Adapting Online Blended E-Learning Solutions to Diverse K-12 School Contexts: Lessons Learned and Opportunities for Future Development

Rebecca Reynolds, Ph.D.
Associate Professor
Rutgers University
School of Communication & Information
Rebecca.reynolds@rutgers.edu

Introduction

Game design has been recognized as a promising approach for engaging students in programming, by allowing students to explore challenging CT and CS principles in a creative context that captures their imagination and enables student expression (e.g., Grover and Pea, 2013; Kafai & Burke, 2015; Harel 1991, Harel Caperton 2010; Reppening, Webb and Ioannidou, 2010). In addition to computational programming, game design involves development of game message/content and mechanics, the expression of which give students a purpose driving their coding – publishing and sharing an interactive artifact that conveys meaning that can be made personal to them (Harel Caperton, 2010). Game design processes have been found to engender students' systems-based thinking, interdisciplinary thinking, user-centered design, specialist language, meta-level reflection, network literacy, and productive/tool literacy (Salen, Torres, Rufo-Tepper, Shapiro, & Wolozin, 2010).

The cultural responsiveness of a CS education program has been found to contribute to its success. Culturally responsive teaching (CRT) recognizes the importance of including students' cultural references in all aspects of learning (Ladson-Billings, 1995). Vavrus (2008) proposes that such a reform measure seeks to increase the engagement, motivation and achievement of lower socio-economic status students and students of color who historically experience less academic success and greater alienation within public schools, by validating and infusing students' own cultures into the curriculum (2008). While much of the originating work in this arena has been developed in the traditional K-12 academic disciplines, a number of computer science education experts have adapted culturally responsive pedagogy within the computing context (CRC), including projects funded with NSF support (e.g., McLoughlin, 1999; Henderson, 1996, 2007; Pinkard, 2001; Lee, 2003; Eisenhart and Edwards, 2004; Goode and Margolis, 2011; Margolis, Ryoo, Sandoval, Lee, Goode, Chapman 2012; Eglash, Gilbert, Taylor & Geier, 2013; Scott, Sheridan and Clark, 2015).

Under-explored however, is adaptation of CRC within a *blended e-learning approach* to CS education. The lead author's curriculum research and development partner, Globaloria, was founded by her collaborator and the commercializing organization's president, Dr. Idit Harel, in 2007. Since then, this organization has been iterating a blended e-learning game design-based solution for CS education. The Globaloria program has been designed, scoped and sequenced by CS education experts, and is offered to schools as a blended e-learning game design course for integration in the block schedule for a single semester or full year, daily for credit and a grade. In the 2016/2017 school year the program operates in 85 active school locations across several US states, totaling 570 classes implemented across both fall/spring semesters, with 185 teachers and ~10,000 students, at the middle school and high school levels. A small number of schools in Texas are piloting the program's new elementary school-level curriculum.

This SIGUSE workshop submission addresses ways in which e-learning solution providers who employ online information systems and learning management systems to channel their curriculum and instruction are customizing and adapting their offerings to localized school environments, to be "culturally responsive" to specific community needs among diverse school districts in several US regions. The findings indicate levels of success have been charted to date;

there are also new zones of opportunity for refined research and development for improvement (R&D).

Background

The Globaloria organization has been iterating a blended e-learning game design-based solution for CS education for over a decade. The CS education curriculum has been designed, scoped and sequenced by CS experts, and is offered to schools as a blended e-learning game design course for integration in the block schedule for a single semester or full year, daily for credit and a grade. In the 2016/2017 school year the program operates in 85 active school locations across several US states, totaling 570 classes implemented across both fall/spring semesters, with 185 teachers and ~10,000 students, at the middle school and high school levels. A small number of schools in Texas are piloting the program's new elementary school-level curriculum. Prior research on Globaloria as a solution for game design learning and introductory computer science education has been conducted by a network of 15+ academic research partner collaborators since 2008, with findings disseminated in peer-reviewed conferences, journals and as 3rd party audited evaluation research.

Findings have shown positive effects of learner participation on student interest, engagement, and motivation in 6 digital learning domains, as well as measured game design knowledge outcomes (e.g., Reynolds & Harel Caperton, 2009; Reynolds & Chiu, 2012, 2013; Reynolds, 2016a). Findings with matched-case control groups also show significant increases in science, social studies and English and language arts standardized test scores as a result of participation (Chadwick & Gore 2010, 2011; Ho, Gore & Chadwick, 2012). Participation was also shown to attenuate and eliminate known effects of the digital divide such as gender and socio-economic status (Reynolds & Chiu, 2016).

Reynolds (2016a) offers a framework of the "6 Contemporary Learning Practices" that are emphasized in the Globaloria game design initiative, aiming to cultivate "social constructivist digital literacy" in learners. They are described in brief as: "Create," "Manage," "Publish," "Socialize/Collaborate," "Research," and "Surf/Play." Reynolds (2016a) argues that such breadth of activity is epistemic and authentic to much of our real-world purposive and functional engagement with information technologies and work projects. If expertise among students is cultivated across dimensions *in a coordinated way,* through design and creation of a digital artifact, it is proposed that this prepares students for participation in digital cultures, citizenship, and workplaces. Reynolds (2016a) offers empirical support for this claim.

Culturally responsive teaching in Globaloria. No research has addressed the need to adapt blended e-learning solution information system platform implementations, to diverse school community contexts. In December 2016, Harel developed and made available a framework of principles that have long guided the organization's efforts in offering a research-driven learning system for CS education through game design. This framework demonstrates their commitment to and discernment of specific cultural responsiveness features, as fundamental components of computer science learning.

Table 2. Globaloria principles guiding successful "computer science learning culture"

Facilitate learning the *actual* concepts and practices of computer science
Encourage everybody's participation, equity and diversity
Focus on creating computational artifacts (i.e., software, websites, animated characters, games, simulations, mobile apps)
Support the study of computational thinking and algorithmic processes, as well as understanding their design, implementation, and impact on society
Emphasize how computing influences culture, and culture shapes how people engage with computing
Facilitate computational thinking (CT) as central to the practices and concepts of computer science

Practice how to communicate about computing
Provide multiple pathways supporting a learning progression covering many CS concepts and principles.

Other related approaches include Scott, Sheridan and Clark's work in CRC through game design and digital content creation among youth (2015). Similar to Globaloria, they have addressed how technology education can be structured to support digital innovation among diverse youth in two projects, the first exploring game design and peer mentoring among mostly black students; and the second exploring Hispanic girls' engagement with digital project tools to address a self-identified social/community issue (iLife, Scratch, Sims etc.). Students were found to master technical skills in new media creation and innovation, and sociopolitical awareness and agency (2015), findings that connect with Reynolds (2016). The authors (2015) arrive at three conclusions: successful CRC projects engage program designers, educators, and students to *collaboratively reflect* on the intersection of their *experiences* and *identities* with digital technologies; that participants' discovery and building reaches beyond school; and participants foster new *connections* with each other and outside communities. They propose that environments should conceive of digital access in terms of opportunities to create and innovate with digital technologies and work to provide the culturally responsive contexts to support this pathway to digital equity.

The current program of in-progress research addresses the following research question:

In what ways do features, processes and pedagogies utilized by the given organizational e-learning solution provider, contribute to its cultural responsiveness?

This research focuses on 3 domains:

(a) *Organization/School relationship management,* including diverse teacher/student/school recruitment, development of a culturally responsive/relevant 'implementation plan,' teacher training, and ongoing communications and supports.

(b) *Teacher/student/community critical inquiry and engagement with game topics.* How is the curriculum set up to support constructive, deep and meaningful critical inquiry in student/teacher interactions on student-driven game topics?

(c) *Teacher/student information resource uses.* How does the curriculum support information text usage? What information literacy instruction is included? How are student information skills, reading and interpretation, considered?

Methods

Through interviews with Globaloria program staff, participating school teachers and students across Globaloria implementation settings in the U.S., the author is collecting data addressing these questions. Sampling is being conducted based on recommendations from the Globaloria organization as well as based on snowball sampling among local teachers who are aware of other area schools and teachers who may be experiencing similar / different patterns of interaction with the organization. Interviews are filmed and/or audio recorded, transcribed and analyzed in Dedoose. For the initial round of coding, we adopt an inductive approach informed by the open, axial, and selective coding sequences of Corbin and Strauss aiming to discover major categories for the research questions. I will generate a coding scheme for each category and engage another round of coding, to further refine the category's definition and establish detailed sub-categorical results.

In-Progress Observations

Globaloria as a culturally responsive blended e-learning solution. To-date, the organization has worked predominantly within rural low income school communities in the states of West Virginia, Wyoming and Oklahoma, as well as Hispanic immigrant and ELL communities in Austin, TX, Houston, TX, San Jose, CA, and black and Hispanic students in Queens and the Bronx, NYC. The founder and staff help schools develop an implementation plan and choose relevant course offerings. Schools can choose whether to link the course to a specific school

subject or allow full student choice of game topics for greater cultural relevance. Globaloria's situated research and development efforts with Hispanic students have led to creation of a specialized bilingual game design CS curriculum for Spanish-speaking learners, implemented in several Texas schools. Another cultural responsiveness feature is an extended mentor network of "Help Center Coding Coaches," employed full- and part-time, who are past Globaloria teachers and students and help schools on-board and manage the program.

Information resource uses, student reading levels, and blended e-learning. One of the cornerstones of a quality education is the ability for learners to read and comprehend text; however, socio-economic status has long been a known predictor of reading success in young people (Barkley, Henry, & Bao, 1998; Deller, Tsai, Marcouiller, & English, 2001). Blended e-learning approaches require students to engage in a variety of informational resource uses as part of the learning process. The very process of *spending time using informational texts* specifically helps address gaps in comprehension for at-risk students (Brenner & Hiebert, 2010; Barnatt, 2010). It appears that this finding may be supported, but with certain conditionals, in this directed project-based learning context, relating to past research by Reynolds (e.g., 2016b).

Integrated development environment. Stemming in part from past research findings (e.g., 2016b) on the challenge of student uses of blended e-learning based information resources to learn programming, the organization recently launched an Integrated Development Environment for middle schoolers (the GIDE), that much more closely scaffolds their learning of Javascript programming. This feature offers a contained set of sequential activities to complete within a single browser window productivity space in which close, contextual instructional supports are offered adjacent to the specific coding activities as needed. This is different from the past instructional design in which a library of tutorials categorized by theme were offered in the LMS, and students were expected to find the right one for their given purpose. Information resources and inquiry are still suffused throughout the LMS; however, programming tasks in particular are now more structured in the IDE in context. More data are being collected as to the ways in which student information literacy is supported, needed, and has potential to be augmented through further program refinements.

Discussion

One challenge in teaching computer science at the K-12 level includes the need for new teacher recruitment and professional development within this newly prioritized discipline (Wilson, Sudol, Stephenson, Stehlik, 2010). How do we begin to scale up CS education opportunities, which require sufficient teacher numbers, training, preparation and expertise? Blended learning approaches for CS education in K-12 may hold promise in this endeavor, in that they deliver expertly scoped and sequenced CS curriculum via online information environments, to give schools and teachers a jump-start in pedagogy. Blended e-learning solution providers' offering of CS education in the US appears to be one solution to help mitigate the challenge of teacher training, in that their propagation can bear some of the initial burden of instructional design and development for CS pedagogy, and give teachers a jump-start in deploying CS opportunities. E-learning organizations like Globaloria can use blended e-learning platforms to train teachers alongside students, in parallel.

Key to the success of this venture is offering culturally responsive affordances that make the offering conducive to diverse students and districts. This research contributes to understanding feasibility of such an endeavor, and specific findings on strategies that may and may not be working. There are significant instructional theory, information use theory, and design implications for this work.

References

Barkley, D. L., Henry, M. S., & Bao, S. (1998). The role of local school quality in rural employment and population growth. *The Review of Regional Studies*, *28*(1), 81.

Barnatt, J. (2010). The power of nonfiction: Using informational text to support literacy in special populations [WWW page]. Available at: http://linguistics.byu.edu/faculty/henrichsenl/APA/APA09.html

Chadwick, K. & Gore, J. (2010). *The relationship of Globaloria participation and student achievement.* Charleston, WV: Edvantia.

Chadwick, K. & Gore, J. (2011). *Globaloria replication study: Examining the robustness of relationships between Globaloria participation and student achievement*. Charleston, WV: Edvantia.

Deller, S. C., Tsai, T. H. S., Marcouiller, D. W., & English, D. B. (2001). The role of amenities and quality of life in rural economic growth. *American Journal of Agricultural Economics*, *83*(2), 352-365.

Eglash, R., Gilbert, J. E., Taylor, V., & Geier, S. R. (2013). Culturally responsive computing in urban, after-school contexts: Two approaches. *Urban Education, 48*(5), 629-656.

Eisenhart, M., & Edwards, L. (2004). Red-eared sliders and neighborhood dogs: Creating third spaces to support ethnic girls' interests in technological and scientific expertise. *Children Youth and Environments*, *14*(2), 156-177.

Goode, J., & Margolis, J. (2011). Exploring computer science: A case study of school reform. *ACM Transactions on Computing Education (TOCE), 11*(2), 12.

Grover, S. & Pea, R. D. (2013). Computational thinking in K-12: A review of the state of the field. *Educational Researcher. 42*(1), 38-43.

Harel, I. (1991). *Children designers: Interdisciplinary constructions for learning and knowing mathematics in a computer-rich school*. Norwood, NJ: Ablex.

Harel Caperton, I. (2010). Toward a theory of game-media literacy: Playing and building as reading and writing. *International Journal of Gaming and Computer-Mediated Simulations, 2*(1), 1-16.

Henderson, L. (1996). Instructional design of interactive multimedia: A cultural critique. *Educational Technology Research and Development*, *44*(4), 85-104.

Henderson, L. (2007). Theorizing a multiple cultures instructional design model for e-learning and e-teaching. In A. Edmundson (Ed.), *Globalized e-learning cultural challenges* (pp.130-153). Hershey, PA: Information Science Publishing.

Ho, H., Gore, J., & Chadwick, K. (2012). *Globaloria replication study: An examination of the relationships between Globaloria participation and student achievement in year 4 of the West Virginia pilot implementation.* Charleston, WV: Edvantia.

Kafai, Y. B., & Burke, Q. (2015). Constructionist gaming: Understanding the benefits of making games for learning. *Educational Psychologist*, *50*(4), 313-334.

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal*, *32*(3), 465-491.

Lee, C. D. (2003). Toward a framework for culturally responsive design in multimedia computer environments: Cultural modeling as a case. *Mind, Culture, and Activity*, *10*(1), 42-61.

Margolis, J., Ryoo, J. J., Sandoval, C. D., Lee, C., Goode, J., & Chapman, G. (2012). Beyond access: Broadening participation in high school computer science. ACM Inroads, 3(4), 72-78.

McLoughlin, C. (1999). Culturally responsive technology use: developing an on-line community of learners. *British Journal of Educational Technology*, *30*(3), 231-243.

Pinkard, N. (2001). *Lyric reader: Creating intrinsically motivating and culturally responsive reading environments*. Center for the Improvement of Early Reading Achievement, University of Michigan.

Reppening, A., Webb, D., & Ioannidou, A. (2010). Scalable game design and the development of a checklist for getting computational thinking into public schools. *The 41st ACM Technical Symposium on Computer Science Education, SIGCSE 2010*, (Milwaukee, WI), ACM Press.

Reynolds, R. (2016a). Defining, designing for, and measuring "digital literacy" development in learners: A proposed framework. *Educational Technology Research & Development*. 64(4), 735-762.

Reynolds, R. (2016b). Relationships among tasks, collaborative inquiry processes, inquiry resolutions, and knowledge outcomes in adolescents during guided discovery-based game design in school. *Journal of Information Science: Special Issue on Searching as Learning, 42*, 35-58.

Reynolds, R., & Chiu, M. (2012). Contribution of motivational orientations to student outcomes in a discovery-based program of game design learning. Proceedings of the *International Conference of the Learning* Sciences (ICLS), July 2012, Sydney, Australia.

Reynolds, R., & Chiu, M. (2013). Formal and informal context factors as contributors to student engagement in a guided discovery-based program of game design learning. *Journal of Learning, Media & Technology*, *38*(4), 429-462.

Reynolds, R., & Chiu, M. (2016). Reducing digital divide effects through student engagement in coordinated game design, online resource uses, and social computing activities in school. *Journal of the Association for Information Science and Technology (JASIST), 67*(8), 1822–1835.

Reynolds, R., & Harel Caperton, I. (2009). The emergence of 6 contemporary learning abilities in high school students as they develop and design interactive games. Paper presented at AERA, April 2009.

Salen, K., Torres, R., Rufo-Tepper, R., Shapiro, A., & Wolozin, L. (2010). *Quest to Learn: Growing a school for digital kids*. Cambridge: MIT Press.

Scott, K., Sheridan, K., & Clark, K. (2015). Culturally responsive computing: A theory revisited. *Learning, Media and Technology, 40*(4), 412-436.

Scott, K. & White, M. (2013). COMPUGIRLS' Standpoint: Culturally responsive computing and its effect on girls of color. *Urban Education, 48*(5): 657-681.

Sheridan, K., Clark, K. & Williams, A. (2013). Designing games, designing roles: A study of youth agency in an informal education program. *Urban Education, 48*(5): 734-758.

Vavrus, M. (2008). Culturally responsive teaching. In T. L. Good (Ed). *21st century education: A reference handbook* (Vol. 2, pp. 49-57). Los Angeles: Sage Publications.