Advancing Culturally-Relevant Computing through a Researcher-Practitioner Partnership

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Abstract: This paper shares the ongoing work of the Advancing Culturally-Relevant Computing Project, a researcher-practitioner partnership situated in the diverse, multicultural context of Hawai'i. Focused on the topic of culturally-relevant computing, the project aims to better understand how to prepare elementary teachers to integrate Computer Science into their classrooms in ways that are effective, efficient, and meaningful. The presentation introduces culturally-relevant computing, showcases examples of culturally-relevant computing lessons, and shares highlights from a three-day professional development workshop for elementary teachers.

Introduction

Computer science (CS) education continues to be a major area of unevenness across K-12 schools. For some, CS education has become a core discipline, fueled, in part, by the substantial amount of work exploring how CS teaching and learning unfolds in K-12 classrooms (Proctor et al., 2019). For others, CS education initiatives are in their infancy, hampered by ongoing shortages of qualified teachers (Shein, 2019). With so few teachers available, many schools are forced to ask teachers with minimal prior experience to teach CS courses (Gal-Ezer & Stephenson, 2010). This results in a subpar learning experience for students and an overwhelming experience for instructors. In fact, research has shown that without formal training in CS education, many teachers face challenges such as pedagogical issues, lack of community, and little understanding of course content (Yadav et al., 2016).

To help promote CS education and address the teacher shortage, some researchers and practitioners have begun to draw on *culturally-relevant pedagogy* as a mechanism for promoting CS. Ladson-Billings (1994) defined culturally-relevant pedagogy as using "cultural referents to impart knowledge, skills, and attitudes" (p. 17-18), ultimately empowering students intellectually, socially, emotionally, and politically. A central idea behind culturally-relevant pedagogy is to make explicit connections between students' home culture and the subject matter they are learning (Gay, 2010; Ladson-Billings, 1995). This idea is supported by research showing that using culturally-relevant

approaches in the classroom can result in increased motivation for learning and improved academic achievement (Boutte, et al., 2010; Capper, 2021; Langlie, 2008).

Culturally-relevant pedagogical approaches have been combined with CS education to form a practice known as *culturally-relevant computing* (Eglash et al., 2013; Kafai et al., 2014; Madkins et al. 2019; Nakajima & Goode, 2019; Scott et al., 2015; Scott & White, 2013). Culturally-relevant computing tries to use the core concepts and practices of CS to help students grow intellectually and morally, develop cultural competence, and critical consciousness. This combination of CS and culture has led practitioners and researchers to develop CS-related activities and resources that are culturally-relevant for learners and their communities (Buechley et al., 2007; Scott & White, 2013; Nakajima & Goode, 2019). Supporting these efforts is a number of empirical studies showing how culturally-relevant computing can increase student engagement and academic performance (Franklin et al., 2011; Martin et al., 2017; Mejias, 2018; Scott & White, 2013).

Current Study

With this background in mind, a team of researchers at a public university in Hawai‘i established a researcher-practitioner partnership with the Hawai'i State Department of Education (HIDOE). Funded by the National Science Foundation, the main goal of the partnership was to 1) design and develop instructional modules and resources for in-service teachers working in upper elementary, 2) deliver professional development workshops integrating culturally-relevant computing, and 3) build a professional learning community around culturally-relevant computing. In addition to these goals, the project aims to develop a theoretical and practical understanding of how culturally-relevant computing can prepare educators to promote valued CS and culture-based education outcomes. Given the interdisciplinary nature of the project, the research team is composed of four faculty members in the field of learning design and technology, three in-service resource teachers, and four graduate students. Now in its second year, the project spent its first year designing and developing three culturally-relevant computing (CRC) modules. The modules are multi-day, multi-lesson units that are meant to introduce and operationalize the concept of culturally-relevant computing.

Designing Culturally-Relevant Computing Modules

In the first year of the project, the interdisciplinary team developed three CRC modules. The goal was to provide educators with concrete “plug and play” examples of culturally-relevant computing modules. In terms of content, each module focused on a single core concept of CS. According to the CSTA K-12 CS Standards, there are five core concepts of CS, including computing systems, networks and the internet, data and analysis, algorithms and programming, and impacts of computing. In terms of cultural content, each module drew on social studies standards unique to Hawai'i.

The first module, entitled “Pūnaewele Puni Honua: Our Online Community,” was designed to explore the culture in Hawai‘i, its places, people, and their relationships. This module acknowledges and celebrates Hawaii’s multiculturalism while simultaneously analyzing how computing and technology impacts daily life. In this module students learn about the concept of digital citizenship and practice applying Hawaiian cultural values such as malama (to care for) and kuliana (responsibility) to decisions made online and off.

The second module, “Community, Petroglyphs, and Sprites,” was designed to provide opportunities for students to connect our modern lives and stories to the lives and stories of early Hawaiians. Further, students in this module make connections between two different systems– the computer and Hawaiian society. Through this

process, students learn how to use Code.org's SpriteLab to create digital stories of their own. After studying how early Hawaiians used petroglyphs to document important events and tell stories, students created their own stories by creating animated petroglyphs in SpriteLab.

The third module developed in the first year of the project was titled, "Storytelling through Digital Media." This module allows students to explore the migration patterns of early Polynesians and how they used wayfinding to navigate from place to place without modern technology. Culturally, the module draws on pop culture, focusing on Moana the animated feature film by Disney. Through the module, students learn about the tradition and historical value of wayfinding in Hawai'i, as they learn how to sense the environment and capture data about using computer systems.

To design these modules, the research team developed a hybrid framework to guide the process of developing culturally-relevant computing modules. This hybrid framework started with ADDIE, the generic instructional design model consisting of five interconnected phases (Analysis, Design, Development, Implementation, and Evaluation). Using the ADDIE model as a base, the team realized an additional perspective was needed to ensure cultural relevance was properly integrated. To this end, the research team created a list of questions that should be considered during the phases of analysis, design, and development. For example, for the analysis phase, the research team started with essential questions such as "Who are our students?", "What are their interests?", and "What is their previous CS Knowledge?" In the design phase, other questions were listed including, "What CSTA standard are we planning to cover?", "What are Social Studies standards should or could be covered?", and "What specific cultural reference/idea/topic can we anchor the module on?" Lastly, for the development phase, the team asked, "How can we use culturally diverse examples to express the same content and learning expectations?", "How can we empower student identity?", and "Are student voice, agency, and self-determination prioritized in our module?" By combining these guiding questions with the generic ADDIE model of instructional design, the research team felt they had developed a promising approach to making the design of culturally-relevant computing lessons more effective, efficient, and meaningful.

The three CRC modules that resulted from using this hybrid framework were composed of multiple lessons. The modules themselves include a full suite of instructional materials including lesson plans, video tutorials, presentation slides, and student activity sheets. The intent of developing the modules with various concrete instructional resources was to provide complete instruction for teachers so that even teachers new to CS education can "*plug and play*" the modules in their classrooms without investing their time and effort to prepare their own CS lessons.

Professional Development Workshop

After completing the design and development of the three CRC modules, the research team designed a three-day, face-to-face professional development workshop. The purpose of the workshop was twofold: 1) to build shared understanding of the concept and practice of culturally-relevant computing, and 2) to form a community of educators interested in promoting culturally-relevant Computer Science in Hawai'i. Accordingly, the professional development was designed as a hands-on experience, which allowed in-service elementary teachers to engage in practical activities, pedagogical exploration, and deep discussion. More specifically, the workshop was designed with the following format:

1) Teacher-participants experienced live demonstrations of lessons from the CRC modules from a student perspective.
2) Teacher-participants shared their experiences being "students" of CRC and made connections to their teaching practice.

3) Teacher-participants prepared and planned to teach other participant-teachers lessons from the same CRC module using or modifying the instructional resources provided.
4) Teacher-participants taught other participant-teachers, in a small group, their original or modified CRC module lesson.
5) Teacher-participants shared and reflected on their experiences practicing CRC instruction.

Using this approach, all workshop participant-teachers had experienced all three CRC modules, first as teachers learning and second as teachers teaching.

In the summer of 2022, after completing the workshop development, the research team invited in-service teachers to participate in a pilot test of the project's first three-day workshop. A total of 16 participant-teachers volunteered to participate in the workshop. Throughout the workshop, discussions on the "what, why, and how" of designing and implementing culturally-relevant computing lessons were facilitated.

Since this was the first time implementing the workshop using the newly developed CRC modules, the research team embedded robust formative evaluation into the workshop. For example, after experiencing a live demonstration of a lesson from a CRC module, the participant-teachers were asked to fill out an evaluation survey. The purpose was to gather anonymous feedback about the design of the module. Participant-teachers were asked to respond to 19 statements such as, "I found this module engaging," "I believe this module will help students develop an interest in computer science," and "I am likely to use this module in my classroom." All items used a Likert scale anchored at the endpoints ("1 - Strongly Disagree" to "5 - Strongly Agree"). In addition to answering the Likert-scale items, teacher-participants were asked to explain their answers by elaborating on why they agreed or disagreed with each statement. Further, after the teacher-participants had opportunities to learn about the modules and experience teaching them, they were asked to participate in a focus group interview. The focus group interviews consisted of four teacher-participants and a member of the research team. The focus group interviews were meant to provide an open forum for the teacher-participants to share openly about the individual CRC modules, their experience teaching lessons from the modules, and their overall experience with the workshop.

While data analysis is still ongoing, preliminary findings suggest the CRC modules were well received by the teacher-participants. For example, the average rating on the 19 Likert-scale items was 4.22 (SD = 0.81) out of 5.00. Teachers also shared positive comments about their experiences with the workshop. Importantly, the teacher-participants' constructive feedback helped the research team produce a list of revisions to the CRC modules to make them even more approachable and practical for elementary classrooms.

Conclusion

While a great deal has been learned about the principles and processes of how to make the vision of culturally-relevant computing a reality in elementary classrooms, there is still a lot more work that needs to be done. This project's researcher-practitioner partnership with the Hawai'i State Department of Education represents an honest attempt to bring together an interdisciplinary team to advance culturally-relevant computing. To date, the partnership's work of developing CRC modules and a corresponding PD workshop has helped improve the field's theoretical and practical understanding of how culturally-relevant computing might prepare educators to simultaneously promote valued CS and culture-based education outcomes.

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Acknowledgements

This work was supported by the National Science Foundation through the Division of Research on Learning (Grant #2122874).