AI for Social Good Education Through a Culturally Responsive Pedagogy

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Abstract The advances of artificial intelligence (AI) have impacted and opened opportunities for almost every single industry. Meanwhile, it also holds potential to address pressing societal issues such as traffic, climate change, and poverty. It is therefore crucial to educate the next generation of students from various disciplines to be capable of practical AI skills while having the awareness and confidence to innovatively contribute to their communities. We introduce the AI for Social Good (AI4SG) project that aims to teach AI through the lens of social good to students of multiple disciplines. We deployed the AI4SG curriculum among 514 undergraduate students in management information systems, geography, and computer science at three universities. Students reported increased level of interest and curiosity in learning AI, appreciated project-based learning, and developed learning space within and beyond their classroom.

Keywords Artificial intelligence · Education · Social good · Interdisciplinary education · AI for Social Good · Undergraduate education · STEM education culturally responsive pedagogy

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1 Introduction

Advances in new technologies, including artificial intelligence (AI), have fueled the Fourth Industrial Revolution affecting the way people live, work, and relate to one another. As part of its 2030 Agenda for Sustainable Development, the United Nations, in 2015, set up the 17 Sustainable Development Goals (SDGs) (e.g., reduce inequality, provide affordable and clean energy, improve health and education) which were a call for action by countries in a global partnership in AI innovation and education for social good [1]. These goals align with the mission of the California State Universities (CSUs), with 21 of 23 campuses being Hispanic-Serving Institutions (HSIs). Faculty and researchers from the CSU system have been exploring how AI can be used for social good by addressing societal challenges, thereby improving people's lives. This raises two questions for educators: (1) How can undergraduate students from diverse majors learn AI so they are equipped with the necessary skills for the future workforce and become tomorrow's model citizens and leaders? (2) How can student engagement and learning in AI be increased to reduce the equity gap in AI education?

The AI for Social Good (AI4SG) project aims to broaden AI education by developing and studying the efficacy of innovative learning practices and resources for AI education for social good. We have developed three AI learning modules for students to (1) identify social issues that align with the SDGs in their community (e.g., poverty, hunger, quality education), (2) learn AI through hands-on labs and business applications, and (3) create AI-powered solutions in teams to address social issues they have identified. Student teams are expected to situate AI learning in their communities and contribute to their communities. Students then use the modules to engage in an interdisciplinary approach, facilitating AI learning for social good in management information systems, geography, and computer science at three CSU HSIs (San Jose State University (SJSU), Cal Poly Pomona (CPP), and CSU San Bernardino (CSUSB)).

2 Related Work

2.1 Culturally Responsive, Relevant, and Sustaining Pedagogy (CRRSP)

Culturally Responsive, Relevant, and Sustaining Pedagogy (CRRSP) is a student-centered teaching framework, drawing upon decades' worth of research [2–6], that recognizes and affirms students' racial, linguistic, and cultural identities to develop their agency, encourage academic rigor and critical thinking skills, uplift marginalized voices, and empower students to become agents of change through a strong development of their sociopolitical or critical consciousness. CRRSP recognizes and responds to students' identities and needs by using the cultures, experiences, and

narratives of culturally diverse students as resources for their own learning and the teaching of peers [7]. Teaching that recognizes the cultural characteristics, experiences, and perspectives of culturally diverse students affirms the cultural knowledge and skills they and their communities offer the classroom [3]. CRRSP realizes that student learning is impacted by factors that go beyond the classroom [3, 7]; integrating students' and communities of Color's knowledge and skills into classroom learning normalizes the knowledge and skills of communities of Color, enriches classroom learning, and promotes a curriculum that is accessible and relevant to all students [5], thereby increasing students' social, cultural, and academic success [8–11].

CRRSP does not replace rigor with inclusion or vice versa; rather, it intentionally empowers students intellectually, "socially, emotionally, and politically" [5] (p. 159). Because CRRSP integrates community and diverse academic knowledge and skills, students develop their critical consciousness and cultural awareness of society, others, and themselves [5, 7, 12]. A culturally affirming instructor integrates practices that simultaneously foster academic success and empower students to ask critical questions [2, 13]. Through the development of student agency, CRRSP builds students' critical literacies to connect their lives/cultures to examples of oppression in curricula, institutions, and disciplines [14].

In contrast to CRRSP's concern with connecting students' identities, cultures, and communities to the classroom, past research has made visible the lack of diversity in particular fields, including computer science (CS). CS has historically been inaccessible to racially marginalized groups, women, and students from working class communities [15]. Work has been done to take a culturally affirming approach to CS education by examining and diversifying what artifacts are produced, how courses are taught, and how to deepen student participation [16, 17]. From this work, culturally responsive computing (CRC) has emerged based on the principles of CRRSP to encourage students to engage, reflect, and build tools while simultaneously challenging the status quo in computing [18, 19].

CRC promotes equity in STEM by rooting the curriculum in a social critique lens [19, 20] to leverage the cultural and linguistic assets of the local community and students [21, 22]. Through CRC, students engage and challenge political, economic, and social issues, including oppressive conditions they have experienced. CRC has five main tenets that shape a culturally responsive computing environment: (1) every student is capable of digital innovation; (2) the learning context must support the transformational use of technology; (3) learning should be about one's self along various intersecting sociocultural lines that allow for technical innovation; (4) technology should be a vehicle for students to reflect and demonstrate understanding of their intersectional identities; and (5) standards for technological success must consider who creates, for whom, and to what end, rather than who endures socially and culturally irrelevant curriculum [19] (pp. 420–421). In sum, CRC's goals are similar to those of CRRSP: to create an educational (computing) environment that values student/family/community expertise, to provide opportunities for collaborations with local community organizations and community experts, and to focus not

only on the content (i.e., tool design) but also on the design and implementation of a CRC curricula [22].

Past examples of CRC demonstrate the connection it has to CRRSP. Examples include teen girls using digital technology to educate their local community about relevant, but stigmatized, social issues (e.g., teen pregnancy) [23], using "social GIS" to explore social justice issues with data science and mapping tools [24], using computational skills to share Indigenous knowledge and language [20], and working with young women to develop a Zambian Women's Rights mobile app [25]. Past research has established that when students are encouraged to embed their identities, cultures, and communities into their STEM learning and computing, students' motivation is enhanced, which has the potential to also increase student agency and STEM participation [10, 26]. Teaching through a CRC lens creates opportunities to align the goals of instructors and community members through a collaboration that leverages "community assets" that are relevant to the students and their lived realities [22] (p. 5) while also promoting equity in CS [27].

3 AI4SG Curriculum Design

We designed AI learning modules called "AI for Social Good (AI4SG)" to educate undergraduates from STEM and non-STEM backgrounds. These instructional modules are a result of interdisciplinary work from the research team and are based on CRC and targeting sustainability as an application case [20]. CRC is particularly suitable for interdisciplinary, community-based, and inclusive AI education due to its five tenets: (1) all students are capable of digital innovation, modules will have varying levels of learning support and application; (2) the learning context supports transformational use of technology, modules will be designed to address relevant social issues in students' communities; (3) learning should be about one's self along various intersecting sociocultural lines that allow for technical innovation, modules are interdisciplinary and the exchange of cultural values will be incentivized; (4) technology should be a vehicle in which students reflect and demonstrate understanding of their intersectional identities, modules will be designed for students to express and bring their full self into the practice and community; and (5) barometers for technological success should consider who creates, for whom, and to what ends rather than who endures socially and culturally irrelevant curriculum, modules will emphasize the importance of social good, community, and ethics in AI, enabling students to contribute to their communities as they learn AI. In addition to CRC, the project also incorporated sustainability, particularly the United Nations' Sustainable Development Goals (SDGs), into the AI4SG modules. This integration aims to educate students about the role of AI in achieving these global goals and encourage them to consider sustainability in their AI projects as a case for social good.

We designed modules that (1) encourages students to choose topics that they care about—sustainability, (2) offers appropriate difficulty levels that students feel competent to work on, and (3) empowers students to create concrete solutions relevant and beneficial for their communities and future careers. Therefore, "AI for Social Good" is deployed as a student-team project with three modules [28–31]:

- Module 1: identifying sustainability challenges in students' communities (using the SDGs as guide)
- Module 2: learning AI concepts and applications through hands-on AI labs and study cases
- Module 3: learning AI innovation by proposing or creating, in teams, AI-powered solutions to address the social issues and discussing the benefits and risks

In Module 1: Social Problem, students were provided with material on the Sustainable Development Goals (SDGs) and local applications of the SDGs for initial ideation of possible topics of study. Additional material was provided on how to identify a social issue and connect it to the SDGs. Students formed teams and identified relevant social issues in their community through observation, taking photos, and interacting with the community. This task allowed students to connect the module content to their lived experiences, motivating them by choosing challenges that mattered to them. This module also helped students establish an intrinsic value to learn skills to address problems relevant to them and their communities.

In Module 2: AI Labs, students were provided with AI "toolkits" to learn the concepts and applications of AI. The purpose of providing these toolkits was to facilitate ideation on how they might use AI to address the social issue identified in Module 1. The project curated demonstrations (demos) of common AI applications and tutorials on how to use them from leading AI companies (e.g., IBM, Google). These AI applications covered machine learning, conversational agents, visual recognition, speech to text, text to speech, sentiment analysis, etc. This module encouraged students to learn AI concepts by using the provided AI demos and to summarize the definitions and functions of these AI applications. For advanced options, students participated in hands-on labs using an adapted version of existing AI platforms and tutorials from the industry to meet students' levels. The project team compared alternative platforms that best served project and student needs (i.e., Google, Microsoft). Subsequently, students were provided with short study cases in which companies and organizations use AI to create innovative solutions. Studying the technical and application aspects of AI helped them connect what they learned about AI to the problems in their communities they had selected. We expected that using cutting-edge technologies and application cases that matched students' capabilities allowed students to increase the attainment value in learning.

Finally, in Module 3: AI-Powered Innovation, students worked with their teams as simulated "startups" to create AI-powered solutions for pressing social issues in their communities. Having identified a social issue in Module 1 and learned about AI toolkits in Module 2, student teams integrated these modules and ideated how AI applications could be utilized to address their chosen topics. Students were guided through brainstorming based on a simplified design thinking framework, an

analytical and creative problem-solving framework that engages a person to ideate, prototype, and evaluate solutions iteratively. Students were also instructed on a risk/benefit analysis to evaluate their plans of AI4SG in their communities [32]. For advanced options, student teams have created prototypes based on the hands-on AI labs they learned in Module 2. Students then presented their solutions, complete with a risk/benefit analysis, in front of gamified "investors"—external industry or community guests who served as judges for the student presentations. The AI4SG project guided students in developing AI solutions for community issues, emphasizing the value of their diverse backgrounds for innovation. Through a simulated "social entrepreneurship" experience, students presented their ideas to external judges, enhancing their sense of social citizenship and leadership. Furthermore, the project incorporated the SDGs, encouraging students to align their AI solutions with these goals. This fostered global citizenship and responsibility among students, positioning the AI4SG project as a tool for not just teaching AI but also promoting sustainable development and social good.

4 AI4SG Implementation

Our project aimed to implement AI4SG modules by engaging undergraduate students in practical projects across a range of disciplines and institutions, thereby promoting AI learning, community engagement, and inclusiveness. Adopting an interdisciplinary approach, we recognized the necessity of drawing upon multiple disciplines due to AI's broad applications across all industries and the complex nature of social problems. Consequently, the teaching modules developed in the project's initial phase were deployed across various disciplines to meet the diverse needs of undergraduate students at different academic levels. Lower division students were introduced to AI concepts, applications, and innovation, while upper division students gained hands-on experience by creating prototypes, preparing them for AI-related careers and potential startups.

We emphasized an interdisciplinary approach throughout the project. Before starting Module 1, students engaged with existing projects completed by their peers, as documented in studies [30, 31, 33], to understand the context for community-engaged projects. This step aimed to enhance students' appreciation for the value of their work. Before Module 2, we facilitated idea exchanges between students from different disciplines and campuses (SJSU, CSUSB, CPP), fostering an appreciation for disciplinary, cultural, and regional diversity. Following Module 3, students showcased their AI-powered social innovation projects in a workshop across the three campuses, further enhancing their understanding of the projects' utility value.

The project's commitment to diversity was evident in its execution across the three highly diverse CSU campuses. We engaged students from both upper and lower academic divisions, encouraging teamwork to explore AI solutions to social

problems. For the upper division, students progressed beyond ideation to actually implement and deploy prototypes addressing social issues of their choice.

In Fall 2022 and Spring 2023, the project had reached 514 undergraduate students across 13 classes on the three campuses. These students represented a wide array of majors, including Management Information Systems, Finance, Business Analytics, Accounting Information Systems, Entrepreneurship, General Business, Marketing, International Business, Management, Psychology, Economics, Criminology, Advertising, Kinesiology, Mechanical Engineering, Computer Science, Computer Engineering, Geography, History, Anthropology, Geology, Urban and Regional Planning, Electrical Engineering, Landscape Architecture, Environmental Biology, Agribusiness, and Food Industry Management. This diverse participation underscored the project's comprehensive reach and impact on promoting interdisciplinary AI education and community engagement.

5 Findings

In Fall 2022, we conducted individual interviews with three students at the beginning and end of the semester to pilot the interview questions and to determine any initial themes that emerged to inform the focus groups next semester. During Spring 2023, the research team decided that focus groups would be the main data source for the qualitative data collection to ensure that the qualitative data was rich and robust, given the diversity of the student-participant pools. Thirteen students participated in the beginning-of-semester focus group and nineteen students in the end-of-semester focus group. To maintain independence and impartiality, the interview and focus group studies were conducted by a co-author from a different institution who had no direct involvement in the courses integrating AI4SG modules. This section presents three preliminary findings from our qualitative interview and focus group studies [34].

Developing an Interest and Curiosity in AI Technology Results indicate that students develop an interest in the potential application and development of AI technology over the course of the semester. Most students appear to take the courses because they are "required" for their major across all three institutions; during interviews at the start of the semester, very few students discuss being personally interested in the content of the courses.

However, by the end of the semester, findings indicate that students develop a clearer understanding of the uses of AI, the impact that AI has on people's lives, and the potential AI holds to improve people's lives (including for communities of Color), and, overall, many more students are interested in integrating AI into their future careers or are open to the possibility, should one arise. For example, one student who is unsure if something like AI would be used in their future career still states that "if my future company does have that [opportunity], I would love to be a part of those organizations that actually take time" to help bring computer science,

AI, and other technology to others, such as children and marginalized neighborhoods. The course and project sparked an interest in these students to share the benefits of AI technology with those who may not have access otherwise.

By the end of the course, students are able to discuss the limits of AI, including various ethical dilemmas that AI technology may present in the future as further developments are made. One student brings up the fact that "the people that are actually developing the technology will have their biases," while another student states that the potential for future developers working in AI have "a lot of power and with that comes a lot of responsibility." Many students agree that AI technology needs to be monitored because it can "definitely be used for good, but it can also be used for very bad things." Through the process of completing the project, including the group work (see finding #2) and the emphasis on community (see finding #3), students now understand there are both scientific implications and humanistic implications when developing AI technology.

Appreciation for Project-Based Learning Assessments Initial findings suggest that the learning modules used in the courses at the three institutions are the type of learning experiences students desire, as expressed in the interviews. For example, when asked what advice they would give course instructors about how to make course content more relevant to their lived experiences, at the beginning of the course, the majority of focus group students begin the semester wanting as many opportunities as possible to practice applying the course content in contextualized situations.

During focus groups at the end of the semester, students across all courses refer to the "AI for Social Good" project done in the present course as an example of what other STEM-related courses should use as a summative assessment.

"Project-based learning" (PBL) is a type of inquiry-based learning that provides students with opportunities to construct knowledge through real-world questions, problems, and practices [35] to create meaningful learning experiences [36] that include peer social interactions and the sharing of knowledge and understanding with others. As a PBL assessment, the students discuss aspects of the "AI for Social Good" project they enjoyed, including collaborating with their peers, applying their personal knowledge and expertise, and demonstrating their content knowledge through an authentic context. When talking about the advantages of collaboration, one student explains that "a huge advantage of working in a group is that you're able to get perspectives from so many different places," demonstrating their understanding of how effective group-based learning is compared to the traditional, passive learning found in lecture-based courses. Another student even calls the present course "an outlier" because "STEM courses tend to focus more on a technical understanding, or it's very just 'get it done,' instead of having that human factor to it," which, they feel, their course did take into consideration in relation to the course content, completing the PBL assessment with their peers, and designing the final product with other communities in mind.

Developing Community Inside and Outside the Classroom A final theme is how students discuss the importance of "community" both inside and outside the classroom. At the beginning of the course, when discussing a hypothetical scenario of a student of Color who is struggling to feel included in a STEM course, the topic of "community" is consistently brought up. Some students speak about struggles they experienced before finding their community on campus; other students mention their family and friends from home who support them emotionally and help them to persist through difficulties in school.

During focus groups at the end of the semester, students still hold the same views on the importance of community when unpacking another scenario with the hypothetical student of Color. The student's expressed disappointment with the hypothetical classmates in the scenario who are described as "unsupportive" or "mean." Several students contrast the scenario to their own positive group experiences during the "AI for Social Good" project; students across the courses characterize their learning environments as "welcoming," with one student feeling "very lucky and fortunate to have such a diverse class of people" to work with over the semester. Another student talks about how through this project their instructor created "a pretty strong bond within the class," revealing the class community that was created through the efforts of the instructors, the learning that linked course content to community, and the process of collaborating with peers. Likewise, several students share how their ideas for the group project are based on their own lived experiences (e.g., struggling with basic needs, searching for affordable textbooks) and were taken up by their group for the final project.

Worth noting is that students do not mention the role of communities geographically local to campus during focus groups at the start of the course; but, by the end of the course (Spring 2023 focus groups), students include the role of local communities in the context of their learning and future careers. For example, when asked what advice they would give instructors to make the courses more relevant to their lived experiences, students suggest instructors integrating more opportunities to integrate the local community, such as interviewing local community members and working with local community organizations to understand their needs and to "improve the social good" of the local community more directly.

Additionally, when asked to rank the importance of the course content to either their future careers, their daily lives, or improving the lives of communities of Color, by the end of the semester, less students prioritize themselves and instead, prioritize improving the lives of communities of Color. One student uses the class project as an example of improving the social good for others (over themselves), stating: "a great example of this [priority]was just in the class itself. A lot of the [group] projects were based on helping communities of Color, whether it be gaining access or knowledge about food, or bridging a gap between education, between different levels of income . . . and I think it could be utilized in helping communities of Color." By leveraging their experiences within their own communities alongside their content knowledge and skills, initial findings indicate that through this project, students begin building connections between the self, others, and the greater good—something lacking in

their previous STEM experiences. Any evidence of students developing an interest in investing in local and/or marginalized communities by the end of the semester will be further examined in future semesters.

6 Dissemination

To maximize the impact of the AI4SG project, we devised a strategic dissemination plan aimed at broadening the project's scope beyond our immediate academic and geographic confines. Central to this strategy was a project website, designed to showcase the diverse "AI for Social Good" projects undertaken by students across participating CSU campuses, available at https://www.aiforsocialgood.org/. This Web site not only highlights the innovative solutions our students have developed to address societal challenges through AI but also serves to inspire educators, stakeholders, and investors about the potential of AI for social improvement. It aims to connect the theoretical knowledge of AI with practical, community-focused applications, thereby engaging current students and motivating future participants.

Further amplifying our outreach, we organized a virtual symposium in collaboration with the CSU Chancellor's Office and STEM-NET, designed to foster cross-disciplinary and cross-institutional dialogues about AI's role in societal transformation. The First Annual CSU AI for Social Good Student Innovation Symposium brought together students, faculty, industry partners, and community stakeholders, facilitating a rich exchange of ideas and highlighting career opportunities in the field of AI. It attracted about 150 attendances in May 2023. Through these initiatives, our dissemination effort not only showcased the practical outcomes of the AI4SG project but also established a foundation for ongoing collaboration and innovation in the application of AI for Social Good.

7 Conclusion

In this study, we introduced the AI for Social Good (AI4SG) project, which aims to offer an innovative educational pedagogy to impart AI knowledge to undergraduate students from diverse academic disciplines, with a focus on societal betterment. Students were instructed to gain a multifaceted understanding of AI applications through case studies, practical hands-on lab sessions, and the prototyping of AI-driven solutions for local societal challenges. The AI4SG curriculum was implemented among three universities between Fall 2022 and Spring 2023 semesters, encompassing 514 students from three distinct disciplines. Students have reported increased level of curiosity and interests in learning AI and a stronger inclination toward AI-related careers. They also appreciated the project-based approach to address important social issues in their own community. Finally, students found it enriching to transcend the traditional classroom boundaries, taking

their learning experience into their communities. With the promising preliminary results, we plan to continue to implement the project among more instructors from a variety of disciplines.

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References

1. Keating, J., & Nourbakhsh, I. (2018). Teaching artificial intelligence and humanity. *Communications of the ACM, 61*(2), 29–32.
2. Brown, J. C., & Crippen, K. J. (2016). The Growing Awareness Inventory: Building capacity for culturally responsive science and mathematics with a structured observation protocol. *School Science and Mathematics, 116*(3), 127–138.
3. Gay, G. (2018). *Culturally responsive teaching: Theory, research, & practice* (3rd ed.). Teachers College Press.
4. Kelley, H. M., Siwatu, K. O., Tost, J. R., & Martinez, J. (2015). Culturally familiar tasks on reading performance and self-efficacy of culturally and linguistically diverse students. *Educational Psychology in Practice, 31*(3), 293–313.
5. Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal, 32*(3), 465–491.
6. Paris, D. (2012). Culturally sustaining pedagogy: A needed change in stance, terminology, and practice. *Educational Researcher, 41*(3), 93–97.
7. Gay, G., & Kirkland, K. (2003). Developing cultural critical consciousness and self-reflection in preservice teacher education. *Theory Into Practice, 42*(3), 181–187.
8. Byrd, C. M. (2016). Does culturally relevant teaching work? An examination from student perspectives. *Sage Open, 6*(3), 1–7.
9. Howard, T. C. (2001). Telling their side of the story: African American students' perceptions of culturally relevant teaching. *The Urban Review, 33*(2), 131–149.
10. Hughes, R. M., Nzekwe, B., & Molyneaux, K. J. (2013). The single sex debate for girls in science: A comparison between two informal science programs on middle school students' STEM identity formation. *Research in Science Education, 43*(5), 1979–2007.
11. Wiggan, G., & Watson, M. J. (2016). Teaching the whole child: The importance of culturally responsiveness, community engagement, and character development in high achieving African American students. *The Urban Review, 48*, 766–798.
12. Sleeter, C. E. (2005). *Un-standardizing curriculum: Multicultural teaching in standards-based classrooms*. Teachers College Press.
13. Brown, J. C., & Crippen, K. J. (2016). Designing for culturally responsive science education through professional development. *International Journal of Science Education, 38*(3), 470–492.
14. Gutierrez, K. (2008). Developing a socio critical literacy in the third space. *Reading Research Quarterly, 43*(3), 148–164.
15. Zweben, S., & Bizot, B. (2018). 2017 CRA Taulbee survey. *Computing Research News, 30*(5), 1–47.
16. Fields, D.A., Landa, J., Nakajima, T.M., Margolis, J., Chapman, G., Kafai, Y.B., & Goode, J. (2016, October). Putting making in computer science classrooms: An electronic textiles high school curriculum for Exploring Computer Science. Palo Alto, CA: *Demonstration presented at the annual FabLearn conference*.
17. Fields, D. A., Lui, D., & Kafai, Y. B. (2017). Teaching computational thinking with electronic textiles: High school teachers' contextualizing strategies in Exploring Computer Science. In S.

C. Kong, J. Sheldon, & R. K. Y. Li (Eds.), *Conference proceedings of international conference on computational thinking education 2017* (pp. 67–72). The Education University of Hong Kong. isbn:978-988-77034-4-0.
18. Lachney, M. (2017). Culturally responsive computing as brokerage: Toward asset building with education-based social movements. *Learning, Media and Technology, 42*(4), 420–439.
19. Scott, K. A., Sheridan, K. M., & Clark, K. (2015). Culturally responsive computing: A theory revisited. *Learning, Media and Technology, 40*(4), 412–436.
20. Sandoval, C. D. M. (2013). Critical ancestral computing: A culturally relevant computer science education. *PsychNology Journal, 11*(1), 91–112.
21. Lachney, M., Babbitt, W., & Eglash, R. (2016). Software design in the "construction genre" of learning technology: Content aware versus content agnostic. *Computational Culture, 5*.
22. Lachney, M., Eglash, R., Bennett, A., Babbitt, W., Foy, L., Drazin, M., & Rich, K. M. (2021). pH empowered: Community participation in culturally responsive computing education. *Learning, Media and Technology*, 1–22.
23. Vilchis, M., Scott, K., & Besaw, C. (2015). COMPUGIRLS speak: How we use social media for social movements. In E. Middaugh & B. Kirshner (Eds.), *#youthaction: Becoming political in the digital age* (pp. 59–79). Information Age Publishing.
24. Tully, K. (2015). *Social GIS: Creating a mapping tool to engage middle and high school students with their neighborhoods and STEM*. Rensselaer Polytechnic Institute.
25. Buolamwini, J. (2013). *Proposal for pilot Rhodes year of service: Promoting women's rights through technology education*. http://zamrize.org/showcase/pdf/pilot.pdf
26. Reynolds, R. (2016). Defining, designing for, and measuring "social constructivist digital literacy" development in learners: A proposed framework. *Educational Technology Research, 64*(4), 735–762.
27. Scott, K. A., Aist, G., & Zhang, X. (2014). Designing a culturally responsive computing curriculum for girls. *International Journal of Gender, Science and Technology, 6*(2), 264–276.
28. Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist, 26*, 369–398.
29. Chen, Y., Albert, L. J., & Jensen, S. (2022). Innovation farm: Teaching artificial intelligence through gamified social entrepreneurship in an introductory MIS course. *Decision Sciences Journal of Innovative Education, 20*(1), 43–56.
30. Chen, Y., Albert, L. J., & Macias, H. (2023). *Prototyping AI-powered social innovation in an undergraduate MIS course. International conference on information systems 2023*.
31. Chen, Y., & Hill, T. R. (2023). AI for Social Good (AI4SG) education in an undergraduate introductory MIS course. *American conference on information systems 2023*.
32. Çetinkaya-Rundel, M. (2021). *Data science in a box*. Retrieved June 1, 2021, from https://datasciencebox.org/ethics.html
33. Creswell, J. W., Hanson, W. E., Clark Plano, V. L., & Morales, A. (2007). Qualitative research designs: Selection and implementation. *The Counseling Psychologist, 35*(2), 236–264.
34. Patton, M. Q. (1990). *Qualitative evaluation and research methods*. Sage.
35. Blumenfeld, P., Fishman, B. J., Krajcik, J., Marx, R. W., & Soloway, E. (2000). Creating usable innovations in systemic reform: Scaling up technology-embedded project-based science in urban schools. *Educational Psychologist, 35*(3), 149–164.
36. Wurdinger, S., Haar, J., Hugg, R., & Bezon, J. (2007). A qualitative study using project-based learning in a mainstream middle school. *Improving Schools, 10*(2), 150–161.