Music, Coding, and Equity: An Exploration of Student and Teacher Experiences in Decoding Messaging and Discussing Equity with the ”Your Voice Is Power” Curriculum

Dr. Sunni Haag Newton, Georgia Institute of Technology

Sunni Newton is currently a Senior Research Scientist at the Georgia Institute of Technology in the Center for Education Integrating Science, Mathematics, and Computing (CEISMC). Her research focuses on assessing the implementation and outcomes of educati

Roxanne Moore, Georgia Institute of Technology

Roxanne Moore is currently a Research Engineer at Georgia Tech with appointments in the school of Mechanical Engineering and the Center for Education Integrating Mathematics, Science, and Computing (CEISMC). She is involved with engineering education inno

Dr. Meltem Alemdar, Georgia Institute of Technology

Dr. Meltem Alemdar is s Associate Director and Principal Research Scientist at Georgia Institute of Technologyâ€™s Center for Education Integrating Science, Mathematics and Computing (CEISMC). Her research focuses on improving K-12 STEM education through

Joycelyn Wilson, Georgia Institute of Technology

Joycelyn Wilson is an educational anthropologist and assistant professor of Black media studies in the School of Literature, Media, and Communication (LMC) at Georgia Tech. Her current area of inquiry focuses on hip hop-inspired pedagogics and its intersection with design thinking, computational media-making, and integrative curriculum design.

Sabrina Grossman, Georgia Institute of Technology

I am currently a Program Director in Science Education at Georgia Tech’s Center for Education Integrating Science, Mathematics, and Computing (CEISMC), which is a K-12 STEM outreach center for the university. I am working on several exciting projects inc

Music, Coding, and Equity: An exploration of student and teacher experiences in decoding messaging and discussing equity with the Your Voice is Power curriculum

Abstract

Your Voice is Power is a curriculum that seeks to promote racial equity and increase interest in computing careers by integrating elements of computing, music, social justice, self-expression, and entrepreneurship. The curriculum consists of five modules lasting 60-90 minutes each. Students engage with music through lyrical analysis to extract and explore present themes of social justice using the OUTKAST Imagination framework. Students then engage with musical concepts from a computing perspective to create their own remixes using EarSketch, a web-based, learn-to-code through music platform developed at Georgia Institute of Technology (Georgia Tech). These elements are further supported by discussions around racial justice and the pathways to equity. The program culminates with an optional online competition with student submissions judged by industry professionals. This program has been ongoing since the 2019-2020 school year, and program evaluation efforts have been undertaken since the program's inception.

Participatory evaluation framework principles were followed, including a process to obtain input from program leaders and staff to create program goals and a logic model that maps out the program's activities and how these link to the goals. The evaluation includes the collection of data from all program participants (i.e., teachers, students, and judges) via online surveys conducted immediately after the conclusion of the online competition. In these online surveys, we gather participants' feedback on various aspects of the competition, as well as their perspectives on their motivation to participate. Additionally, the survey is designed to measure the impact that program participation has had on them (and on their students, in the case of teacher participants). Program evaluation results from the first two years have suggested that, in general, participants in all three groups find Your Voice is Power to be a valuable experience, one they would repeat and/or recommend to a friend or colleague.

For the year three data collection, following the past years' evaluation findings, we further investigated two areas of interest to program leaders: 1) students' experiences with a framework (the OUTKAST Imagination framework) [1] included in the curriculum to guide students through a detailed analysis of a song's lyrics and their meaning, and 2) teachers' self-efficacy for and attitudes around teaching on racial equity-related topics, including the specific pedagogical approaches non-racist teaching, culturally relevant teaching, and anti-racist teaching. This paper will present the results of the current evaluation with a specific focus on these two newly added areas of inquiry. Results indicate that students and teachers found lyric analysis and the OUTKAST Imagination framework to be a useful and valuable tool, and that teachers are generally comfortable with, and seek opportunities for, teaching on race-related topics, but they vary in their self-efficacy for specific pedagogical approaches to teaching on race-related topics.

Introduction

Computing jobs are ubiquitous and lucrative, with median salaries nearly double those of the overall job market [2]. However, diversity in computing education and careers, and particularly the inclusion of Black and African-American students and employees, continues to be a challenge [3]. The need for inclusive, culturally responsive curricula that encourage participation of historically excluded populations has been well documented, including by the authors [4]. Developing inclusive curricula for computer science that prominently feature historically excluded demographic groups and adequately make the case for participation from these groups may necessitate discussions not just around computational constructs, but also around race and structural inequities. These conversations are necessary for understanding and progress, particularly as we seek to foster inclusivity, and not simply diversity.

However, recent trends in the political climate have drastically increased scrutiny on educators providing instruction on racial and social justice topics [5; 6]. The backlash against critical race theory (CRT) has cast a shadow over, and in some cases led to censorship or banning of, instruction on historical events and current conditions related to race, with anti-CRT bills in 29 states preventing educators from utilizing critical pedagogies and in doing so, "[continuing] the suppression of knowledge and truth for K-12 students" [5]. Legal scholar Kimberle Crenshaw notes that [7]:

> "Critical Race Theory and intersectionality have not only been labeled as 'divisive', 'dangerous', and 'un-American', they have also been appropriated as a container to denounce the wider project of antiracism and social justice writ large….Politicians have sought to censor any study of the way that the American legal system sometimes facilitates and reinforces racial inequality. That legislators can appropriate law to banish critiques of law should rattle every last one of us."

Simultaneously, race-related events in the news and politics surround students and impact them emotionally and psychologically, such that some students seek out content and discussion on these events in their classrooms. Teachers are caught in the middle of this maelstrom, in many cases pulled between what they want to tell their students and what they feel they are allowed to tell their students, aware of the possibility that "if they offer any school-sponsored training or curriculum that touches on race or gender, they'll land in hot water" [8]. Teachers' own racial identities as well as the interaction of students' and teachers' racial identities also impact teaching, with prior research noting that race of the teacher related differentially to various types of discomfort with race-related pedagogical approaches, such that "aspects of a teacher's racial identity shape the way they construct, talk, and teach about race/ism" [9].

These conflicts play out nationally, state-by-state, and locally within a given school or community. Teachers must take the pulse of the leanings of their students, parents, school administration, and communities when deciding whether and how to engage with their students on potentially controversial race-related topics. They are also guided by their own personal values and opinions regarding these issues, as well as constrained by the school, county, and state standards of the courses they are teaching. Decisions around teaching students about these

topics and the potential negative repercussions of doing so are added to the rigors and stressors already inherent to the job of an educator.

The YVIP curriculum, which was developed after the tragic murder of George Floyd in 2020, aims to aid teachers in facilitating race-related discussions by providing a scaffolded process for discussing the topics of racial equity, social justice, allyship, and messaging through music. The curriculum gives teachers tools for presenting and working through these topics in a curriculum that is both academically rigorous and tied directly to computing standards. It is our hope that the YVIP curriculum and competition provides teachers with a means to connect with their students around race-related topics in a way that is both personally meaningful to students and also defensible to stakeholders who may prefer that teachers avoid engaging with this content.

Background

A previous paper by the authors [4] described YVIP and its components in detail; here, we summarize these contents and then focus on the evaluation results, with a particular focus on the new survey items focused on lyric analysis and the racial equity aspects of the curriculum.

Your Voice is Power- Overview

Building on creating a safe space within classrooms to give students a voice in social justice is just one track for the Your Voice is Power competition and curriculum. Georgia Tech, Amazon Future Engineer, and Pharrell Williams' foundation, YELLOW, collaborated to create an innovative multi-day learning experience and competition for students by integrating these social justice themes through the lens of computer science, music, and entrepreneurship [4; 10]. In the 2022 competition, students had access to songs from three top recording artists, Alicia Keys, Khalid, and Pharrell Williams, to analyze and remix. (The 2021 competition included only Pharrell's song with Jay-Z, *Entrepreneur* [4]). During this experience, middle and high school students seek to answer the question - How are music, computer science, and entrepreneurship pathways to achieving equity?

The OUTKAST Imagination

The Your Voice is Power competition and curriculum center around significant prior work in lyric analysis and Hip Hop Pedagogy. As part of YVIP, students and teachers are also introduced to the O.U.T.K.A.S.T. Imagination (The OI) [1] to better understand the messaging in "Entrepreneur" by Pharrell Williams, "Underdog" by Alicia Keys, and "New Normal" by Khalid. Students are then encouraged to use the existing lyrics in novel ways or even write their own lyrics for their final musical compositions. The OI is a design and annotation hermeneutic that samples the narrative modes and perspectives of the original acronym associated with the Atlanta-based rap duo, OUTKAST ("Operating Under The Krooked American System Too-long") [11]. For YVIP, students and teachers use seven principles: Open-minded thinking, Uprightness, Truth, Kinship, Accountability, Sequence, and Teach, to engage in sentiment mining. The OUTKAST Imagination Framework is depicted in Figure 1 and additional details about its usage can be found in [4].

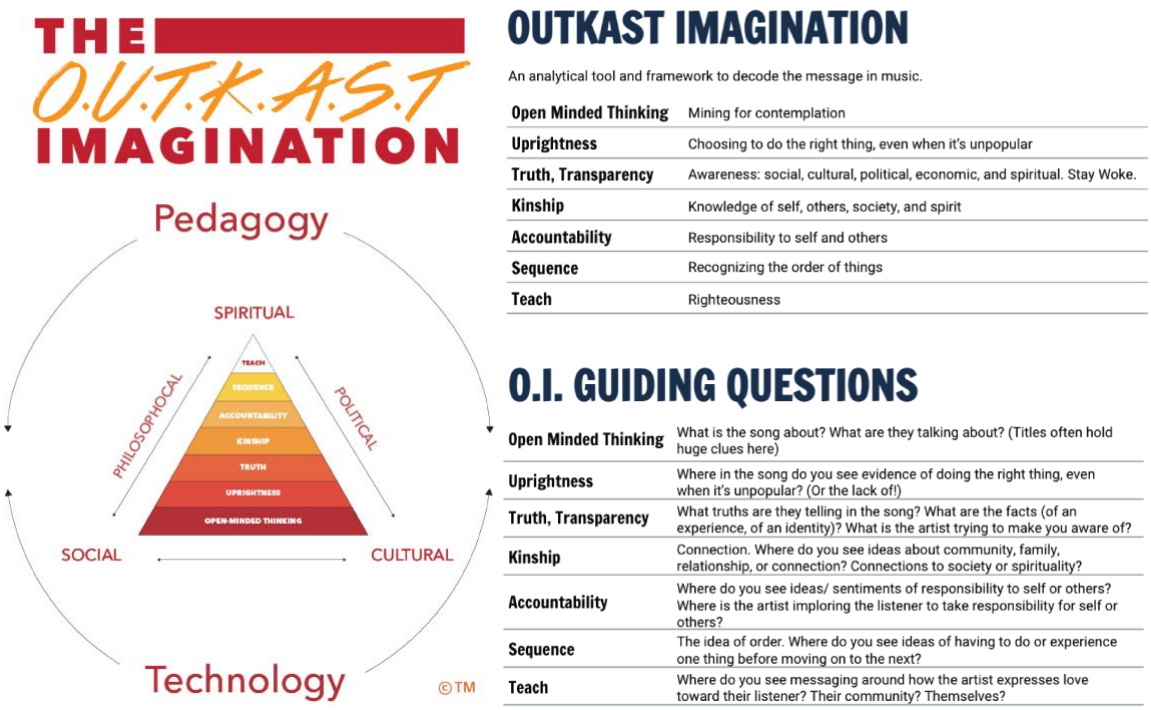

Figure 1. The OUTKAST Imagination (OI)

As a critical design remix – particularly in relation to YVIP - the OI serves three purposes: one, it functions as a "scientific method" for explaining to teachers and students how Hip Hop works, two, as a mnemonic device to remember the seven principles necessary for sentiment mining in the song's verses and hooks, and three, as an "annotation algorithm" to control for the generation of culturally-centered themes and ideas, grounding them in larger understandings about diversity, equity, inclusion, and justice. One of the primary capabilities of the OI principles rests in its support of current discourses around racial equity and social justice. Taking the principle of kinship as an example, students are asked to consider the ways in which the lyrics they analyze address collective action and the pursuit of equity for the common good in order to promote a society that is just, considering equity for all individuals that reflects the cultural and social diversities amongst them. These ideals are baked into a Hip Hop-inspired consciousness, and automatically considered in the analysis exercises that students participate in. This approach guides student creatives to design, create, and write songs that remix themes that advance their understanding of not only the 7 principles, but also their understanding of race, equity, and justice in their daily lives.

EarSketch

The Your Voice is Power curriculum is also centered around EarSketch, a learn-to-code through remixing music platform developed at Georgia Tech where students code in Python or JavaScript to create novel songs using a library of existing samples. Creating original remixes in EarSketch entails using code to create a musical collage that can be both visualized using a Digital Audio Workstation and listened to using the playback feature. The interface for EarSketch is depicted in Figure 2, and many more details about EarSketch and its efficacy with historically excluded populations can be found in prior work [12; 13; 14].

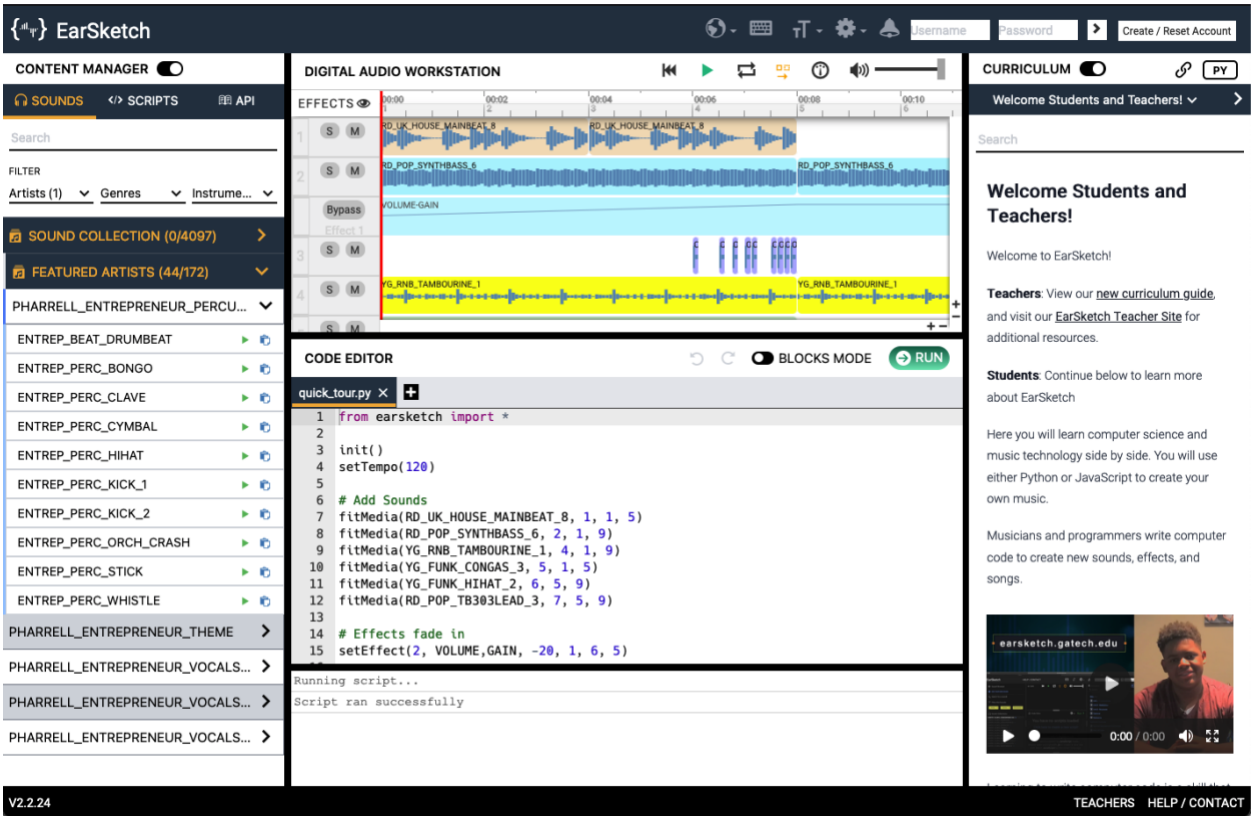

Figure 2. The EarSketch Interface

Your Voice is Power- Curriculum & Professional Development

Teachers implement the Your Voice is Power program using seven scripted modules that include specific learning objectives in social justice, music, and computing. The curriculum makes use of the EarSketch platform, where students write code to create novel remixes of musical stems. Each module connects a theme in social justice or music to coding. For example, as students explore lyric analysis and messaging in music, they also learn how to write comments to embed messages in their code. While learning about the spirit of entrepreneurship, students learn how to create an uplifting mood in their music by using the function setTempo() in their code, which changes the speed of their music. Please see Figure 3 for details on each of the modules. Each module is accompanied by videos featuring Pharrell's audio engineer and a graduate of Georgia Tech's music technology programs, along with PowerPoints, student sheets, and formative assessments. These resources provide a scaffolded approach to both coding and social justice discussions. By the end of this experience, students can submit a thirty-second to two-minute song using musical stems from one of the featured songs. The songs are coded to meet specific coding requirements, and in addition to their song, students submit a reflection that explains their message of social justice.

Big Unit Question: How are music, computer science, and entrepreneurship pathways to achieving equity?		
Module 0: *Optional* **Introduction to EarSketch** Students will create an EarSketch account and gain a basic understanding of how to utilize the coding platform.	**Module 1:** **Decode the Message in the Music** Students will explore how to decode the message in the music and embed messages in their code with comments.	**Module 2:** **Layers of Injustice** Students will examine the "layers" of both racism and music and will code instrumental layers in their song using variables and functions.
Kickoff Lesson: Start Here The Message in the Music		
Module 3: **Set Your Own Tempo** Students will hear the stories of amazing entrepreneurs who "set their own tempo" and will code their own unique 16 measure song.	**Module 4:** **Song Structure - Every Part and Person has a Purpose** Students will discover the various roles people can play in the fight for racial justice and dissect Pharrell's song structure to code the different parts of their song with custom functions.	**Module 5:** **Call to Action** Students will code a song in EarSketch remixing stems from Pharrell's song *Entrepreneur* that uses their "voice" (or includes a message) to promote equity.
Student Engineering Notebook **Final Project Rubric** (for reference only) - **Advanced Exemplar Project** **Basic Exemplar Project**		

Figure 3. YVIP curriculum modules

Teachers can attend a robust selection of professional development offerings before implementing YVIP in their classrooms. At the launch of each YVIP competition, teachers can enroll in weekly evening virtual PD sessions with content ranging from "Getting Started in EarSketch" to " Racial Discourse in the Classroom." These sessions range from 1-2 hours, are facilitated by YVIP curriculum directors, include hands-on activities, and are recorded for future reference.

Methods

Evaluation Framework

The evaluation was conducted following the principles of the participatory evaluation framework, defined as "applied social research that involved a partnership between trained evaluation personnel *and* practice-based decision makers, organization members with program responsibility, or people with a vital interest with the program" [15]. These various stakeholders were involved in the planning and design of the evaluation, which has been carried out since the program's inception and has evolved to meet the changing foci and elements of the program. Each year, program staff and evaluators met to refine the program's logic model and program goals. Evaluation instruments were reviewed and iterated upon by both program staff and staff from funding organizations. It is our expectation that by soliciting and using input from program staff and other relevant parties, we will achieve a stated aim of participatory evaluation, namely, that "this approach is likely to enhance intended use by intended users within the local context." [15].

Instruments

Online Teacher Survey

The online teacher survey is designed to gather teacher feedback on their experiences with implementing the competition, their perceptions on how competition participation impacted their students, as well as their attitudes and values around certain aspects of teaching computer science. Survey items include items written by program staff and items taken directly from or modified from published, validated surveys. Most items are closed-ended, with a few open-ended items to collect more general feedback. Survey item topics include demographics, teaching background, competition implementation details, use of YVIP professional development sessions and curriculum materials, perceived benefits of the competition for students, and impact on teachers' practice. Teachers were presented with items taken from validated survey instruments measuring self-efficacy for teaching on race-related topics [9] and for teaching about computing [16].

Online Student Survey

The online student survey is designed to gather student feedback on their experiences with participating in the competition as well as their standing on various outcomes directly related to program goals. Survey items include items written by program staff and items taken directly from or modified from published, validated surveys. Most items are closed-ended, with a few open-ended items included as follow-up items and at the end of the survey to collect more general feedback. Survey item topics include demographics, prior experience with computer-based music creation, prior coursework, competition participation details, feedback on the EarSketch platform and other aspects of the competition, and interest in future careers related to music technology and computer science.

Students were asked whether they had participated in the Your Voice is Power curriculum; the curriculum is not required for students to take part in the competition. Students who responded "yes" were then asked a subset of items related to anticipated outcomes of the Your Voice is Power curriculum experience pertaining to areas of racial justice, activism, and addressing inequity.

Data Collection

Online Teacher Survey

The online teacher survey invitation and survey link were distributed upon conclusion of the competition. The survey was open for roughly one month, and periodic reminder emails were sent during the duration of the survey period. After removing data from participants who had provided little to no survey data, a total of 57 responses (11% response rate) were retained for analysis.

Online Student Survey

The online student survey was administered in two rounds, corresponding to the two rounds of competition. Each survey invitation and survey link was sent out upon conclusion of the given round of the competition. After removing data from participants who had provided little to no survey data, a total of 66 responses (5% response rate) were retained for analysis.

Participants

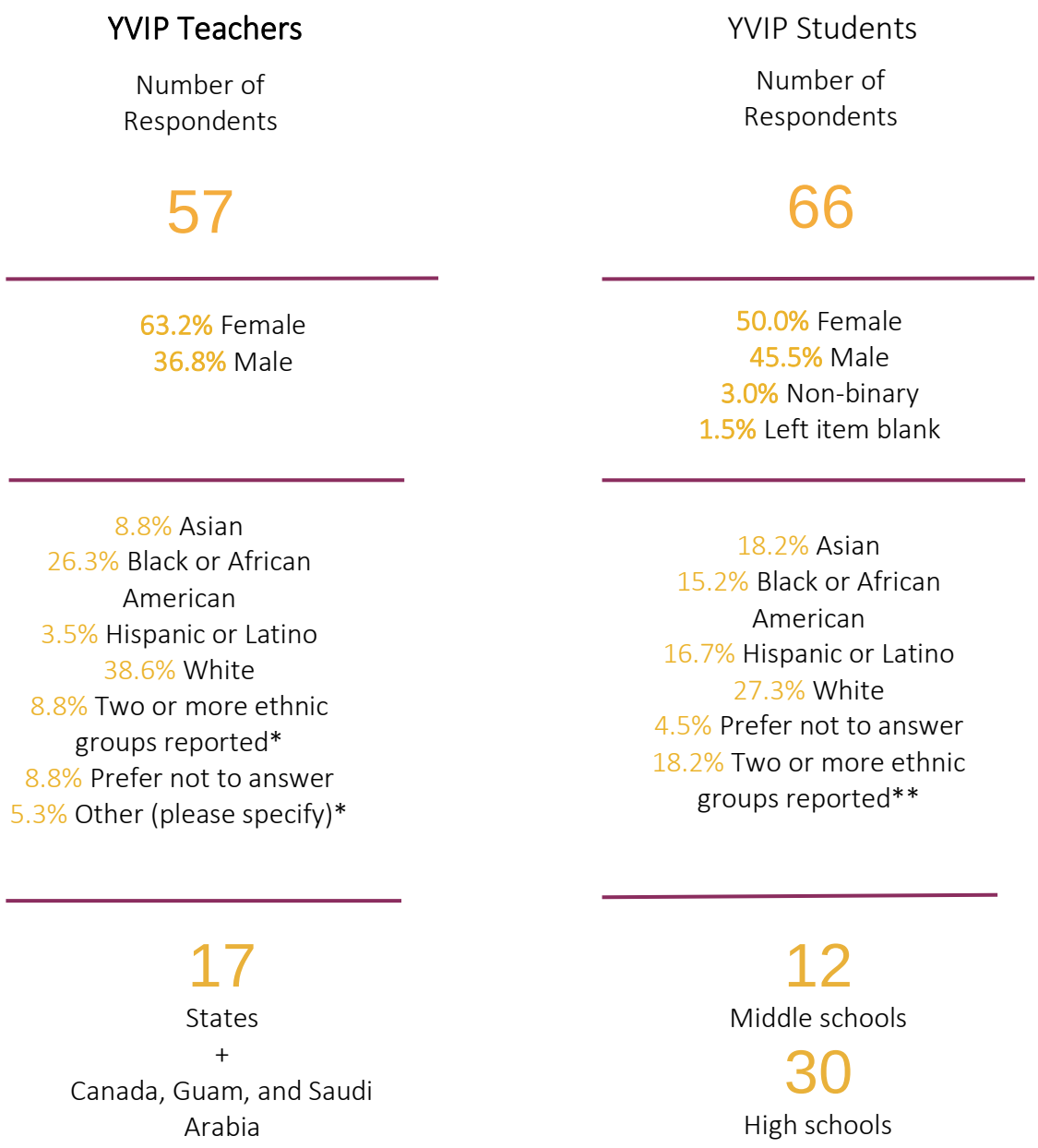

Figure 4. *Participant characteristics*

Note: *includes American Indian, Asian, Black or African American, Caribbean, Hispanic or Latino, Indian, and White
**includes American Indian or Alaskan Native, Asian, Black or African American, Hispanic or Latino, Jamaican, White

Teachers

All teachers who we had records of interacting with the competition were invited via email to participate in the online teacher survey. These teacher email addresses were obtained in two ways: 1) registration with the online teacher site; or 2) a student provided the teacher's email address when asked what teacher had supervised their participation in the competition. A total of 523 teachers were invited to participate in the online teacher survey.

Participants are predominantly female (63.2%), with the remaining participants being male (36.8%). Nearly 40% of participants are White and just over 25% of participants are Black. Less than 10% of participants reported each of the following ethnic backgrounds: Asian, Hispanic or Latino, and two or more categories. The remaining participants responded with either another unlisted category or preferred not to answer. Participants are from 17 different states as well as Canada, Guam, and Saudi Arabia (one participant each).

Students

All students who had submitted entries to the online competition and met the criteria for research eligibility were invited via email to participate in the online student survey. Research eligibility criteria included meeting the grade level cutoff (6^{th} – 12^{th} grades only), the age cutoff (ages 12 and above), and providing a parent/guardian email address for us to send the online parental permission letter in cases where the student participant was under the age of 18. A total of 1221 students were invited to participate in the online student survey across two rounds of survey administration.

Respondents from Round 1 and Round 2 are combined into a single student group for analyses. The survey respondent group contains comparable numbers of male and female students; it includes 33 female students (50.0%), 30 male students (45.5%), and two non-binary students (3.0%). One student did not respond to the gender item. The most frequently occurring ethnic background category among survey respondents is White (27.3%), followed by Asian (18.2%) and two or more categories (18.2%), Hispanic or Latino (16.7%), and Black or African American (15.2%). Three students preferred not to answer (4.5%). Survey respondents represent 12 middle schools and 30 high schools. Students range in age from 12 to 18 and are concentrated in grades 8 (24.2%), 9 (19.7%), 10 (19.7%), and 11 (18.2%), with smaller numbers of students in grades 6 (1.5%), 7 (7.6%), and 12 (9.1%).

Results & Discussion

Teachers

Teaching background and implementation context

In terms of their teaching background, teachers responding to this survey were primarily experienced teachers, with 86% of respondents having 6 or more years of teaching experience. Nearly all teachers had previously taught computer science, and over half (60%) had used EarSketch prior to this year's competition. Roughly half of teachers had students participate in the competition prior to the 2021-2022 school year. This group of teachers is highly experienced in general, has experience with teaching computer science, and roughly half of them reported having prior experience with using EarSketch and/or the implementing the competition.

Most teachers were teaching CS during the 2021-2022 school year (75.4%), with smaller numbers of respondents teaching engineering (19.3%), math (15.8%), business/innovation (15.8%), science (7.0%), and music (3.5%). Just over 2/3 of teachers implemented the competition as a class project (mostly within a CS or other STEM class). Slightly less than 1/3 of teachers (29%) implemented outside the context of a course project, including extra credit within courses or after school or summer programs. A few teachers (7%) reported that they had not implemented the competition, in some cases having passed along the competition information to their students. Please note that these percentages of courses taught and implementation context sum to more than 100% because some teachers reported two or more categories.

Teachers' estimates of participation impact on students

Teachers, on average, reported positive beliefs about the competition impacting their students in a variety of ways; mean responses on most of these items were very close to or above 6.0, which corresponds to "Agree" on the seven point response scale (1 = "Strongly Disagree", 4 = "Neutral", 7 = "Strongly Agree"). Specific student impacts of competition participation rated highly by teachers include enthusiasm for learning about computing (m = 6.04), enthusiasm for learning about music (m = 6.04), enthusiasm for learning about music technology (m = 5.94), ability to program in Python or JavaScript (m = 5.90), and ability to be creative (m = 6.26). Somewhat lower though still high levels of agreement were provided on items related to students' understanding of racial injustice and the connection between music and activism (m = 5.31 and m = 5.33, respectively). All mean responses to these perceived student impact items are on the high end of the response scale, indicating that teachers believe competition participation imparts meaningful benefits to their students. Descriptive statistics on the items are provided in Table 1.

Table 1. Teachers' estimates of competition impact on students

Participating in the EarSketch Competition has increased my students…	Number of Teachers	Mean	SD
enthusiasm for learning about computing	51	6.04	1.03
enthusiasm for learning about music	51	6.04	1.09
enthusiasm for learning about music technology	51	5.94	1.16
understanding of racial justice	51	5.31	1.52
understanding of the connection between music and activism	51	5.33	1.48
ability to program in Python or JavaScript	51	5.90	0.88
ability to be creative	51	6.26	0.78

Note: Response scale ranges from 1 = "Strongly Disagree" to 7="Strongly Agree"

Teachers' feedback on specific competition elements & impact on their practice

Teachers were asked to provide their level of agreement with a series of statements about specific elements of the competition. Mean responses on all but one of these items were near or above 6.0, which corresponds to "Agree" on the seven-point response scale (1 = "Strongly Disagree", 4 = "Neutral", 7 = "Strongly Agree"). Teachers, on average, agreed that EarSketch is engaging for students (m = 6.33), is useful for teaching coding (m = 6.16), and worked well with few technical issues (m = 6.08). Teachers also agreed that the music samples from famous artists were important to students (m = 6.22). In terms of specific components of the curriculum, teachers felt that the social justice focus was a valuable part of the curriculum (m = 5.59) and saw enthusiasm among their students for the coding (m = 5.76) portion of the competition curriculum. A slightly lower level of agreement corresponding roughly to "Slightly Agree" on the response scale was provided for the item on students' enthusiasm for the social justice components of the curriculum (m = 4.96).

In terms of their own practice and the competition's impact on their teaching, teachers largely agreed that the competition materials helped them to feel confident about teaching EarSketch (m = 5.77) and guiding discussions about racial injustice (m = 5.60). Teachers are likely to use EarSketch outside of the competition context (m = 5.92) and feel motivated to reach a diverse audience of students with their CS teaching (m = 6.42). Descriptive statistics on these items are provided in Table 2.

Table 2. Teacher feedback on specific competition elements

Item	Number of Teachers	Mean	SD
I feel motivated to teach computer science to a diverse audience of students	52	6.42	0.91
EarSketch is engaging for my students	51	6.33	0.74
Having samples from a famous artist like Pharrell was important to my students	51	6.22	0.94
EarSketch is useful for teaching my students how to code	51	6.16	0.88
EarSketch generally worked well with few technical glitches	51	6.08	0.82
I am likely to use EarSketch in my teaching outside of this competition	52	5.92	1.19
Using the competition curriculum and/or other online material helped me to feel confident about teaching EarSketch	52	5.77	1.34
My students were enthusiastic about the coding components of the curriculum	51	5.76	0.95
Using the competition curriculum and/or other online material helped me to feel confident about guiding class discussions about racial injustice	52	5.60	1.46
The focus on social justice was a valuable part of the Amazon EarSketch competition curriculum	51	5.59	1.59
My students were enthusiastic about the social justice components of the curriculum	51	4.96	1.48

Teaching on race-related topics

The YVIP curriculum invites students to consider, discuss, and formulate a musical response to race-related topics including racism, equity, and social justice. Teachers guide students through this content and open their classrooms to deep and at times difficult discussions accordingly. While many of our teachers have expressed a high level of motivation to engage with their students on these topics, the political and legal context around teaching this content is currently fraught. To further explore teachers' feelings of motivation for, comfort with, and self-efficacy for incorporating this content into their teaching, a combination of newly written and validated scales on teaching of race-related topics were included in the survey.

A series of locally developed items was included in the survey to assess the extent to which teachers are personally comfortable with teaching on race-related topics as well as the level of support various groups within their schools and communities provide for such teaching. Teachers reported moderately high average levels of both personal comfort with as well as stakeholder support for teaching on these topics, agreeing that they feel comfortable teaching about race-related topics (m = 5.40) and that their school administration (m = 5.26), other teachers (m = 5.04), and their students' parents (m = 4.76) support their teaching about these topics. Additionally, they reported a moderately high level of agreement that their students welcome these types of discussions (m = 5.19). Teachers largely disagreed with items suggesting that they would or should avoid teaching on these topics for a variety of reasons. Teachers disagreed with items suggesting that teaching such content would create problems at work (m = 3.40), put their job in jeopardy (m = 2.92), is inappropriate (m = 3.29), is irrelevant to their course content (m = 3.67), would make them uncomfortable (m = 2.75), would make their students uncomfortable (m = 3.21), and is avoided because the social and political climate of their community would make it difficult (m = 3.23). Lastly, teachers provided a moderately high level of agreement that they have taught or are currently teaching on race-related topics (m = 4.60). Further details on this set of items is provided in Table 3

Table 3. Teachers' comfort and support levels for teaching on race-related topics

Item	Number of Teachers	Mean	SD
I feel comfortable teaching about race-related topics (e.g.,social justice, racial inequity, systemic racism).	50	5.40	1.67
My school administration supports my teaching about race-related topics.	50	5.26	1.4
The majority of my students welcome class discussions on race-related topics.	48	5.19	1.36
Other teachers at my school support my teaching about race-related topics.	50	5.04	1.26
My students' parents support my teaching about race-related topics.	50	4.76	1.3
I have taught and/or am now teaching on race-related topics.	48	4.60	1.59
Teaching on race-related topics is not relevant to my course content.	48	3.67	1.91
Teaching about race-related topics would create problems for me at work.	50	3.40	1.7
It is not appropriate for me to lead class discussions on race-related topics.	48	3.29	1.7
I would like to teach on race-related topics, but the social and political climate of my community would make it difficult.	48	3.23	1.74
Teaching on race-related topics would make my students uncomfortable.	48	3.21	1.5
Teaching about race-related topics would put my job in jeopardy.	49	2.92	1.74
Teaching on race-related topics would make me uncomfortable.	48	2.75	1.58

Note: 7-point response scale ranging from Strongly Disagree to Strongly Agree

We used a recently developed and validated scale of teacher self-efficacy for three different pedagogical approaches to teaching race-related topics [9]; this scale is called the Racialized Teaching Efficacy Scale and includes two new subscales combined with a previously established subscale [9; 17]. The first of these pedagogical approaches, culturally responsive

teaching, entails a belief that success can be achieved by all students and that the knowledge they possess should be valued and utilized in the classroom. Additionally, this pedagogy entails a focus on deep and meaningful student-teacher relationships and a belief that knowledge is always evolving [9]. The second pedagogical approach for engaging with students about race-related topics is anti-racist pedagogy, which entails "actively challenging the persistent institutional and structural aspects of race/ism while seeking to expose white supremacy" [9]. Teachers taking an anti-racist approach explore the forces that undergird racism and examine how they impact everyday society; an anti-racist teacher "challenges the assumptions of white privileges, deconstructs race relations, articulates the influence of whiteness and white supremacy, and seeks to actively reject all manifestations (both individual and institutional) of white supremacy" [9]. The third approach to teaching on race-related topics is non-racist pedagogy, which stands in direct contrast to anti-racist pedagogy and is marked by "acknowledging that racism is problematic yet avoiding direct dialogue or teaching related to its continued institutional features, and rather focusing attention on individualized acts of overt racism" [9]. This is a colorblind approach in which the role of racism in society is reduced to a sole focus on individual bad actors and their racist behaviors.

Teachers were asked to rate their confidence in their ability to engage in a series of teaching practices associated with each of the three pedagogical approaches (non-racist, culturally responsive, and anti-racist). Teachers provided mean levels of confidence on each of these three subscales ranging roughly between 5.0 and 6.0, corresponding to "Slightly Agree" and "Agree", respectively, on the response scale. Teachers' mean responses on the subscales were as follows: m = 5.70 for non-racist teaching, m = 5.78 for culturally responsive teaching, and m = 4.93 for anti-racist teaching. These data are displayed in Table 3. These subscales demonstrated high internal consistency reliability, with alpha = .90 for non-racist teaching, alpha = 0.93 for culturally responsive teaching, and alpha = 0.96 for anti-racist teaching.

There is a trend in these responses for teachers to express more confidence in their ability to practice non-racist and culturally responsive teaching practices as compared to anti-racist teaching practices. This is perhaps due to teachers' relative inexperience with and/or lack of training on these more novel and recently adopted, at least for many teachers, anti-racist approaches. Also potentially contributing to this finding is the possibility that the anti-racist practices require an intense inward focus on one's own racial standpoint and context as well as wading into discussions that may be uncomfortable or otherwise difficult for students. Some teachers may simply feel unequipped to carry out such practices. In addition, anti-racist approaches are more controversial in today's political climate. Descriptive statistics on each subscale as well as its individual items are provided in Table 4.

Table 4. Teaching self-efficacy scales for non-racist, culturally responsive, and anti-racist teaching

Subscale (number of items)	**Count**	**Mean**	**SD**
Anti-racist teaching (11 items)	47	4.93	1.15
Culturally responsive teaching (7 items)	47	5.78	0.86
Non-racist teaching (6 items)	46	5.70	1.05
Item (Subscale: Anti-racist)	**Count**	**Mean**	**SD**
Analyze the social construction of race and racism	46	5.02	1.36
Examine the influence of whiteness in your course curriculum	46	4.80	1.47
Address student anxiety about controversial racial issues	46	4.96	1.35
Use classroom content to challenge racial bias	46	4.85	1.35
Discuss current radicalized events within their historical contexts	46	4.85	1.38
Encourage students to explore their racial identity	46	5.17	1.50
Examine the curriculum to determine whether it reinforces negative cultural stereotypes	46	5.04	1.25
Revise instructional material to include a better representation of cultural groups	46	5.02	1.20
Make race relevant in an all-white classroom	47	4.79	1.41
Serve as the expert when talking about race and racism in the classroom	47	4.49	1.54
Engage in cross race dialogue with colleagues	47	5.30	1.44
Item (Subscale: Culturally Relevant)	**Count**	**Mean**	**SD**
Use the interests of my students to make learning meaningful for them	47	5.89	1.01
Obtain information regarding students' academic interests	47	5.94	0.96

Help students to develop positive relationships with their classmates	47	6.04	0.91
Use my students' cultural background to help make learning meaningful	47	5.75	1.03
Develop a community of learners when my class consists of students from diverse backgrounds	47	5.94	0.96
Identify ways in which students communicate at home may differ from school norms	47	5.36	1.13
Use examples that are familiar to students from diverse cultural backgrounds	46	5.57	0.98
Item (Subscale: Non-racist)	**Count**	**Mean**	**SD**
Teach all students the same regardless of their racial identity	45	5.80	1.22
Adopt a colorblind stance in the classroom	46	5.35	1.58
Look past racial differences to promote harmony in the classroom	46	5.87	1.20
Draw on common sense beliefs in the classroom	46	5.85	1.09
Implement a non-biased approach to teaching content	46	6.00	0.92
Help students think of people as American, not African American, Mexican American, or Italian American	46	5.37	1.50

Note: 7-point response scale ranging from Strongly Disagree to Strongly Agree

Teacher perspectives on the social justice curricular focus

Teachers were asked the following open-ended item relating to the social justice focus of the curriculum: "What are your thoughts on the social justice focus of this year's curriculum?" Teachers' feedback on the social justice focus of the YVIP curriculum was somewhat mixed, with largely positive feedback suggesting that this content is "important and needed", "excellent", and "appropriate and fair". The following comments illustrate these positive sentiments regarding the curriculum's social justice focus:

- *It is needed. No matter what color you are. We must talk about these issues and find common ground so we can get to equity and the beloved community. I do not want us to be color blind.*

- *I like the social justice component in EarSketch and it can be a prelude to having those difficult conversations that communities to start to have to begin the healing process that is [needed] to make all people feel they count.*

Teachers noted that the curriculum was useful to "engage my students in such a difficult conversation" and helped their "students experience programming for a cause". Some teachers offered suggestions for expanding the social justice focus beyond Black entrepreneurs, stating that "you should broaden the focus to include different struggles of different people" and that the curriculum "should be broader to address more injustices that just color".

Other teachers felt that the social justice lessons were too time consuming or difficult to cover given their minimal link to the subject matter they needed to teach, stating that "Unfortunately, because I mainly teach math, social justice cannot be a focus, but more of discussion." One teacher felt that they would like to see song creation without the social justice requirement but noted that "I think this also has to do with compassion fatigue or just being tired of having to fulfill so many more roles now as a teacher". Another issue raised by teachers is sensitivity among parents and/or within the larger political landscape around teaching social justice and related topics: "This year I had a couple problems with the parents who didn't like this focus". Similarly, one teacher replied that "when the local legislatures are proposing bills that specifically prohibit topics such as 'critical race theory', it is hard to feel safe discussing related topics as a teacher. Do these efforts need challenged? Yes, they do! The question is how to do it." While largely recognizing its value for their students, teachers' feedback on the social justice focus of the curriculum shows the complexity and potential challenges associated with this content.

Students

Coding music background and participation context

Roughly half of students reported having made music using a computer, and roughly 1/3 of students reported having used EarSketch, prior to their participation in the competition. Over 80% of student respondents worked on their music for the competition both at home and at school, and over 80% of students reported that they participated in the competition as part of a class project. In most cases, the project was required, and for most students, they worked on the competition as part of a computer science course, though students also participated in the competition as part of an engineering, music, science, history, and architecture courses.

Anticipated outcomes of YVIP curriculum participation

Students were asked to indicate whether they had participated in the Your Voice is Power curriculum experience; going through the curriculum is not a requirement for participating in the competition. Students who responded that they had taken part in the curriculum were asked to respond to a set of items about their standing on attitudes and values expected to be impacted by the curriculum: 1) awareness of social and racial injustice (items 1 – 3 in Table 5) and 2) social agency (feeling capable of enacting positive social change; items 4 – 6 in Table 5). Students also provided feedback on their perceived value and utilization of the OUTKAST Imagination

framework [1] and their understanding of the link between music and social justice (items 7 – 11 in Table 5). Students responded to these statements by indicating their level of agreement on a five-point response scale ranging from 1 = "Strongly Disagree" to 5 = "Strongly Agree".

Nearly half of students responding to the survey took part in the "Your Voice is Power" curriculum (45.5%). The remaining students were either unsure (39.4%) or did not take part in the curriculum (15.2%). It is curious that over 1/3 of students were unsure as to whether they took part in the curriculum; we plan to reach out to program staff and teachers to explore the reasons behind this finding. Students' average standing on the curriculum outcome-focused items was high, with mean responses on all but one item falling between 4.0 and 5.0, which represent a response of "Agree" and "Strongly Agree", respectively. These responses indicate that students who have experienced the "Your Voice is Power" curriculum as part of their competition experience are aware of racial injustice (m = 4.21) and means of promoting equity (m = 4.32), as well as the ways in which coding can be used to promote equity (m = 4.39). High mean responses to the item on using coding to promote equity demonstrate the program's success in meeting this goal: *high levels of student awareness of the potential use of coding to promote equity and social justice issues.* Descriptive statistics on these items are provided in Table 5.

In terms of consideration of and intentions to take personal action to promote equity, students agreed that they have both thought about (m = 4.18) and could see themselves addressing inequity (m = 4.18) in their schools or communities. In addition, students agree that promoting social justice in their communities is important to them (m = 4.36). High mean responses on these items related to thinking about and potentially taking action to promote equity demonstrate the program's success in meeting this goal: *high levels of student feelings of empowerment and agency to use their knowledge and skills to effect change in their lives, schools, and/or communities*. Descriptive statistics on these items are provided in Table 5.

Students provided high average levels of agreement to a series of statements on the utility of the OUTKAST Imagination framework and on their understanding of how music and its lyrics can be used to promote social justice, with mean responses on this series of five items ranging from m = 3.89 to m = 4.50. This feedback from students indicates that they felt the OUTKAST Imagination framework was a useful tool to support lyric analysis, and that they can analyze lyrics from and think critically about music they encounter in their daily lives. Descriptive statistics on these items are provided in Table 5.

Table 5. Students' standing on curriculum outcome variables

Item	Number of Students	Mean	SD
I now have an increased awareness of racial injustice.	28	4.21	0.74
I now have a better understanding of the different ways that people can promote equity as an activist or ally.	28	4.32	0.61
I now have a better understanding of how coding can be used to promote racial equity.	28	4.39	0.69
My experiences in the competition have inspired me to think about ways I could address injustice or inequity in my community.	28	4.18	0.77
I can see myself getting involved in a school or community effort to address a problem or injustice.	28	4.18	0.61
Working to promote social justice in my community is important to me.	28	4.36	0.73
I now have a better understanding of how music and its messaging can be used as a tool for social change.	28	4.50	0.69
Using the OUTKAST imagination framework improved my ability to understand and artists' message.	27	3.89	0.75
The OUTKAST imagination framework was a useful tool for analyzing the lyrics of songs in the curriculum.	27	4.00	0.78
I can analyze the meaning of song lyrics I hear in my daily life.	28	4.39	0.63
After this challenge, I think more critically about song lyrics and their meaning as I listen to music.	28	4.29	0.71

Note: Response scale ranges from 1 = "Strongly Disagree" to 5 = "Strongly Agree"

General competition feedback and career interest: comparison of pre-competition and post-competition level

A single item assessing students' perception of the competition in general asked them to rate the competition on a scale from one to five, with one corresponding to "Not good, I really didn't like it at all" and five corresponding to "Awesome! I loved this learning challenge". The survey concluded with a series of items written using the retrospective post-then-pre design [18]. This design asks participants to rate, at the same point in time, their standing on an outcome of interest both prior to and after their competition experience. The before and after ratings can then be compared to assess the extent to which students believed they experienced a shift in these outcomes over the duration of their competition experience. This design is often used when a true pre-post design is not feasible and has been shown to reduce response shift bias; response

shift bias refers to a difference in a participant's pre vs. post responses driven not by a true change in their attitude, but rather by a change in their understanding of or knowledge about the outcome of interest [18]. A single overall satisfaction item was also included.

Most students (89.2%) provided a rating of 4 or 5 for the single general rating item. The mean response on this item was 4.29 (SD = 0.80, range = 1 to 5), providing evidence of a high level of student satisfaction with the overall competition experience. Students were also asked to provide what is known as a "net promoter score", responding to the item "I would recommend the Your Voice is Power curriculum and competition to a friend." As is typical of net promoter scores used in various industries, an 11-point response scale was used for this item, with 0 = Extremely Unlikely and 10 = Extremely Likely. Sixty-six students responded to this item, providing a mean score of 7.82 (SD = 2.24, range = 0 to 10). Additionally, 82.5% of students provided a net promoter score of 7.0 or higher.

Student responses were compared on the before challenge and after challenge versions of items concerning three outcomes of interest, ranging from most distal to most proximal: level of interest in a career in computer science, level of interest in studying computer science in college, and level of interest in taking more computer science courses. Please note that these items are not presented to students in two separate surveys; rather, students are asked to respond to two related items within the same survey: 1) "Before this competition, I was interested in a career in computer science", and 2) "After this competition, I am interested in a career in computer science. Similar pairs of items are presented for interest in studying computer science in college and interest in taking more computer science courses.

Mean responses on all six of these items fell between 3.0 and 4.0, corresponding to "Neutral" and "Agree", respectively, on the response scale. Descriptive statistics on these items are provided in Table 6. One-sample t-tests were conducted to assess whether a significant difference in the before challenge and after challenge version of the item was present. All three differences in the before and after challenge items were significant. For the CS career item, $t(57) = 5.08$, $p < .001$; for the studying CS in college item, $t(57) = 3.51$, $p < .001$; for the taking more CS courses item, $t(57) = 3.85$, $p < .001$. These results suggest that for these three sets of items, students reported a significantly higher level of agreement with the item asking for their level of interest after the challenge, as compared to their level of interest before the challenge, in a) a career in computer science; b) studying computer science in college; and c) taking more computer science courses.

Table 6. Students' responses to retrospective post-then-pre items

Item	Number of Students	Mean	SD
Before this challenge, I was interested in a career in computer science.	58	3.17	1.37
After this challenge, I am interested in a career in computer science.	58	3.76	1.05
Before this challenge, I was interested in studying computer science in college.	58	3.22	1.28
After this challenge, I am interested in studying computer science in college.	58	3.64	1.04
Before this challenge, I was interested in taking more computer science courses.	58	3.38	1.35
After this challenge, I am interested in taking more computer science courses.	58	3.95	1.03
I was satisfied with the Your Voice is Power curriculum and competition.	57	4.14	0.97

Note: Response scale ranges from 1 = "Strongly Disagree" to 5 = "Strongly Agree"

Students' learning: social justice awareness, promotion, personal engagement, and link to music

In their responses to a question on how their experience with the competition influenced their understanding of social justice, students discussed an increased awareness of social justice, a more thorough understanding of ways to promote social justice, a personal desire to engage in social justice promotion, and a deepened understanding of music and its messaging. Through their competition experiences, students "have become more aware of the [social injustice] issue", "understand that there are many different forms of social justice", and "realize that there is a lot of injustice happening that isn't talked about." In addition to broadening their awareness and understanding, the competition experience "showed me ways I could help" and "helped me realize there are more ways to promote social justice." Students also discussed how their experiences in the competition fostered a desire to promote social justice, such that the competition "has influenced me greatly to want to make a change in today's society." and "influences me to help people who have dreams that they are pursuing." Lastly, students commented that they learned about the power of music to express one's beliefs as well as how to listen to the lyrics of a song more deeply. Students noted that "I can use music to show how I feel about social justice" and that "music can be used as a tool for speaking against hate." Further illustrative comments are provided below:

- *I now better understand the social struggles many face and hope to continue to express social justice through music.*

- *My experience with the competition influences my understanding of social injustice because I have become more aware of the issue. However, I have learned that there are ways to express one's feelings about an adversity such as social injustice. One way could be through creating music, just like this competition*

- *The competition let me understand that if people want change to happen, they have to actually do something instead of just speaking about it, they have to act on those words instead of just saying the words.*

- *Well I've seen many other people's projects and realized the injustice throughout the world. I hope to help change it because of those projects.*

- *I grew to appreciate the symbols and meanings that were hidden inside music lyrics like the ones we remixed. Sometimes that happy tune could be a metaphor to cover up the dark realities that take place. It was almost like a switch clicked in my brain, and now I can perceive the deeper truths to songs that I once thought were shallow.*

- *After watching videos and reading articles from the curriculum, I understood that social justice is more than people speaking out on social media and protesting. It can be found in music too. I began to think of music differently when listening to it and actually taking time to understand it.*

Conclusion

The YVIP curriculum, which was developed after the tragic murder of George Floyd in 2020, aims to aid teachers in facilitating race-related discussions by providing a scaffolded process for discussing the topics of racial equity, social justice, allyship, and messaging through music. The curriculum gives teachers tools for presenting and working through these topics in a curriculum that is both academically rigorous and tied directly to computing standards.

The self-selection of both students and teachers to participate in the survey coupled with low response rates for both groups represents a substantial limitation of the study. We have considered adding incentives for responses (i.e., entry into a lottery for a gift card) in an effort to increase response rates. We acknowledge the possibility that students and teachers who had more positive feelings about the program may have been more likely to self-select to take the survey as compared to the full pool of student and teacher participants. Another potential limitation is that the same series of items was presented to all of our participants in grades 6 – 12. In future work with this population, we will consider lowering the reading level of the items for the middle school grades.

Based on evaluation of teachers and students, the Your Voice is Power curriculum is effective in promoting interest and persistence in computer science courses while also advancing understanding of racial equity and social justice issues. Through scaffolded discussions around race and the use of the cutting-edge OUTKAST Imagination framework, students are able to see the connections between computing, music, and social justice. Students showed evidence of thinking more deeply about the messaging in lyrics rather than simply the mood of a particular song. These outcomes are compelling at a time when race and critical race theory are contentious and highly politicized.

Teachers showed a high level of comfort with non-racist pedagogy, but their comfort decreased somewhat as they moved to culturally responsive pedagogy and anti-racist pedagogy. While most teachers felt it was important to address race and racial inequities in their classrooms, some teachers internalized the political pressure or cultural pressure to omit or reduce the emphasis on these topics.

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