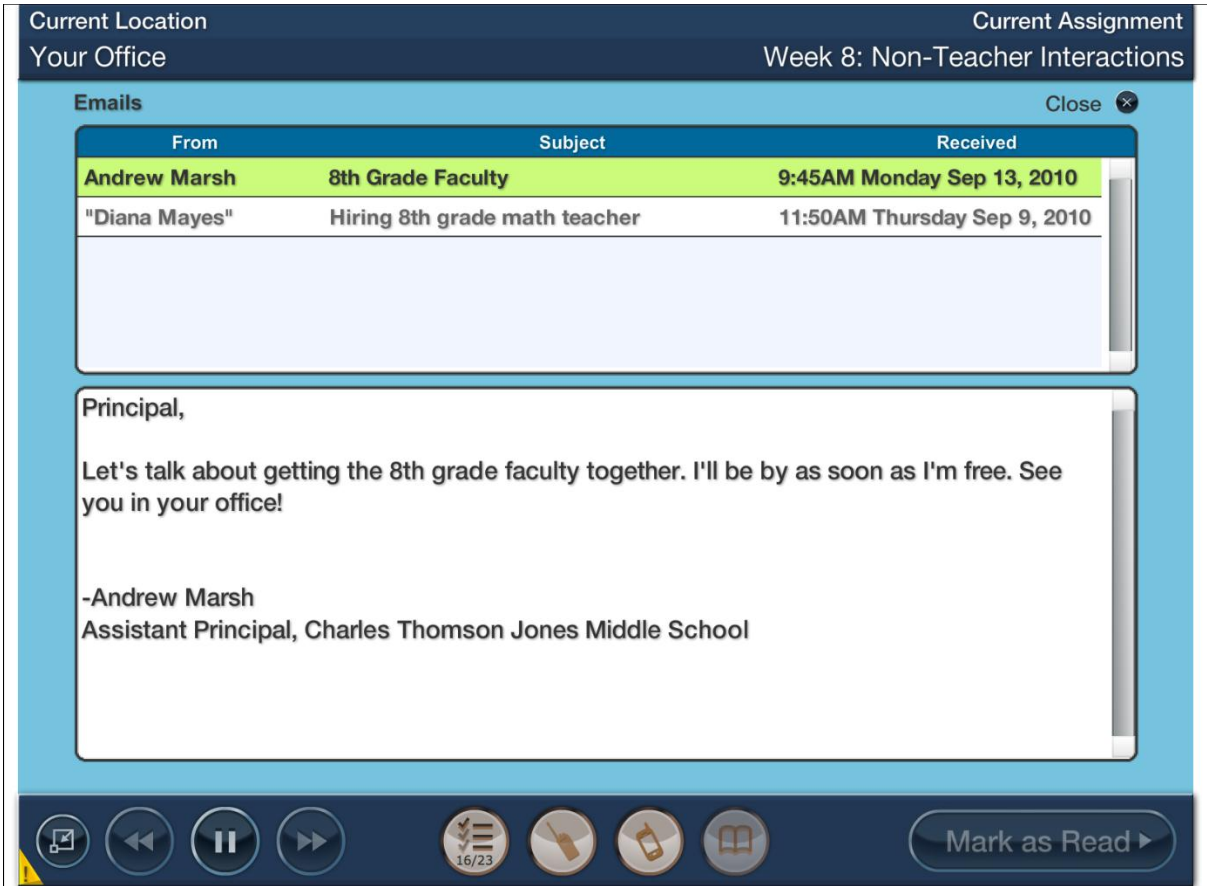

Figure 5. Screenshot of an event (email) within the Project ALL simulation.

The Hybrid Deployment of the Project ALL Simulation

The simulation proceeds in conjunction with mentors provided by the school district and with conventional graduate course work. The simulation includes paper materials and off-line activities. Charles Thompson Middle School includes a print package with abbreviated versions of: (a) the student information system, (b) class schedules, (c) the physical plant, (d) teacher contracts and descriptive characteristics on (e) enrollment and (f) information technology, (g) curriculum-as-taught, and (h) promotion/retention standards and patterns. Some learner responses to some of the simulation problems occur off-line. For example, after a contentious and prolonged (on screen) faculty meeting, the principal has to create a memo to the faculty. That memo is prepared in print for review by each learner's school system mentors.

Interim and Summative Information about Simulation Performance

One of the critical advances in teaching and learning available from this generation of simulations is the availability of knowledge about one's choices or decisions. Every decision in running Charles Thompson Middle School is scored and the scores are aggregated by leadership domain, both during the course of the simulated school year and summatively at the end of the year. The domains are instructional leadership, teacher supervision, professional development, student performance assessment, budgeting and business, planning, safety, communications, and community relations and professionalism. The school has been designed as chronically low-achieving and in need of improvement. Individual decisions are scored according to whether or not the actions are likely to advance school improvement in the judgment of a reference group consisting of exemplary current educational leaders and professionals, all of whom are well-versed in the evidentiary base. The evaluation data are also stored so that individuals can be compared and the group can be assessed as a whole on various dimensions of school leadership.

Participant Perspectives

Participants appreciated having Internet access to the simulation so they could work on their responses at any time they wished to do so. However, to ensure that all participants were making regular progress, two hours on each Monday of the program were specifically allocated to simulation work. Some of the participants needed face-to-face support from instructors in the initial stages. While all the participants were comfortable with the use of everyday instructional technology, none had encountered an immersive virtual learning environment (VLE) such as Project ALL. Increasing familiarity and the rapid development and refinement of the interface through an interactive design cycle effectively calmed the early anxieties that some participants experienced.

More substantive uncertainties emerged later. For example, one of the thoughtful participants commented that “I teach high-level test-taking strategies, and I can pretty easily figure out the alternative that will receive the highest score. But should I be doing that, or should I be choosing what I really think I should do in the situation?” This question was posed at a feedback meeting after the participants had been engaged with the simulation for about three months. It would be fair to say that at that stage a number of participants were disconcerted by the low scores they were accumulating. (Multiple aspects of participants’ responses to the simulation are scored in the background and made available at key points in the simulation.) From the point of view of one of the faculty who was working with the participants, the spread of scores was encouraging, as he had been doubtful that the simulation would allow for fine-grained differentiation among the participants. The context of the simulation has been purposely loaded to present the circumstances of a chronically low-performing school with a vividly presented array of dysfunctions. Not all the learners recognized the needs of the school and even fewer were willing to commit “their” principalship, “their” leadership to the kind of actions necessary to turn the school around.

Also, from the participants’ perspectives, there was a wholesome reluctance to accept unquestioningly the judgments woven into the scoring rubric. The complicated, subtle, and authentic representation of school problems provoked discussions among the users. In addition, because all the users were trying to solve the problems of the exact same school, the discourse among the learners was not hampered by the usual noise of “Oh, I’m in a high school, and we’re different,” and so forth. On a number of instances, participants were prompted to ask, “Who says that’s the best answer?” Each rubric judgment was predicated on current best-practice in the field as judged by the reference group referred to above, so the “who says” question provided the opportunity for motivating learning outside the simulation VLE.

To return to the question of how the participant should approach the decision-making, this highlights the difference between simulation and dissimulation in a VLE environment (see Bligh & Bleakley, 2006). This is the difference between a participant choosing an action that he or she believes is appropriate on the basis of his or her experience to that time and in the face of the potentially incomplete knowledge at hand (simulation), and a participant choosing an action that is not what he or she believes to be appropriate but an action that he or she believes the rubric will score highly (dissimulation). The effectiveness of learning in a simulation VLE (i.e., the transfer of learning from the virtual world to the real world) would be expected to be inversely related to the dissimulation of the participant. By responding as if he or she was in the real situation, a participant’s action may be scored as non-optimal in the VLE. In that case, however, the participant is in a position to revisit the thinking that led to that response and refine his or her thinking that led to the making of that response. This process describes learning from a simulation. On the other hand, a participant who views the task as “guess the best answer” may be improving his or her score, but in a way that is unlikely to transfer to real life (a process that Bligh & Bleakley referred to as the simulation of learning).

This simulation environment (or the perceived low scoring in the simulation environment) appears to have invoked a conflict about the aim of the simulation in the mind of a couple of participants. Other participants were more interested in asking the broader question: “Why are our decisions being scored?” These participants were invited to consider that in the real world a school leader has no option about being assessed. His or her every move is judged by multiple constituencies from the first day he or she is in a leadership position. The participants understood that the scoring in the simulation was rational and based on best-practice standards—which may not be properties that could be ascribed to real world assessments. That is, in the real world of educational leadership, judgments of the leader’s performance may be less than rational, or based on standards that are difficult to uphold from a best-practice perspective. The feeling of some participants was that they should be able to make mistakes in the simulation with no penalty because it is a learning environment. In other words, some participants felt that it was an imposition to evaluate their performance, because knowing that there were penalties for *poor* choices constrained them. This point was acknowledged, but the point of this simulation is to decrease the stakes of a poor choice, not eliminate consequences entirely. We expect participants to be invested in performing well in the simulation, and we believe that this investment is enhanced by their knowing that their decisions will be recorded and scored. Hence, a *no penalty* approach could well be adopted in some learning environments, but this approach has not been adopted in this simulation.

A final participant perspective on learning in this simulation VLE concerns the difficulty of recovering from poor decisions. The simulation intentionally does not allow back-tracking because, in real life, one does not get a chance to make a decision a second time. However, for a number of participants, the inability to access data from earlier simulation scenarios was an issue. For example, one of the participants was lulled into a false sense of security and found himself in difficult situation when he did not take careful note of data that were crucial to a subsequent scenario in the simulation. He learned a healthy respect for the sophistication of the simulation, but he puzzled over how to recover from his error.

Conclusion

The outcomes from the first cohort of students to engage with this immersive, interactive, web-enabled computer simulation have provided ample evidence of the viability of this modality as a trigger for learning. Problem-based learning has played a part in developing educational leadership for some time (Bridges & Hallinger, 1991; Schechter, 2011), but the video simulation developed for Project ALL has set the direction for the next generation of problem-based learning.

Christensen et al. (2011) asserted that, while expanding access over the past 50 years has allowed more students to afford higher education, there are segments of the population who have yet to be better educated. Against this background, Christensen et al. called for a post-secondary education that is "fundamentally affordable" (p. 1), meaning an education that is lower in cost, not just in price, and that is simple and convenient, and that re-defines quality in terms of outcomes that are important to students. Such a redesigned post-secondary education, Christensen et al. suggested, will focus on "next-generation learning models…such as competency-based learning with actionable assessments, [and] not just make the traditional model of education more convenient" (p. 5).

Virtual learning environments are conceptually well-placed to assume the mantle of disruptive innovation. If a VLE is well-designed and produced, it is not low-cost to create. However, if the start-up costs can be defrayed over many participants or over time, participation in the VLE becomes affordable for institutions and students. A VLE adds convenience to the learning process, but may go well beyond convenience to facilitate the implementation of problem-based learning (PBL) approaches, along with the making of performance competency judgments on the basis of actions taken (or not taken) by the participant.

Although the simulation developed in the context of this project is still in its alpha version, its production quality, and the quality of the learning it has motivated has demonstrated the potential for such a simulation to play a strong role in the next generation of principal preparation programs. In particular, the online availability of the simulation invites the extension of principal preparation programs to include those who have difficulty physically attending class meetings held at customary times. This expanded availability may empower those who otherwise might not be able to demonstrate their leadership potential.

Our experience has highlighted the advantages of problem-based learning for prospective educational leaders—especially when it is implemented in an immersive, interactive, web-enabled environment. Project ALL was established as a school/university collaborative venture, and the collaborative nature of the project has been a key element in its success. Educational leadership programs seeking to implement a similar approach would be advised to institute a similar collaborative arrangement to ensure that the bases of the multiple problematic situations embedded in the simulations remain true-to-life. The production of the Project ALL simulation has been a resource-intensive process, but some economies of scale will be reaped now that the framework and programming infrastructure has been established. Clearly, the simulation will require continual updating so that its scenarios remain current. Ongoing refinement will be required to respond to participant feedback and evaluation outcomes. However, now that the technological infrastructure in place, making refinements will be less resource-intensive than the initial programming. In this sense, this project approximates the characteristics of a disruptive innovation in the preparation of educational leaders (Christensen et al., 2011).

Gijbels, Dochy, Van den Bossche, and Segers (2005) found that “studies examining the effects of PBL are conclusive regarding the problem-solving ability of students” (p. 27). The value added to the static case-study approach to the PBL process by this immersive, interactive, web-enabled computer simulation stems specifically from the immersive and interactive components. With respect to the former, participants are visually drawn into the simulation as characters in the simulation address them directly. With respect to the latter, participants make choices that determine their path through the simulation along a trajectory that is dictated by their prior choices. This level of engagement and detailed decision-tracking and feedback is made feasible by leveraging the capacity the Internet. This simulation breaks new ground in establishing the parameters of the next generation of problem-based learning environments in educational leadership.

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