

Dr. R.O. Bott Will See You Now: Exploring AI for Wellbeing with Middle School Students

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Abstract

Artificial Intelligence (AI) is permeating almost every area of society, reshaping how many people, including youth, navigate the world. Despite the increased presence of AI, most people lack a baseline knowledge of how AI works. Moreover, social barriers often hinder equal access to AI courses, perpetuating disparities in participation in the field. To address this, it is crucial to design AI curricula that are effective, inclusive, and relevant, especially to learners from backgrounds that are historically excluded from working in tech. In this paper, we present AI for Wellbeing, a curriculum where students explore conversational AI and the ethical considerations around using it to promote wellbeing. We specifically designed content, educator materials, and educational technologies to meet the interests and needs of students and educators from diverse backgrounds. We piloted AI for Wellbeing in a 5-day virtual workshop with middle school teachers and students. Then, using a mixed-methods approach, we analyzed students' work and teachers' feedback. Our results suggest that the curriculum content and design effectively engaged students, enabling them to implement meaningful AI projects for wellbeing. We hope that the design of this curriculum and insights from our evaluation will inspire future efforts to create culturally relevant K-12 AI curricula.

Introduction

From chatbots to social media, Artificial Intelligence (AI) is increasingly involved in the lives of people of all ages, yet most people are uneducated about how AI-powered technologies work (Gallup and Northeastern University 2019). There has recently been a significant increase in efforts to educate people about AI, including in K-12 classrooms. Yet, issues of access and participation in Computer Science (CS) education persist, especially for groups that continue to be systematically excluded and marginalized in tech (Code.org, CSTA, and Alliance 2022). Prior research in CS education has shown that teachers can help address these disparities by intentionally centering the needs and interests of marginalized students (Ko et al. 2020; Ryoo, Margolis, and Scott 2021; Vakil 2018). Thus, to be inclusive to all, AI literacy education should not only be accessible but also engaging and empowering for marginalized youths (Madkins, Howard, and Freed 2020; Ryoo, Margolis, and Scott 2021).

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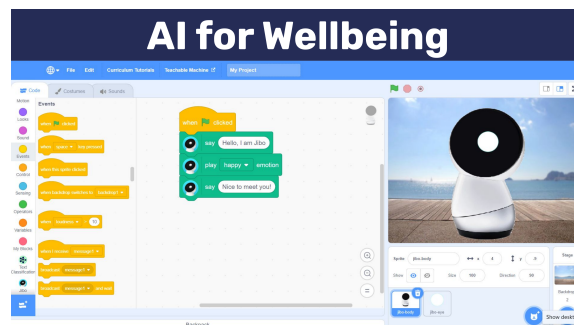


Figure 1: The header for the AI for Wellbeing curriculum and a screenshot of the AI Playground and virtual Jibo robot used in some curriculum activities.

To this end, we designed Impact.AI, an AI literacy framework that supports students in developing identities as technosocial change agents. This framework builds on work in culturally responsive-sustaining computing, which aims to empower all students to learn about and reimagine technology, society, and themselves (Scott, Sheridan, and Clark 2015; Madkins et al. 2019). In this paper, we briefly describe our framework and then present AI for Wellbeing, a framework-aligned curriculum that introduces principles of AI chatbot design to middle school-aged youth.

We piloted AI for Wellbeing during a summer workshop with 23 students and five in-service teachers. We used a mixed methods approach to analyze the data we collected from the pilot to answer our two research questions: (1) How effective was AI for Wellbeing in supporting technical and ethical AI knowledge gain and changing students' perspectives of AI? and (2) How well does Impact.AI align with teachers' desires to bring culturally relevant AI curricula to their classrooms?

Background

Frameworks for K-12 AI Literacy

Researchers have defined frameworks for K-12 AI literacy to guide educators in designing and selecting educational resources for their students. Two particularly relevant frameworks are the Five Big Ideas in AI and the "What is AI literacy" paper by Long and Magerko (Long and Magerko

2020; Touretzky et al. 2019). The Five Big Ideas in AI, defined through a collaboration between the AI4K12 initiative, Computer Science Teachers Association (CSTA), and Association for the Advancement of Artificial Intelligence (AAAI), are Perception, Representation and Reasoning, Learning, Natural Interaction, and Societal Impact (Touretzky et al. 2019). Long and Magerko conducted a literature review of AI curricula, identifying 17 vital AI competencies, including how algorithms work and the limitations of AI. The progress of the K-12 AI literacy movement is evident in the growing number of published articles on K-12 AI curricula that have been implemented both in formal and informal education. A recent review noted more than 100 articles (Williams and Breazeal 2023).

Addressing Diversity in AI Literacy

A common goal of K-12 AI literacy is that to enable all students as users and creators of AI (Long and Magerko 2020). However, little attention has been paid to addressing issues that bar students from marginalized groups from participating in Computer Science (CS). Research in AI ethics has illustrated how AI systems can perpetuate inequity and harm vulnerable groups (Benjamin 2019; Buolamwini and Gebru 2018; Noble 2018). These harms are frequently linked to the underrepresentation of women, gender minorities, Black, Hispanic, and Native / Indigenous Americans in the AI workforce (West, Whittaker, and Crawford 2019).

In the field of CS education, researchers recognize that the broader societal factors that lead to the exclusion of women and other minoritized demographic groups often leak into the classroom (National Academies of Sciences, Engineering, and Medicine and others 2021). Although more than half of high schools now offer computer science courses, opportunities for students from marginalized groups benefit from these courses less often than their peers (Code.org, CSTA, and Alliance 2022). Achieving equity in K-12 AI classrooms requires educators to directly address issues of access and inclusion through inclusive pedagogical practices (Morales-Chicas et al. 2019; Ko et al. 2020; Ryoo, Margolis, and Scott 2021; Vakil 2018).

Frameworks such as Culturally Responsive Computing (Scott, Sheridan, and Clark 2015), Culturally Relevant CS Pedagogy (Kapor Center 2021; Madkins et al. 2019), and Liberatory Computing (Walker, Sherif, and Breazeal 2022) offer guidance to how CS education can challenge, rather than perpetuate systemic discrimination. Culturally Responsive Computing emphasizes students' academic achievement, cultural competence, critical consciousness, and identify as change-makers in STEM (Scott, Zhang et al. 2014; Scott, Sheridan, and Clark 2015; Madkins et al. 2019).

Recently, K-12 AI educators have been specifically working toward integrating Culturally Responsive Computing in AI education (Solyst et al. 2023; Li et al. 2023). For AI education, this looks like helping students develop AI competencies, cultural competence, critical awareness of AI's role in society, and identities as tech change-makers (Everson, Kivuva, and Ko 2022; Kapor Center 2021; Madkins et al. 2019; Solyst et al. 2023). In alignment with these goals, we developed an AI literacy framework that builds on existing

literacy frameworks and Culturally Responsive Computing.

Conversational AI and Diversity

Conversational AI is a highly relevant, engaging, and important topic to teach today's youth. A recent article by Insider Intelligence stated that 35% of people in the USA over the age of 12 owned a smart speaker (Lebow 2022). Because of the voice interface of these devices, even very young children can interact with these devices. In fact, prior research on child-AI interaction has found that children who regularly interact with conversational agents in smart speakers and toys often form friendly, trusting relationships with conversational agents (Druga et al. 2017). However, with limited opportunities to learn about these technologies or how they work, youth are at risk for privacy and consumer rights violations (McReynolds et al. 2017).

Existing K-12 AI curricula teach students concepts like chatbots, programming, the Turing Test, and agent design, often using inclusive teaching practices (Ureta and Rivera 2018; Benotti, Martínez, and Schapachnik 2014; Keegan, Boyle, and Dee 2012; Bigham et al. 2008; Druga et al. 2019; Kim et al. 2021; Norouzi, Chaturvedi, and Rutledge 2020; Van Brummelen, Tabunshchik, and Heng 2021; Van Brummelen, Heng, and Tabunshchik 2021; Zhu and Van Brummelen 2021).

Some curricula grow students' critical consciousness by exploring issues related to bias in speech recognition and chatbot design alongside technical concepts (Kim et al. 2021; Van Brummelen, Tabunshchik, and Heng 2021; Van Brummelen, Heng, and Tabunshchik 2021). Others encourage students with less exposure to technology to pursue CS through hands-on experiences creating conversational agents (Bigham et al. 2008; Druga et al. 2017). Tools such as graphical user interfaces (GUIs), voice user interfaces (VUIs), block-based programming languages, and text-based languages with screen readers have been used to enable new programmers to successfully build conversational agents (Song et al. 2023; Van Brummelen et al. 2020; Van Brummelen, Tabunshchik, and Heng 2021; Van Brummelen, Heng, and Tabunshchik 2021; Zhu and Van Brummelen 2021; Keegan, Boyle, and Dee 2012).

Impact.AI

We developed the Impact.AI framework to empower young people as technosocial change agents and to address tech's lack of diversity by centering students from marginalized groups. The framework encompasses what knowledge students should gain and curriculum design principles. Impact.AI aims for students to learn both technical and ethical AI concepts, acquire skills, and develop more proactive attitudes toward AI. Our AI content structure, as shown in Figure 2, draws inspiration from the concepts, practices, and perspectives framework laid out by Brennan and Resnick for computational thinking (Brennan and Resnick 2012).

Impact.AI defines AI concepts as background knowledge about AI, interdisciplinary topics (e.g. biological science, data science, math) taught alongside AI (Long and Magerko 2020), plus the Five Big Ideas in AI (Touretzky et al. 2019).

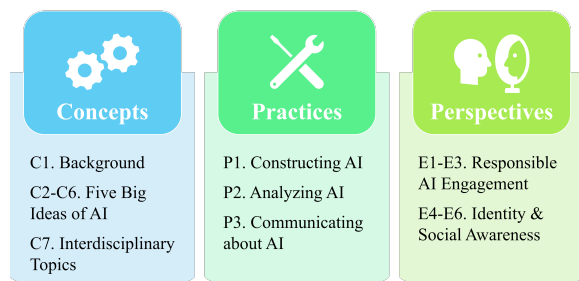


Figure 2: Overview of the Impact.AI framework. The framework encompasses the AI concepts, practices, and perspectives youth should learn as empowered, technosocial change agents.

Specific topics within conceptual areas include key term definitions, distinctions between natural and machine intelligence, explanations of significant algorithms, and examples of related technologies.

We reviewed the skills taught in other K-12 AI curricula, then categorized them into three AI practices: constructing, analyzing, and communicating about AI. Specific skills within these practices include learning different methods and tools, and leveraging conceptual knowledge to determine when to use these approaches and tools. Notably, in most AI curricula construction AI practices are emphasized while analyzing and communicating about AI are overlooked (Garrett, Beard, and Fiesler 2020; Skirpan et al. 2018). However, these practices are essential for students to develop a more holistic view of AI systems that are best positioned to benefit society (DiPaola, Payne, and Breazeal 2020; Payne 2020; Ryoo, Margolis, and Scott 2021; Saltz et al. 2019).

Finally, we define AI perspectives as students' developing beliefs promoting responsible AI engagement (E1. digital literacy, E2. critical digital literacy, and E3. digital citizenship) and activist identities in AI communities (E4. self-efficacy, E5. identity and expression, E6. activism and community). Building on the Culturally Responsive Computing framework by (Scott, Sheridan, and Clark 2015), the identity and social awareness perspectives target students developing an awareness of their potency as technosocial change agents.

Impact.AI also recommends three curriculum design principles: active learning, embedded ethics, and lowering barriers to access. With active learning, students learn through engaging in hands-on activities (e.g. unplugged demos, programming, projects) then reflecting (Michael and Modell 2003; Bonwell and Eison 1991). Embedding ethics means incorporating discussions about the societal implications of AI throughout the curriculum, especially in students' project work (Williams et al. 2022). Lowering barriers to access means designing curricula to reduce obstacles to engagement, comprehension, and access (CAST 2018). This means aligning content with students' prior knowledge and using low-cost, beginner-friendly, and localized educational materials. Designing curricula in alignment with these principles has been shown to be effective in working with students

from diverse backgrounds (Williams et al. 2022).

Curriculum Design

We designed AI for Wellbeing's activities, educator materials, and hardware and software tools in alignment with the Impact.AI framework.

Activities

Each unit in the AI for Wellbeing curriculum explores different technical and ethical concepts related to the design of AI chatbots. We incorporated culturally responsive pedagogy by building on students' prior knowledge and experience to explore AI concepts, directly addressing equity issues, and attending to students' sense of self-efficacy and belonging throughout each lesson (Madkins et al. 2019). Table 1 outlines the major units in the curriculum, and a complete description of the activities is available on the curriculum website¹.

Unit 1 began by having students formulate a basic definition of AI, recall everyday examples of AI (C1. Background in AI), and explore AI's potential societal benefits and harms (C6. Big Idea #5 Societal Impact). Teachers facilitated a discussion of AI's capabilities and limitations, building off examples students were familiar with, to develop their awareness of the importance of constructive critique of technology design (E1. Digital Literacy, E2. Critical Digital Literacy). Then, Units 2 and 3 lessons delved into how AI technologies worked, focusing specifically on the technical details of supervised machine learning (C4. Big Idea #3 Machine Learning) and conversational agents (C5. Big Idea #4 Natural Communication). These lessons also addressed ethical issues related to chatbots, such as privacy and algorithmic bias, highlighting how AI role models were using their expertise to address these concerns.

Every workshop unit ended with a programming lesson (P1. Constructing AI) leveraging a block-based programming platform called the RAISE AI Playground. Students used the playground to program a social robot named Jibo, write rule-based language processing algorithms, and train supervised text classification models. The next section of this paper further describes these tools.

Students learned to analyze the impact of AI systems (P2. Analyzing AI) by leveraging a Design Justice framework. Design Justice is an approach that puts marginalized communities at the forefront of challenging inequality through thoughtful design (Costanza-Chock 2020). Our lesson, building on top of an activity created by Blakeley H. Payne (Payne 2021), broke Design Justice down into three questions: "Who participated?" "Who benefitted" and "Who was harmed" through the design of a technology or system. After asking these questions, students considered how to redesign systems to protect those who are most vulnerable. Students practiced this framework in an immediately relevant activity by creating classroom policies and then applied it more broadly to their final AI projects.

¹AI for Wellbeing, <https://sites.google.com/media.mit.edu/dr-robot>

Unit	Activities	Learning Outcomes <i>Students were able to...</i>
1 Intro to AI	Intro to AI Programming Jibo	Co-construct a definition of AI as a class, learn about AI benefits and harms, explore everyday examples of AI Complete a programming tutorial for Jibo robots
2 Text Classification	Intro to Design Justice Intro to Text Classification	Use design justice framework to evaluate and design classroom policies Assemble datasets, then train and test text classification models
3 Chatbot Design	Algorithmic Bias Robot Commander	Audit text classification models, explore everyday examples of algorithmic bias Use rule-based and/or machine learning text classification to program Jibo to respond to commands
4 Final Projects	Project Brainstorm Work Time	Use the design justice framework to brainstorm AI projects that promote wellbeing Use programming skills from the week to implement projects
5 Closing	Showcase	Share AI for Wellbeing project ideas and progress with fellow workshop participants

Table 1: The activities and learning outcomes of the AI for Wellbeing curriculum, organized by units and then activities.

Finally, Units 4 and 5 emphasized students building confidence in their AI skills (E4. Self-efficacy) by considering how they could use AI to promote wellbeing in their lives and communities (E5. Identity and Expression). Students consolidated their knowledge into AI for Wellbeing projects by brainstorming topics, using the Design Justice framework to consider ethical issues, and then using the RAISE AI Playground to implement their ideas. The workshop concluded with students briefly sharing and providing feedback on one another’s AI projects (P3. Communicating about AI).

Hardware and Software

AI for Wellbeing relies on hardware and software tools developed to support active learning while lowering barriers to access.

The playground was the main programming platform for the course. This platform is a fork of the Scratch 3.0 repository with AI extensions (Jordan et al. 2021; Reddy, Williams, and Breazeal 2021). It allows students to tinker with AI concepts, such as word embeddings and text classification blocks, and use them in their programs. Block-based programming environments like Scratch are known to be helpful for new programmers getting started (Resnick et al. 2009). The AI Playground is designed to make setup easy by working totally client-side in a web browser to connect to free AI services and robots without the need for accounts or software installation.

We also integrated two AI education tools into the curriculum to support students’ learning. The first tool was Sparki, a large-language model-based brainstorming assistant to help users develop their project ideas (in preparation). The other tool was LevelUp, an automatic code assessment tool built into the AI Playground that assesses students’ text classifier code (Reddy, Williams, and Breazeal 2021).

For hardware, the curriculum revolved around an autonomous social robot for the home named Jibo. In its autonomous mode, Jibo has a vibrant personality and can hold

single-turn conversations with users, entertaining them with games and music, and information from the Internet. We mailed Jibo robots to students’ homes as part of this workshop, but the AI Playground also comes with a virtual Jibo. In programming mode, students had full control of most of Jibo’s functionality. We intended for students’ experiences living with a social robot to bolster their experiences programming one.

Teacher Training Materials

We developed educator materials, including an educator guide, slide deck, and student worksheets that are available online for free². The educator guide includes thorough instructions on how to run activities, including possible pathways for group discussions and instructions for programming lessons. Lesson plans ask educators to create links between the subject matter and students’ interests, experiences, and strengths. We provided teachers participating in our workshop with 5 hours of professional development.

Methods

During the workshop, students and teachers met online for five consecutive days, spending two hours together each day. Additionally, teachers and the researcher had an extra hour daily for professional development and to review students’ progress. The total workshop time was 10 hours for student participants and around 15 hours for teachers.

Participants

This workshop was part of a free online summer STEAM program that students applied for. We recruited teachers from a mailing list of teachers interested in bringing AI to their classroom; we compensated teachers \$500 to co-teach the workshop. Overall, our workshop included 26 students,

²AI for Wellbeing, <https://sites.google.com/media.mit.edu/dr-robot>

eight teachers, and one researcher. Once enrolled, students and teachers were invited to be participants in the research study, in accordance with the procedures approved by our institution's research ethics board. In total, 23 students and 5 teachers opted to join the study.

Student participants ranged in age from 10 to 15 (average 11.8 years-old), 13 identified as female, 10 identified as male, and none selected another gender. Thirteen students (56.5%) identified as Asian American / Pacific Islander, six (26.1%) identified as Black / African American, 1 identified as multiracial, 1 identified as Caucasian / White, and 2 did not specify. Thirteen students (56.5%) stated that they spoke other languages in addition to English at home.

All of the teachers have K-12 teaching experience, ranging from 2 to 20 years, with an average experience of 12 years. In addition, one of these teachers also instructs college students, including those with autism. All five teachers use technology as part of their classroom, four of them had already taught AI to their students, and three of these had taught it to middle school students.

Assessments

Student Pre and Post Questionnaires We developed a 9-item questionnaire to assess students' knowledge and perceptions of AI before and after participating in the workshop. Students completed their pre-assessments and final projects within the span of the 10 hour workshop. They were given additional time to turn in their post assessments.

The questionnaire contained three parts: a multiple-choice assessment of AI knowledge (4 items), a self-assessment of AI practices (1 item with 4 parts), and a survey on perceptions of AI. We developed these instruments using AI conceptual exams, self-assessments, and perception of AI surveys from other K-12 AI curricula (Zhang et al. 2023; Reddy, Williams, and Breazeal 2022; Rodríguez-García et al. 2021; Norouzi, Chaturvedi, and Rutledge 2020; Carolus et al. 2023). The full text of the questionnaire is available in Appendix A. Due to small sample sizes and unmatched data, on multiple choice questions we used the Mann-Whitney U Test to determine the statistical significance of any differences between pre and post tests.

Student Final Project Rubric We developed a final project rubric to analyze common themes and assess students' ethical analysis and construction skills in their projects. Two researchers (one an author on this paper) independently rated each project.

Teacher Survey We used open-ended survey questions to gather teachers' thoughts about the importance of teaching AI and any feedback they had for the curriculum. Teachers completed their pre and post surveys directly before and after the first and last days of the workshop. The full text of the survey is available in Appendix B.

Students' Results

AI Knowledge Assessment

Seventeen (17) participants completed the pre-test and eleven (11) completed the post-test. Students' average score

Perceptions of AI Survey

Distribution of scaled scores

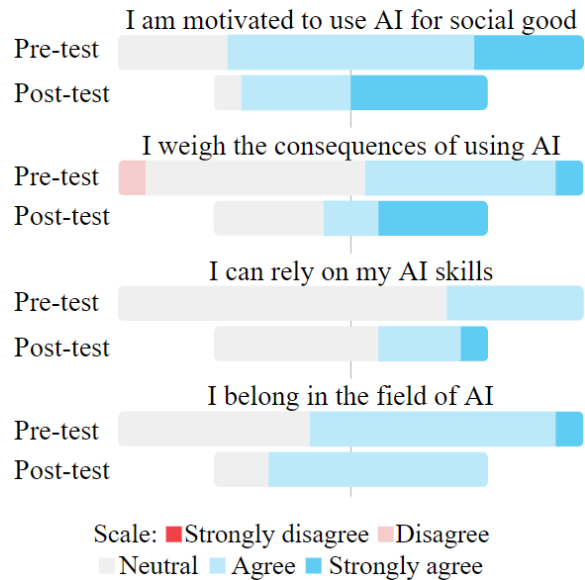


Figure 3: The Perceptions of AI survey contained items that tested students' motivation to engage in AI responsibly, self-efficacy, and belongingness. Students' pre-test and post-test scores were relatively high, indicating that students were interested in AI before the workshop.

on the post-test (71%) was higher than it was on the pre-test (61%), though the difference was not significant ($U = 63.5, p = 0.29$).

The largest score increase from pre-test to post-test were on the items related to the machine learning (32% to 64%) and chatbots (37% to 60%). The pre-test scores on the other two questions about the definition of AI (58%) and the benefits and harms of AI (74%) were fairly high, leaving little room for growth.

AI Practices Self-Assessment

Students' self-assessment of their ability to program did not increase from pre-test to post-test, given that all but one student said that they already had knowledge of programming.

However there was a significant increase in students' self assessment of their ability to use AI for social good (pre-test $mdn=2$, post-test= $3, U = 23, p = 0.001$), analyze the ethical consequences of AI artifacts (pre-test $mdn=2$, post-test= $3, U = 38.5, p = 0.01$), and present AI (pre-test $mdn=2$, post-test= $3, U = 39.5, p = 0.01$). Having gained direct experience with all of these skills during the workshop, students seemed confident in their ability to perform them.

Attitudes Toward AI Survey

The Attitudes toward AI survey, shown in Figure 3, probed students' motivation to use AI for social good, their likeliness to weigh the consequences of using AI, their confidence in their AI skills (self-efficacy), and sense of belonging to

the AI field. Students' pre-test scores were high, so we did not see a statistically significant increase on their post-test scores. Students and their parents self-selected to participate in our workshop.

We also looked at differences in self-efficacy and belonging to AI by students' underrepresented in tech status. Students who were women, Black / African American, or biracial fell into this category. Although differences between groups were not statistically significant, on the pre-test none of the underrepresented students agreed that they could rely on their AI skills (compared with all of the other students), and only half agreed they belonged in AI (compared with all but one of the other students). This changed quite a bit on the post-test where one underrepresented student agreed that they could rely on their AI skills and all but two agreed that they belonged in AI.

Final Projects

The rubric for students' final projects included descriptive and technical evaluation items. One researcher completed the descriptive items evaluation, clustering projects by their application space and primary beneficiaries. If students neglected to submit their code or complete a part of a worksheet, we omitted grading for that item without penalizing them. As shown in Figure 4, the 20 projects produced by students covered a wide range of application areas and targeted many different beneficiaries. Eight projects (40%) applied to the medical field, including many recreations of the personal health robot Baymax from the children's movie Big Hero 6. Six projects (30%) related to mental health and included robot companions to talk with, and an embodied version of the Headspace app. Two projects were robot companions, one of which was specially designed for kids by kids. Another notable project application sought to advance the field of conversational AI in general by improve AI's ability to engage emotionally with people.

Project: AI 1 by a 10-year old Black female

What it Does: It helps create more human like emotions that you can connect to better

Why it's important: When people are sad it's hard to talk to a robot when robots don't really understand

Almost half of the projects were designed to benefit the general public, with no specification of a particular age or demographic group. Three projects (17%) helped medical patients who were sick and three others helped therapy patients struggling with mental health issues. Other beneficiaries included nurses, kids, the author of the project, and non-English speakers. One student elected to work on a project specifically for non-English speakers because, as many students shared, they had experienced issues when trying to communicate with chatbots because of their accents or desire to speak other languages. Currently, Jibo is only capable of speaking English, but using the translation blocks in the AI Playground, students were able to program Jibo to communicate in many different languages.

Project: Around the World by a 13-year old Black female who speaks English and Twi

What it Does: My project takes Jibo and turns him into a translator for a woman or anyone who can't speak English.

Who it helps: It helps the woman and the doctor because the doctor can find out the patients problems and help, while the woman can get the care that she needs.

There were also projects that students created for themselves or "just for fun," indicating that students were interested in remixing social robots to better match their interests or preferences.

Two researchers rated the rest of the projects on the following items: identifying stakeholders, identifying positive and negative impacts, and code implementation. For each of these items, students received one point if they successfully accomplished the task or zero points if not. The interrater reliability between the two raters was very high at 0.95.

Seventeen (17) students submitted the ethics portion of the project, and overall were moderately successful at analyzing their project ideas. Eleven projects (61%) identified at least one relevant stakeholder for their project. Only ten students filled out the positive and negative impact portions of their worksheets, but of those, eight (80%) identified at least one potential harm of their work based on concepts learned in class. We would have liked to see more students complete this portion of the worksheet since identifying the negative consequences of your work is an important skill.

Eleven (11) students submitted their code, and all of these projects ran correctly. Six of the eleven submitted projects (55%) were significantly different from the exemplar project code that we provided students. Even though the other projects were very similar to the exemplar projects, students still personalized them to match their chosen application. The large number of projects that resembled our exemplars may be attributed to the limited time students had for their projects. The gallery of students' projects is available with the educator materials.

Teachers' Results

Most teachers came to the workshop with a fundamental understanding of AI but their responses suggest that there is variation in the depth of this knowledge. While some understand the nuances and complexity of AI's potential, others had a more surface-level interpretation. Their feelings about AI were all positive, with an emphasis on AI's utility and potential rather than any negative possibilities. There was an observable appreciation for the powerful capacity of AI to function as another "brain" (T01).

Teachers were committed to shaping comprehensive AI education, emphasizing technical and non-technical skills. They also stressed the importance of fostering critical thinking and problem-solving:

"Teaching AI is not just about technical knowledge; it's about instilling a passion for lifelong learning, critical thinking, and ethical decision-making." (T02)
 "I hope that students will recognize biases...they will be better creators in tech than we (adults) are

Common Themes in Students' Projects

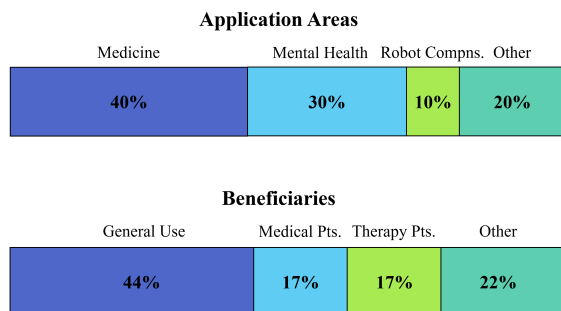


Figure 4: Students' projects commonly applied to medicine, mental health, and robot companionship. Other projects were about physical health, entertainment, human-robot interaction, and time management. Almost half of the projects were meant to benefit the general public. Other projects were specifically meant to help medical patients, therapy patients, nurses, kids, non-English speakers, or the project's author.

currently" (T04)

At the end of the workshop, all teachers considered themselves to be more knowledgeable about AI and believed it was important to take time in the classroom to teach AI. To improve the curriculum, teachers would give students more time and provide more scaffolds:

"Maybe more hands-on time for skill building (like understanding text classification exercises)." (T02)

"Vocabulary and an explanation of what each thing does in playground" (T03)

Most teachers agreed that the workshop changed their approach to teaching computer science or AI, particularly around discussing design justice. They felt that it was important for students to understand the "how's" and the "why's" of AI, as well as more concrete examples of what AI can do in their lives.

Discussion

Designing and testing this curriculum with students and teachers yielded valuable insights into the benefits of and possible improvements to our approach.

Despite our study's limitations, including a small sample size in an informal learning context, our study revealed the importance of intentional efforts to boost students' self-efficacy. We saw that students from underrepresented identities, even though they elected to participate in this study with parental support, had lower confidence in their AI abilities and sense of belonging.

Our approach to raising students' self-efficacy was through promoting their technical competence and critical consciousness, two important components of Culturally Responsive Computing (Scott, Sheridan, and Clark 2015; Madkins et al. 2019). We saw how issues of social inequality

unpacked during discussions directly influenced students' projects, which were a key opportunity for students demonstrate their technosocial agency.

We observed the helpfulness of teacher training in equipping educators to introduce AI to their classrooms with cultural responsiveness. Teachers stated that they were more comfortable with AI concepts and discussions about technology and design justice. We sought to elevate teachers' technical and sociopolitical awareness of AI and found that both are essential for teachers to facilitate inclusive and empowering learning experiences for their students (Madkins 2016).

To improve the curriculum, first, we would continue to iterate on our curriculum materials, especially the knowledge assessments to be able to more reliably measure what students learned. Second, we would want the curriculum to align more closely with the Culturally Responsive Computing tenet of exploring cultural and personal identity (Scott, Sheridan, and Clark 2015) to ensure students' can see how their identities connect to AI. Thirdly, we would include more teacher training about how to balance technical competency and consciousness building activities so they feel that students have enough time to practice programming skills without skipping the critical conversations about ethical issues.

Conclusion

In the future, we hope to see more K-12 AI curricula leverage culturally-responsive pedagogy. Directly addressing students' interests and concerns increases students engagement in curricula. We designed the Impact.AI framework to guide AI curriculum designers in considering the content and designs of their educational materials. In the AI for Wellbeing curriculum, using the Impact.AI framework allowed us to create a meaningful learning experience for middle schoolers around AI for Wellbeing. We were also able to successfully train and inspire teachers to equip students as ethics-minded AI creators with the skills to use technology to benefit society.

Acknowledgments

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