International Society of the Learning Sciences

The Playable Case Study Authoring and Simulation Platform

Elizabeth Bonsignore, University of Maryland College Park, ebonsign@umd.edu
Derek Hansen, Brigham Young University, dlhansen@umd.edu
Daniel Hickey, Indiana University, dthickey@indiana.edu
Philip Piety, University of Maryland College Park, ppiety@umd.edu
Grant Chartrand, Indiana University, gchartra@indiana.edu

Kira Gedris, Mitch Cross, Justin Giboney, Jon Balzotti, Jason McDonald, Kevin Kartchner
kira.gedris@gmail.com, mitch.s.cross@gmail.com, justin_giboney@byu.edu, jonathan_balzotti@byu.edu, jason@byu.edu, kevinkartchner.ca@gmail.com
Brigham Young University

Abstract: Playable Case Studies (PCSs) are online simulations that allow learners to adopt (*play*) a professional role within an authentic scenario (*case*) as they solve realistic problems alongside fictionalized experts in an unfolding narrative. The PCS architecture offers scalable options for creating learning activities for individual learners and student teams, and the means for observing and analyzing these activities. This interactive demo will showcase PCSs the team has developed for topics ranging from cybersecurity to technical writing to disaster response, illustrating how we embed learning assessments and research surveys and run them in classroom environments. Participants and potential collaborators will interact with and provide feedback on the prototype PCS Authoring Tool, designed to streamline the creation of new PCSs.

Keywords: *educational simulation, role-play, career awareness, productive disciplinary engagement, expansive framing*.

Introduction

Game-based and experiential learning studies have long investigated how role-playing activities (e.g., "playing as an urban planner") enable learners to adopt epistemic frames, or ways of knowing in simulated contexts that may transfer to "real world," professional contexts (e.g., Shaffer et al., 2005; Arastoopour et al., 2014). This Interactive Tools and Demo paper introduces a new genre of interactive, role-based simulation called a Playable Case Study (PCS) (Balzotti et al., 2019; Giboney et al., 2021). The PCS architecture is a "designed experience" rather than a content delivery platform (Squire, 2006), enabling learners to take on various professional roles and interact with peers and fictional characters to carry out discipline-specific tasks. Our platform allows us to enact Sandoval's *conjecture mapping* framework (2014) and extend existing work on how professional role-taking and team collaboration can promote STEM career awareness in undergraduate and high school students. For example, a specific PCS *design conjecture* (Sandoval, 2014) is that a learner who takes on the role of Security Analyst can assume responsibilities of that role, such as the authority to allocate specific cybersecurity resources to mitigate their city's risk of malware attacks or being accountable for deciding which systems to shut down during a ransomware attack. Following Sandoval's (2014) framework, we propose that the *mediating processes* enabled by assuming such roles, supported by specific PCS design features, raise a learner's awareness of role-based professional praxis and skills, in potentially meaningful ways. In addition, instructors and researchers can use the PCS authoring tool to embed "in-game" assessments that reveal how the *mediating processes* that PCS activities, characters, and professional resources promote can lead to desired learning outcomes.

Our session will showcase a variety of existing PCSs to illustrate the potential of using them in different domains and demonstrate the PCS Authoring Tool designed to streamline the creation of new PCSs. The goals of the demo session are to (1) identify researchers and educators who want to integrate existing PCSs into their courses, extending design research using Sandoval's (2014) conjecture maps; and (2) identify researchers who want to develop and study PCSs in new content areas using the PCS Authoring Tool.

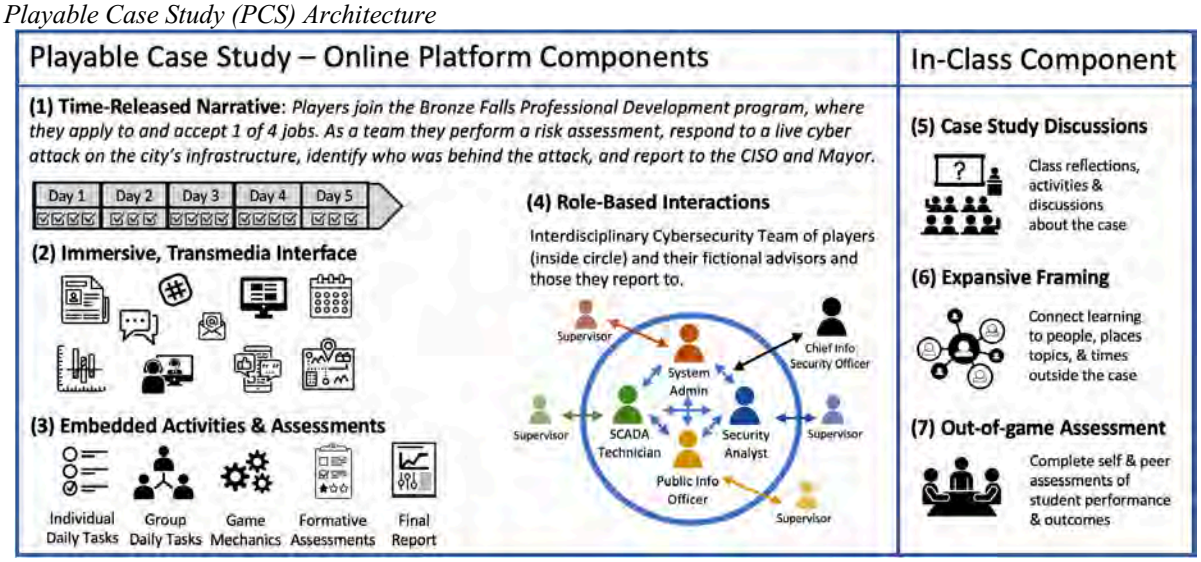
Playable Case Studies

Playable Case Studies (PCSs) situate learners in authentic scenarios (*cases*) where they adopt (*play*) a professional role as a member of an interdisciplinary team. Players work alongside fictionalized experts as they solve realistic problems embedded into a narrative that unfolds over several virtual days, integrated in a classroom or as a standalone experience. The online experience can be augmented by in-class activities designed to provide educational scaffolding. The PCS provides a scalable way to simulate high-risk activities for novices to experience

in a safe environment, as well as a platform in which to study individual and group activities (Giboney et al., 2021). As players take on unique roles in a PCS, they enact principles of productive disciplinary engagement (Engle & Conant, 2002) by: (1) tackling disciplinary problems, (2) gaining authority to make in-game decisions, (3) holding each other and themselves to disciplinary norms, and (4) using resources provided by the PCS. Figure 1 presents the core elements of a PCS, using our team-based, Risk Analysis cybersecurity PCS as an example. This PCS walks learners through the NIST Cybersecurity Framework, as they assume distinct roles as members of a municipal government Professional Development Program in the fictional city of Bronze Falls. Players complete five virtual days, collaborating on various team-based activities such as risk assessment, incident response, and attribution. Each numbered element in Figure 1 is described below.

Figure 1

Playable Case Study (PCS) Architecture



1) *Time-released narrative*. Learners become active participants in an engaging, yet realistic narrative as they move the story forward through interactions with fictional characters and fellow learners. Narrative elements are released as players complete individual and group tasks assigned to them by fictional characters over the space of 5-6 virtual days. Our PCS Authoring Tool includes an event system that allows for learner actions (e.g., submitting a report) to trigger other events (e.g., a supervisor email).
2) *Immersive, transmedia interface*. Learners experience the story through an immersive, transmedia interface that includes everyday technologies such as video conferencing, email, and document sharing (see Figure 2). PCSs adhere to the "This is Not a Game" (TINAG) ethos adopted by players of alternate reality games, which is designed to create authentic and engaging mixed-reality experiences (Bonsignore et al., 2012). Our PCS Authoring Tool includes built-in modules including email, chat, task tracking, video-conferencing, collaborative authoring, document sharing, and surveys. It also enables the creation of custom modules for specific PCSs such as a Linux Terminal or Cybersecurity Incident Response Tool.
3) *Embedded activities and assessments*. Learning activities and assessments in the online component are embedded within the storyline. For example, a System Administrator may analyze server log files to help identify a hacker. Team tasks may require team members to make decisions based on distributed information or react to "live" events, like a cybersecurity attack. Players reflect on the professional skills they are practicing as they draft emails and reports, which are embedded into the storyline. The PCS Teacher Dashboard shows the submissions and progress of each student and group (see Figure 3).
4) *Role-based interactions*. Players take on a specific role in a PCS, allowing them to experience a day-in-the-life of a certain career long before they could normally do so. In multi-player PCSs, players take on different roles on an interdisciplinary team (e.g., Security Analyst, System Administrator, Public Information Officer, SCADA Technician). Individual tasks and information can vary for each role, creating opportunities for collaborative problem solving and decision-making activities. Fictional supervisors specific to each role provide guidance and accountability. This approach also allows players to be exposed to, and envision themselves in, several different STEM roles. Using the PCS Teacher Dashboard, instructors can automatically and manually assign roles and create groups based on preferences expressed by players during a "job preference ranking" survey (see Figure 3).

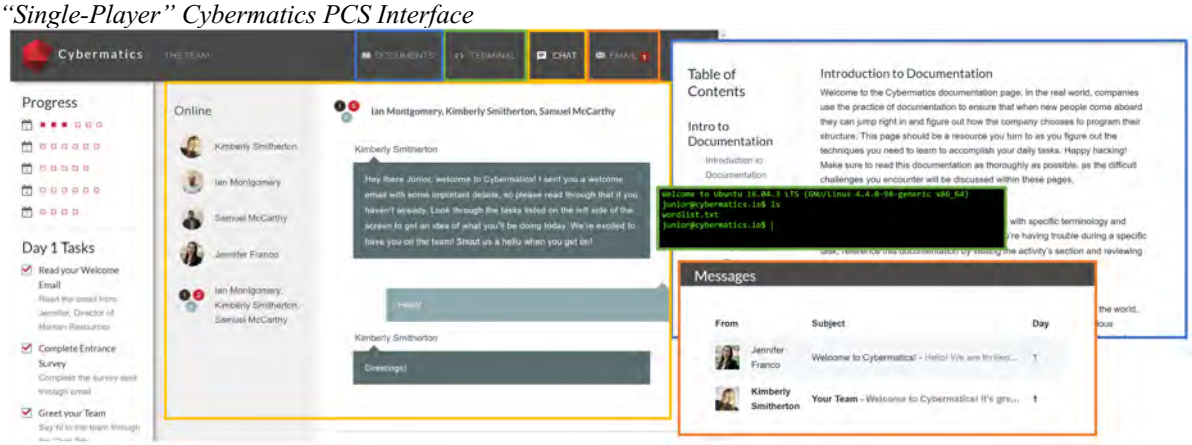
5) *Case study discussions*. As with traditional case study teaching, students are asked to identify the salient aspects of the case, discuss the challenges and lessons it affords, and attempt to generalize key insights (Barnes et al., 1994). As teams compare their decisions and outcomes with other teams in classroom discussions, they will understand how they fared and what they could have done better.
6) *Expansive Framing*. Expansive framing helps players connect what they learn in the highly situated PCS with their personal experiences and lives (Engle et al., 2012; Hickey et al., 2020). This is done through in-class activities and discussions that challenge students to interpret and connect concepts to the people, places, topics, and times in their own lives. For example, learners can be asked to reflect on and discuss how the professional roles that they are asked to take on intersect with their own professional trajectories, and how their personal orientations (i.e., race, gender, culture) shape their experiences. Expansive framing can also be embedded into activities and assessments (#3 above).
7) *Out-of-Game assessments*. While many assessments are embedded into the online PCS components, some assessments are best captured in class, "outside" of the game world. These may measure knowledge and skills related to the learning outcomes of the game or ask learners to apply what they learned in the PCS to a related, but different context.

PCS Example: Cybermatics PCS

Cybermatics is a single-player PCS that has been run with hundreds of students at multiple universities and high schools, resulting in several publications about its design and impact (Balzotti et al., 2019; Giboney et al., 2021). Players take on the role of a junior cybersecurity penetration tester, working with a team of fictional characters to perform ethical hacking on a client's website (https://riptech.xyz). They perform SQL injection, password cracking, and find hidden files within a Linux machine, and ultimately identify a hacker who placed a backdoor into the system. An ethical dilemma is embedded into the experience to provide a safe place for students to fail and learn from their failure (Neupane et al., 2021). Figure 2 shows the core interface elements.

Figure 2

"Single-Player" Cybermatics PCS Interface



PCS Teacher Dashboard

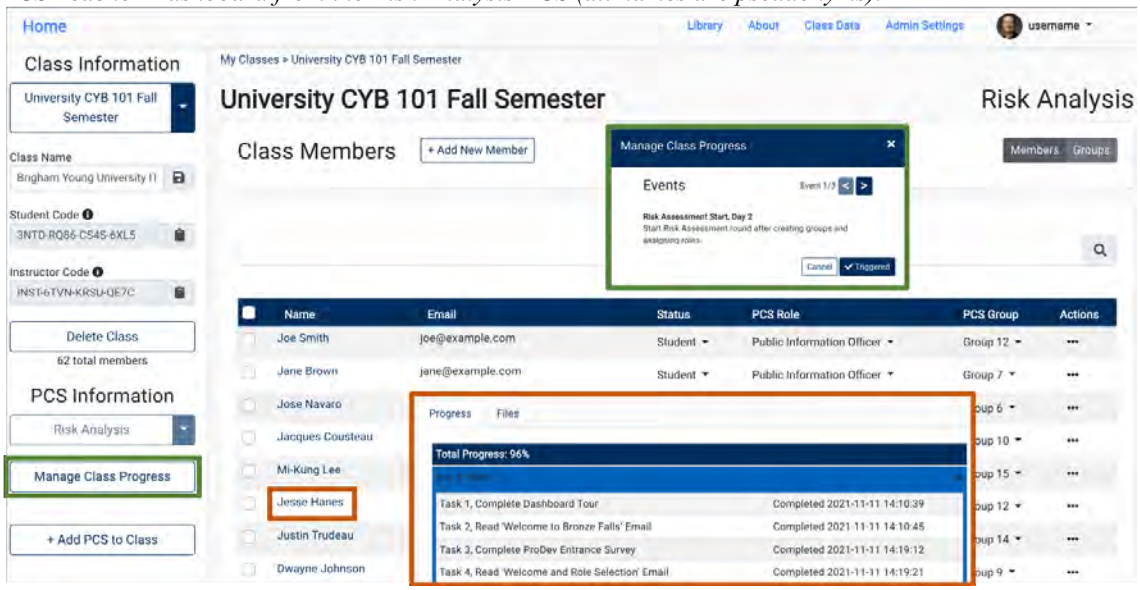
The PCS Teacher Dashboard shown in Figure 3 lists students who have enrolled in the PCS, their role and group. A detailed page for each student shows which tasks they have completed, as well as access to the associated content (e.g. emails they have sent). The dashboard also allows teachers to automatically or manually assign students to roles and groups and trigger certain events, which is often done to start a new virtual day.

Demo Set-up and Structure

We will demonstrate the PCS system on a PC or Mac web browser, sharing two sample PCSs to illustrate their core components, followed by a demonstration of the PCS Teacher Dashboard and the PCS Authoring Tool. Interested participants will be able to interact and give feedback on a sample PCS, sharing their screen to the whole session or in breakout rooms. We will not provide a comprehensive walkthrough of all features; instead, we will illustrate what is possible to do with the platform with the intention of finding potential collaborators.

Figure 3

PCS Teacher Dashboard from the Risk Analysis PCS (all names are pseudonyms).



Acknowledgments

We thank the students/instructors who participated in this work, which was funded by National Science Foundation (NSF) grants #1915563 and #1915620.

References

Arastoopour, G., Chesler, N. C., & Shaffer, D. W. (2014). Epistemic Persistence: A Simulation-based Approach to Increasing Participation of Women in Engineering. Journal of Women and Minorities in Science and Engineering, 20(3), 211–234.

Balzotti, J., & Hansen, D. (2019). Playable Case Studies: A New Educational Genre for Technical Writing Instruction. Technical Communication Quarterly, 28(4), 407–421.

Barnes, L. B., Christensen, C. R., Hansen, A. J., & Christensen, C. R. (1994). Teaching and the case method: Text, cases, and readings (3rd ed). Harvard Business School Press.

Bonsignore, E., Hansen, D., Kraus, K., Ahn, J., Visconti, A., Fraistat, A., & Druin, A. (2012). Alternate Reality Games: Platforms for Collaborative Learning. In ICLS 2012 Proceedings – Volume 1, Full papers (pp. 251–258). ISLS.

Engle, R. A., & Conant, F. R. (2002). Guiding principles for fostering productive disciplinary engagement: Explaining an emergent argument in a community of learners classroom. *Cognition and Instruction*, *20*(4), 399-483.

Engle, R. A., Lam, D. P., Meyer, X. S., & Nix, S. E. (2012). How Does Expansive Framing Promote Transfer? Several Proposed Explanations and a Research Agenda for Investigating Them. *Educational Psychologist, 47*(3), 215–231.

Giboney, J. S., McDonald, J. K., Balzotti, J., Hansen, D. L., Winters, D. M., & Bonsignore, E. (2021). Increasing Cybersecurity Career Interest through Playable Case Studies. TechTrends, 65(4), 496–510.

Daniel T. Hickey, Grant T. Chartrand, and Christopher D. Andrews. 2020. Expansive framing as pragmatic theory for online and hybrid instructional design. *Educational Technology Research and Development 68*(2): 751–782.

Neupane, A., Gedris, K., McDonald, J. K., Hansen, D. L., & Balzotti, J. (2021). Balancing Competing Goods: Design Challenges Associated with Complex Learning. In B. Hokanson, M. Exter, A. Grincewicz, M. Schmidt, & A. A. Tawfik (Eds.), *Learning: Design, Engagement and Definition* (pp. 181–190). Springer.

Sandoval, W. (2014). Conjecture Mapping: An Approach to Systematic Educational Design Research. Journal of the Learning Sciences, 23(1), 18–36.

Shaffer, D. W., Squire, K. R., Halverson, R., & Gee, J. P. (2005). Video Games and the Future of Learning. The Phi Delta Kappan, 87(2), 104–111.

Squire, K. (2006). From Content to Context: Videogames as Designed Experience. Educational Researcher, 35(8), 19–29.

