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Urban Students' Views about Technology: Academic Skills, Career Interest, and Post-Secondary Choices

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Abstract

This mixed methods study, grounded in a social justice framework, explores urban high school students' experiences in a technology program and how those experiences influence both their perception of self-efficacy in STEM related subjects during high school, leading to specific educational interests and career choices. The findings suggest that students' perceptions about post-secondary choices considerably broaden when they are exposed to structured STEM programming; students develop more informed plans for post-secondary education, critical thinking and communication skills and hold higher aspirations for the future. The discussion highlights that providing structured STEM programs to students in urban education settings could minimize the effects that structural factors such as poverty have on the students' perception of their career opportunities after high school. Structured STEM programs serve as means for social justice, opening up opportunities for underserved student populations in urban settings.

Keywords

STEM Education, urban education, high school, post-secondary options, academic skills

I. Introduction

Urban schools play an important role in the ways in which the United States can develop into a more robust global leader, through the genius and hard work of its scientists, engineers, and innovators. In a world that's becoming increasingly more complex, where success is driven by what you can do with what you know, it's more important than ever for our youth to be equipped with the knowledge and skills to solve tough problems, gather and evaluate evidence, and make sense of information. These are the types of skills that students learn by studying science, technology, engineering, and math – subjects collectively known as STEM.

Underprivileged youth, who experience social injustices such as poverty, homelessness, and unsafe living environments, make up a significant portion of the student population in the United States. In urban schools, it is typical for a high percentage of the student population to be students of color. Students in these schools are often impoverished, and many feel that their schools have failed them (Kozol, 1991). We believe it is critical to provide access to high-quality, structured programs that will remedy these injustices and propel all students in urban settings to reach their full potential.

Although there are technology-based activities provided in some urban schools, there is a different perception of STEM subjects and academic performance for students who voluntarily participate in technology-based and college-credit programs compared to students who participate in STEM activities provided by the district schools. The analysis of participating students' experiences and perceptions about the impact that technology-based programs or curriculums have on their proficiency in STEM subjects and the possible opportunities they will have after completing high school sheds significant light on the reception this approach is having among underserved and underrepresented students in a Midwestern school district. The knowledge gained from this study will be relevant to other urban educational environments with similar characteristics and potentially for the implementation of targeted programs to meet similar students' current and future academic needs.

Background

The main intervention used in the study to explore student's experiences in quality STEM programs is the Youth Technology Academy (YTA) of Cuyahoga Community College (Tri-C). YTA is a workforce program for high school students; it focuses on the provision of technical-skills training and education to spark interest in and access for inner-city, underrepresented youth. The mission of the YTA is "To ignite the interest of high school students in STEM studies and STEM career pursuits via robotics and other cutting-edge training, competitions and college credit technology courses" (Cuyahoga Community College).

The YTA is located on the metro Campus of Tri-C in the city of Cleveland, OH. It primarily serves economically disadvantaged, underrepresented urban youth from the Cleveland Metropolitan School District. Cleveland ranks as having the 3rd highest poverty rate among large U.S. cities, and in 2013 CMSD had the third lowest high school graduation rate and second lowest average ACT score of the 601 districts in Ohio (Ohio Department of Education, 2015). As of 2016, the high school dropout rate fluctuates between 46% and 50%; 35 % of the total population lived in poverty, but more striking, 51.4% of the city's children live at or below the poverty level (Aly, Bollig Dorn, Rohling McGee, Bush Stevens, & Sustersic, 2016). This is evidenced in the fact that more than 95% of the students in the Cleveland Metropolitan School District (CMSD) qualify for the free or reduced lunch program. The YTA demographics mirror closely that of the district in that the YTA serves 61% Black students, 21% White students, and 16% Hispanic students. YTA's gender breakdown reveals 55% male students and 45% female students served (Cuyahoga Community College, 2018).

Purpose of the Study

The purpose of this mixed-methods study is to explore urban high school students' experiences in technology programs and how those experiences influence both their perception of self-efficacy in STEM related subjects during high school and their higher education interests and career choices. This study is particularly important given the demographics of the students in the program and the rate of performance of the school district from which the sample of students was taken. This study seeks to answer the following research questions: How do high school students in a STEM technology program compare academically with high school students not in a STEM technology program?; and What are urban high school students' perceptions of the influence of participating in technology classes on a) their self-efficacy on STEM related subjects; b) aspirations to pursue a post-secondary degree in the STEM field; and c) their career interests?

II. Theoretical Framework

Urban youth's awareness of their potential and opportunities are critical to overcoming social and economic oppression (Freire, 1993). This study is grounded in a social justice framework wherein urban youth who are engaged in learning environments that integrate technology and foster the students' mastery of STEM-related courses go through a process of reflection and self-awareness that nurtures positive self-perception (Cammarota, 2007; 2011). The study explores urban students' perceptions of the influence of technology and STEM-related learning experiences. From the point of view of a deficit, the term "urban" is commonly linked to low educational performance and achievement along with dysfunctional families and high criminality (Reed, & Swaminathan, 2016; O'Connor, Mueller, & Neal, 2014).

In this context, the study explores how having access to technology and STEM education positively influences students' perception of their own abilities and provide a wider range of career options. A social justice approach examines how students in urban schools are empowered by STEM education despite the often resource-starved schools they attend (Milner & Lomotey, 2013; Flessa, 2009).

III. Review of the Literature

The School District of the study is characterized by high poverty and high numbers of minority students, having the fifth lowest (69.1%) high school graduation rate as well as the second lowest average ACT score for the years 2015-2016 in the state (ACT, 2017). Research indicates that students in a racial or ethnic minority, with low-income households, and particularly those attending urban schools may exhibit less effective academic behaviors (Finn & Voelkl, 1993; Johnson, Crosnoe, & Elder, 2001). Many urban high school students seem to perceive mathematics and science courses to be challenging and a possible barrier to academic achievement, however, results from quantitative studies show that high school academic experience, student behaviors such as study habits, and motivation to succeed in science courses have an effect on how students perform in "barrier courses" (Suresh, 2006). Suresh (2006) emphasizes that motivation to succeed plays an important role in whether or not students persist in these courses.

Participating in structured academic programs, such as STEM-related courses, may improve urban school students' self-concept, academic achievement, and educational aspirations beyond high school (Crisp, Nora, & Taggart, 2009; Author, 2014). Research indicates that students who pursued and obtained a degree in STEM majors had taken mathematics and science courses in high school; these are seen as 'gatekeepers' in higher education (Crisp et al., 2009). According to Crisp et al.'s (2009) research findings, the potential to earn a degree in a STEM field is related to students' first-semester GPA and enrollment in mathematics and science courses. This relationship may have its roots in earlier interventions to promote academic competencies in high school. The authors discuss the importance of minority- Hispanic -serving institutions and how such institutions facilitate access to STEM fields for their students (Crisp et al., 2009). Having a solid background preparation in STEM subjects is likely crucial to successful academic outcomes once students enter post-secondary institutions.

In terms of gender influence on the level of interest in computer sciences in college, findings from Barron, Martin, Mercier, Roberts, and McPhee (2004) indicate that, while participation in high school programming classes had a relationship with students' interest in computing in college, gender differences did not have significant effects on the subject. The study corroborates the effect of exposure to multiple programming courses on the students' confidence in their ability to work with computers and their interest in pursuing technology-driven courses. The students' views of their abilities in the use of technology, post-secondary choices, and development of necessary academic skills for embracing post-secondary technology- or science-grounded programs depends on their exposure to well-planned science subjects and programs during high school, given that experience increases students' confidence and abilities within a field (Barron, et al., 2004).

Sommers (1996) discusses how female students reliably under-perform on math and science standardized tests when compared to male students, particularly during the first years of high school (as cited in Good, Woodzicka, & Wingfield, 2010). The literature on gender differences in this area also highlights that females' "lower scores on these standardized tests place [them] at a disadvantage when applying to institutions of higher education" (Good, Woodzicka, & Wingfield, 2010, p. 133).

The literature reports that the participation of women in engineering and science professions had increased significantly by the end of the twentieth century, though the overall percentage of women in these professions was still small (Dick & Rallis, 1991). More recent literature emphasizes the low representation of girls and women in STEM courses; however, women who did participate in those programs were twice as likely to aspire to STEM careers, in general in STEM careers, with a higher interest in engineering (Bishop, 2015). The literature reports influential effects on students' self-efficacy in hands-on activities, and mastery experience, such as the intervention program in this study, also indicating that self-efficacy beliefs are sensitive to subtle changes in students' performance context and mediate students' academic achievement (Usher & Pajares, 2008; Zimmerman, 2000). According to Bandura's (1982) theory of self-efficacy, the level of an individual's successful performance is related to his or her level of induced self-efficacy.

Research from the Bureau of Labor Statistics has shown that students who graduate high school are more successful in securing and retaining employment (2015). Unemployment rates were similar for those who dropped out of high school in the past year and recent high school graduates who were not enrolled in college. According to the Economic Policy Institute, young people who have graduated high school or dropped out of high school, who are between the ages of 17 and 20, have varying unemployment rates. For example, in 2016, the Caucasian unemployment rate was 33 percent, while it was 36 and 51 percent for Hispanics and African-Americans, respectively (Economic Policy Institute, 2017).

Research done by the Community College Research Center at Columbia University indicates that students who take college courses while in high school have an increased rate of 4-year university enrollment as well as higher GPAs in college (2017). Taking postsecondary classes while in high school suggests initiative, and subsequently that students may be better prepared

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to succeed in college. This is especially true given that only about forty percent of U.S. high school students meet college readiness levels in English, math and the sciences (ACT, 2017). Succeeding in a dual enrollment program can put to rest any doubts about a student's readiness for higher education. This is supported by the rate of success of YTA's students graduating from high school. Annually, over 90% of the students that take part in the YTA program graduate high school on time.

The nation has nearly 6 million 16- to 24-year-old youth who are neither working nor attending school. The October 2015 Congressional Research Service's report, "Disconnected Youth: A Look at 16 to 24 Year Olds Who Are Not Working or in School," indicates that disconnected youth lack the strong social networks necessary to provide employment connections and other supports such as housing and financial assistance. In the absence of critical connections to work and school, such youth will struggle with the transition into adulthood and will be highly susceptible to negative outcomes. YTA staff provide nonstop activities and opportunities for students to learn, practice, and perfect social skills within the classroom, the robotics lab environment, local and national competitions, and one-on-one interactions.

For a variety of reasons, disconnected youth may have difficulty obtaining the skills necessary to achieve self-sufficiency, and poverty is one of the most egregious. It is a vicious cycle in that disconnection can lead to prolonged poverty into adulthood and poverty often ensures disconnection in youth. One possible way to keep students connected to an environment leading to upward mobility is the practice of project-based learning (PBL), which provides a way to incorporate situated learning in the classroom. According to The Buck Institute for Education (2003), PBL is "a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process… authentic questions and carefully designed products and tasks" (p. 4). The YTA strives to stop the pattern of disconnection by (1) creating technology and academic curiosity in their students; (2) providing students with the means to pursue their interest and increase their overall academic and workforce skills; and (3) introducing students to real-world workforce environments. In this sense, research suggests that significant critical engagement and agency can be observed when youth are actively involved in vivid educational experiences, even when they function within under-resourced academic spaces (Author, 2015).

The YTA program assists students by connecting them to core activities such as education and employment – specifically, school and job training programs that provide wraparound services such as counseling, work readiness skill development, career exploration, work experience, transportation assistance, assistance with attaining a high school diploma, and preparation for the workforce – are critical components in YTA's mission of engaging youth. The key component to sparking interest and excitement in disconnected students is the technology access offered through YTA. The YTA program affords equitable access to technology for inner-city youth who would not otherwise be exposed to STEM.

STEM education is considered essential to drive the country towards new frontiers of science and scientific innovation, increasingly becoming the center of federal programs' grant funding support, including the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA), among others (Holdren, Marrett, & Suresh, 2013). In a 2015 statement, the Department of Education noted that the office's priority would be to ensure that all students have access to high-quality learning opportunities in STEM subjects, highlighting their role in improving P-12 STEM instruction by supporting partnerships among school districts and universities, science agencies, businesses, and other community partners to improve teaching and learning. President Barack Obama stated:

"[Science] is more than a school subject, or the periodic table, or the properties of waves. It is an approach to the world, a critical way to understand and explore and engage with the world, and then have the capacity to change that world..." (U.S. Department of Education, 2015)

The overwhelmingly low performance of many underserved urban districts indicates that most urban students do not have access to such high-quality learning opportunities in STEM subjects. Efforts need to be made to ensure that effective partnerships among different education stakeholders and school districts are formed to improve teaching and learning in urban settings, facilitating high school student engagement in STEM programs. The current study will provide an in-depth analysis of student experiences and performance in STEM-related subjects and programs, contributing to the existing literature on STEM education and facilitating decision-making efforts for providing high-quality curriculums and effective teacher training in urban districts.

IV. Methodology

Research Design

The study used a mixed-method approach. The quantitative approach of the study uses exploratory descriptive statistics in order to describe the participants' individual characteristics. In addition, it uses detailed information about the students' academic performance within the school district. The quantitative data measures included are grade point average (GPA), course grades at Tri-C, and state test performance rate scores. Likewise, the demographic information comprises the type of school, grade level, gender, and socioeconomic status.

A qualitative approach was taken through a narrative/case study design that included a questionnaire and semi-structured interviews with student focus groups. This approach was used both groups – students that participated in the YTA program and a similar group of students attending the same school district but not taking specialized STEM courses - regarding their experiences and perceptions. The data reported by the students described how the exposure to this program (or lack thereof) influenced their perceptions of STEM subjects, individual aspirations about pursuing a higher education degree in the STEM field, and possible career choices and opportunities.

Participants

A sample group of 35 students was selected for the study. The participants in the study included high school (11th -12th grade) students of both genders from the Cleveland Metropolitan School District. All the students attending this school district are eligible for free or reduced lunch (a proxy for poverty level). The school district had the second lowest average ACT score out of the 601 districts in the state as well as the third lowest high school graduation rate. The sample was accessed from the STEM HS1, a regular STEM high school in the district, and one structured YTA technology program. The YTA program is implemented with two groups, one from a STEM high school (STEMHS2-YTA), and the other from a group that attends the technology program at the hosting Community College (YTAC). See Table 1.

Table 1.
Groups of students represented in the study

School	School Type	YTA Technology Classes	Location: YTA Technology Classes
STEM HS1 (SHS1)	District STEM HS	Students NOT taking YTA classes	N/A
STEM HS2 -YTA (YSHS)	District STEM HS	Students taking YTA classes	Embedded in school day
YTA on Campus (YTAC)	Not/STEM focused	Students taking YTA classes	On Tri-C Campus after school

Instruments. I. Quantitative data were collected from the district's public databases. The school district from which the sample of the study is drawn maintains quantitative data including student demographics, grades, performance index, graduation rates, grade point average, and achievement results on local measures and nationally normed standardized assessments. II. For the qualitative data collection, an individual student questionnaire of 14 items was used to explore individual student perceptions or experiences in STEM related courses (See appendix B). The items included closed-ended and open-ended questions. III. A semi-structured interview was conducted with focus groups in order to explore the students' perceptions of the immediate and future effects of participating in technology classes and/or in the YTA program on the students' academic lives and future. The interview was conducted with two focus groups from the metropolitan school district, including students that took STEM classes in school and a second group that attended a specialized STEM program in YTA. Each group was comprised of 15-20 students. The 14-item individual questionnaires were completed with pencil and paper in the classroom, and the semi-structured interviews with the focus groups were audio recorded to ensure fidelity of the information and to allow for multiple reviews of the information, including the participants' voices and emotive expressions. IV. Reflection Field Notes. The researchers took field notes during the focus group interviews, highlighting students' approaches and emotional reactions when answering the questions.

Some of the questions included in the focus group interview were: How did participating in YTA STEM activities affect students': i. Feelings about their self-efficacy (capability for: learning/performing/math) in stem related subjects at school? ii. Academic engagement like going to class, doing homework, better grades, and studying? iii. Learning strategies like the ability to be self-directed, make decisions, and set goals about post-secondary education? iv. Social skills like communication, empathy, cooperation, and responsibility? (with peers/adults), v. Ability to think critically about future career opportunities in the technology field? What were some of the factors related to the STEM classes that you think have helped you, as students, to perform better at school? Please explain whether participation in the STEM classes did anything that affected: i. Student's college perception, ii. Teacher-student relationships in the school?, iii. Student-peers relationships in the school?

Data Collection, Analysis and Procedures

The study follows ethical protocol and was approved by the IRB office at Tri-C. The researchers obtained informed consent from the participants and the questionnaires used for collecting individual and focus group data were pilot tested with a similar-background group of students participating in one section of the YTA program at Tri-C. Some small changes such as question structure and terminology were made after the pilot test.

Data collection was completed using three instruments: a) paper and pencil questionnaires, b) researchers' observations and reflections collected as "field notes", and c) audio recording of the focus groups' interviews (Creswell & Clark, 2011). Focus group interviews occurred in two sessions with small groups of students (15 students approx.), wherein a facilitator posed a set of questions designed to prompt discussion and encourage all students to participate in a meaningful way. As stated by Patton (2002), focus groups are interviews in which participants have the opportunity to hear each other's answers and reactions and to make further comments beyond their own original responses.

The data collection process during the interviews included two interviewers who created rapport and interacted with the students. To ensure the trustworthiness of the data analysis process, all the data collected was secured and only shared with the research team. In addition, researchers' reflection notes were included. The research team was comprised of three coders who worked independently in the analysis and then came together to discuss and draw conclusions in periodic meetings that included discussion of individual analyses to find thematic commonalities and differences. Likewise, an agenda was set for every meeting, including new analysis steps and work distribution. All members of the research team participated in every aspect of the study, from issue identification, access to participants, instrument design, data collection, and individual and group data analysis and report. The use of triangulation allowed for the incorporation of different but complementary data collected from public records, focus groups, individual student questionnaires, and reflection on field notes. The results of the analyses are reported in the findings of the study.

V. Findings

Quantitative Analysis

The quantitative analysis used school district information as well as student demographic and academic information, including students' grade level, gender, racial groups, and socioeconomic level to answer the question "How do high school students in a STEM technology program compare academically with high school students not in a STEM technology program?" The participants' profile, 35 students in total, mirrors the demographic distribution in the school district: 66 percent Black, 15 percent Hispanic, 15 percent White, and 5 percent Asian. The percentage of students graduating with a GPA of 3.0 or higher was 30% and 34% in 2015 and 2016, respectively. Moreover, the percentage of CMSD graduates with a score of 21 or higher on the ACT was 15% for both years. It is important to note that an ACT score of 21 is considered as the national standard for college readiness, indicating to post-secondary institutions that a student is likely to be able to successfully complete college-level coursework.

The 2017 state report card for the school district used in this study shows a performance index of 49.2% (59.1 of a possible 120). The performance index categorizes the test results of every student at six levels, including advanced plus, advanced, accelerated, proficient, basic, and limited performance, in the district. A performance index of 49% gives the district a grade of "F." The official passage rate in the state is set at 80%. The table included

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below indicates the district and individual schools' report card with a passage rates below the expected performance. Table 2 describes how the groups participating in the study compare to each other and to the district's performance. Table 3 includes demographic information for all students in the school district.

Table 2.
CMSD 2017 state report card

Participants (N) = 35.	Performance Index	% of students who have passed state test		
	Measurement of test results of every student	Algebra	Geometry	Biology
District (All schools)	49.2%	17.2	10.1	28.6
SHS1	43.3%	7.3	6.5	26
YSHS	42.7%	12.9	6.8	29.4
YTAC	35.7% 43.3% 42.7%	7.2 7.3 12.9	4.6 6.5 6.8	12.4 26 29.4

Table 3.
Demographic characteristics of CMSD, urban districts, and districts statewide in 2013-14

	CMSD	Urban Districts	Districts Statewide
Total enrollment (%)	37,967	21,481	2,580
Students eligible for free or reduced-price meals	>95	85	43
Asian or Pacific Islander students	1	2	<1
Black students	66	53	6
Hispanic students	15	7	3
Multiracial students	3	7	3
Students with limited English proficiency	8	6	1
Students with disabilities	24	19	14
Students in the district for less than a full academic year	5	4	2
Students in the district for between one and two years	43	42	34
Poverty rate of school-age children in the district catchment area	46	40	18

Note: 2014 Higher Education Compact of Greater Cleveland 2014 Report to the Community, Cleveland Ohio

Qualitative Analysis

The qualitative analysis sought to answer the questions: What are urban high school students' perceptions of the influence of participating in technology classes on their self-efficacy on STEM related subjects, their aspirations about pursuing a post-secondary degree in the STEM field, and their career interest choices? The analysis includes information from focus groups with students from two high schools, the YTA STEM program (YTAC) and the STEM HS1, described as a STEM school, as well as an analysis of questionnaire data. The analysis includes reflections collected in researchers' field notes taken during the focus groups interviews.

Focus Group (YTAC)

Findings from the focus groups suggest that the students' perceptions about post-secondary choices broaden when they are exposed to structured STEM programming and that information about future careers benefits students in developing more informed plans for post-secondary education. For example, when we asked about what things students liked about school, contextualized questions were often structured to continue conversations related to an expressed perspective: What was it that you liked about . . . ? How did this make you feel? How did other students respond?

Improved self-efficacy and self-esteem

The findings from this focus group indicate that, in contrast to their initial skepticism of their capabilities in STEM subjects, the students who participated in the YTA program perceived STEM-related classes as enjoyable and rewarding. Most students felt that their participation provided them with higher self-esteem, self-efficacy, and a sense of resourcefulness. As noted in the literature, motivation to succeed plays an important role in whether or not students persist, and feelings of high self-efficacy in barrier subjects provide the motivation needed for succeeding in challenging urban settings (Suresh, 2006).

One student expressed he had significantly improved his communications skills in terms of being able to use "bigger words" and being interviewed by people, judges, in competitions and 'talking on camera getting interviewed like this'. Another student stated, while the other students seemed to agree with her: 'I basically learned how to apply myself better, and not to give up. Sometimes it gets hard and you want to walk out, but dealing with this robotics stuff you can't give up you just got to keep moving forward." "Then again, you have more responsibility.'

In line with Bishop's (2015) work, two of the female students participating in the focus group and enrolled in the YTA program stated that their interest in future STEM careers increased as a direct result of taking part in the program and that their parents were proud of their academic progress since their involvement in STEM classes. Author 1 wrote in the field notes: One student's face lit up in pride when sharing her parents' remarks about her performance.

Mindshift about STEM Subjects and Academic Engagement

One common factor mentioned during the focus group meetings was that the students' views about STEM classes changed once they started the program and became familiar with the technology, engineering, and/or math language, as well as with the hands-on experiences, breaking with the "stereotypic images of scientists" (Sharkawy, 2015. p. 658). Students noted that taking part in engineering classes, which were practice-based, gave them the hands-on experience that they do not get in regular classes. For example, one student expressed: Student: 'I mean, yeah… with machining I learned how to measure, like, thousandths of inches, but … you don't do that in [regular] math lessons, it's all paper based, not hands-on.'

Interviewer: Is that the big difference between the YTA and your school?

Student: 'Yes.'

When asked about what effect attending YTA classes had on their engagement in academics in their high schools, some students said that participating in hands-on STEM classes, in addition to their regular class schedule in their high school settings, made them feel compelled to comply with the assignments for both activities. This view was shared by a few students, while most described the experience as 'eye-opening.' During the group interview, one student remarked:

"Yeah, it definitely made them [classmates] start thinking about what part of the STEM they were interested in, and… just start focusing in that part, whether it been machining, design, or looking at colleges that are better on those subject…"

Another student responded, when asked how they felt to be in a college level class: 'Being in a college level technology class made me feel I was make a huge change towards my future' . Another student interjected, 'I changed a lot…I was really shy at first and this program really helped me bring out my ideas.'

Development of Critical thinking and Communication Skills

Students observed an increase in their ability to use critical thinking in their college classes as well as their high schools. The following section of the interview illustrates the students' realization of their own change during their experience in the YTA program:

Student: 'Being in this program, it taught me how to multi-task, it taught me how to manage my time, it taught me critical thinking…'

Interviewer: 'And you feel you didn't have that before?'

Student: 'Well I didn't have it as much; I was able to refine my skills…to a point where I'm able to do it more efficiently.'

Student 2: 'It's like you are aware of that now how capable you are of doing things.'

In terms of communication skills, YTA students described how participating in the program helped them improve their communication skills because there were many opportunities during the classes in which they needed to work in groups, discuss projects, and communicate with their other teachers. Some students noted that, having been exposed to multiple projects where they had to problem-solve, they could see the problems studied in their other classes through more than one perspective and many times could find different ways to solve them than explained in those classes.

One student stated, 'There is a more friendly relationship between me and my teachers because now they value more my opinion when I participate in class discussions.'

Post-secondary Education and Career Choices/ Opportunities

The students' perceptions of their readiness for post-secondary education and career opportunities was described as promising, with most students reflecting on and agreeing with one classmate's statement:

'…the way high schools are run, students are only put in the classroom for forty minutes or less… students are not prepared to actual[ly] sit in a college classroom.. I feel this program will prepare them a lot more, give them the knowledge to…go to college'

Students were engaged in the interview by discussing different ways in which they benefited from their experience in the STEM program and how it would open a wider spectrum of opportunities for career options after completing high school and transitioning to college. A sense of confidence was perceived in most students (Authors' reflections from observations and field notes).

Focus Group (STEM HS1)

The focus group interview with students from the STEM HS1 revealed a different insight about their experiences in STEM-related subjects at their high school. In general, we perceived a combination of student awareness of the limited resources the school has and how that lack affects the quality of the education they receive. 'The students expressed their desire to learn life skills. It was very strong in this group! Seems to be priority over technology - life skills and how to help their own communities'(Author's reflections from observations and field notes).

Post-Secondary and Career Aspirations Versus Immediate Life Needs

The students spoke of their post-secondary and career aspirations, but these came second to immediate life needs. When asked to mention some possible benefits of having more STEM courses included in their curriculum, one student stated "[It would help] with more opportunities to do stuff…that [they] ain't never did before." Again, students emphasized that there were very few opportunities in their schools to do real science-based projects or class work and noted that the only classes offered in a regular basis were science, math, and biology. One student noted, 'Those other classes, we don't get them in a daily basis…just Wednesdays.' Students referred to their school's special Wednesday classes as a STEM class in which most of the time they would "just sit there" because they were not given "materials to build anything." The lack of resources in this school restricted what the students could do in a STEM class with no materials. The students agreed when another student talked about immediate life events and needs that were diverting their attention from school: "…they can't even function in school. Something is going on at home that they can't sleep at night, so they come sleep in class." When asked how students in their school could be helped, the student answered: "school therapist;" "some life skill class;" 'They should have a financial literacy class;' 'Independence class, teach you how to be independent;' 'sometimes I think schools teach the wrong thing. First they need to teach life things first, then go on from there;' 'They could've had some course on how to help your community because that's what everybody is talking about.'

The analysis of qualitative data obtained from the focus group interview and from the reflection notes suggested that the learning environment and the lack of exposure to quality STEM programs minimized the students' perspectives about options for their academic and career future.

Self-efficacy in STEM subjects

Self-efficacy is defined by Bandura (1982) as people's beliefs about their capabilities to perform at different levels having an influence over events that affect their lives. Regarding students sense of self-efficacy, it seemed that the students do not readily see their potential to succeed in STEM or make the connection between STEM academic and career pathways and financial success/life stability. The students constantly complained about being lectured in their classes and noted a lack of hands-on activities, which could improve their self-efficacy.

The students had a difficult time trying to explain the ways in which they thought the teaching-learning process would be more effective. Students explained that they wanted teachers that could 'break it down to [them]' and provide more step-by-step assignments. For example, some of the comments made by the students include: 1. 'They just giving us work and say do it. I'll

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need ya'll to break it down to me. I want them to teach us how they teach the white kids. 2. 'To help students in science classes, 'All they gotta do is give us hands-on activities, like experiments and different tools that we can use to experiment.' 3. 'Play with cardboard boxes. The whole year…it was not real engineering'

One reflection note from the interview describes the interaction: 'The students want to learn but cannot verbalize or identify how to learn these complex subjects. High self-efficacy ought to be difficult to achieve without the ability to learn and understand the subject matter.' Nevertheless, there seems to be awareness among the students of the need for more hands-on activities and college classes to improve engagement, learning, and readiness for college. This group of students had a palpable need for more exposure to academic and career pathways.

The students discussed amongst themselves the need for formal STEM education in every school and described the multiple opportunities it would afford them in terms of career options in the future. One student interjected, 'It should be something in every school. Everyone should be exposed to [STEM]…so they can know what they want to do in life and not have everybody working at McDonalds.'

Communication Skills

An emerging theme in both groups was communication. Particularly in this group, there seemed to be many issues regarding teacher-student communication. The students in STEM HS1 complained and blamed teachers for not caring about the students' learning or whether or not the students understood the content. Some of the students claimed that they would be given worksheets with which to spend the class with little or no interaction with teachers. This may be due to the lack of resources for facilitating a STEM class in addition to poor communication skills between teachers and students. We perceived that students felt a deep need to be cared about.

Table 4 shows a summary comparison between urban high school students exposed to the YTA STEM program and those who were not exposed to the program. The summary describes urban high school students' views about their experience in science and technology courses, self-efficacy perception, and perceived postsecondary and career opportunities.

Table 4.
Convergent Analysis - Comparison

	STEM HS1	YTA students
Communication	-Blaming the teachers (non-yta) and taking responsibility about performance and need for opening lines of communication. -Desire for communication - student to teacher and student to student	-YTA Students have to communicate with teachers to ask permissions to attend competitions. -Actively participate in class discussions -More effective communication skills developed as consequence of participation and interaction in competitions and interviews
Self-efficacy and Learning	-Desire for hands on learning - Students want to learn about what they are interested in, not what school/teachers decide for them - Students do not know how to learn complex subjects - this inhibits self-efficacy	-Enjoy hands-on and Project-based learning -Perception of high capability for learning and taking responsibility their education
Post-secondary/ Career aspirations	-Post-secondary and career aspirations are present but secondary to immediate life needs -Desire for life-skills courses in order to break a commonly seen transition from high school to the fields of sports or entertainment.	Awareness of open range of post-secondary opportunities and wider range of career pathways in STEM and sciences, previously unknown.

Discussion and Implications for Practice

Based on the findings of the study, which show an important influence of STEM education on how urban students see themselves and see their academic and career path, there seems to be an increasing need for improved and additional opportunities for high-quality STEM content and experiences for students from low-income, high-need schools in this Midwestern urban school district. Previous research indicates that 58.75% of the students in a STEM program aspired to STEM careers after high school in comparison to only 40% of students with similar academic achievement who were not in a STEM program (Bishop, 2015). Such findings support the current study's findings, in terms of the tentative career options students see as possible after high school.

The study is framed in a social justice approach, and the findings help explain how the self-efficacy perceptions of urban students are increased by participating in STEM education, providing students with a sense of empowerment and more opportunities even when facing challenges derived from or related to poverty, or the low-resource schools which they attend (Milner & Lomotey, 2013; Flessa, 2009). Although all the participants included in the study had similar educational and socioeconomic backgrounds, the intervention program exposed the students in the YTA groups to well-planned science, technology, and engineering subjects, which seemed to increase the students' confidence and abilities within the field as well as their perceived future career and academic options (Barron, et al., 2004). Conversely, student in non-YTA programs showed a passive engagement in the discussion of future career opportunities, instead showing more interest in their immediate personal needs. The two groups illustrate the dynamics of critical engagement versus passivity described in Author (2015).

The findings have implications for policy makers, school administrators, educator preparation programs, and researchers. The authors of the study highlight the importance of providing structured STEM programs to students in urban educational settings as a way to minimize the effects that structural factors such as poverty and under-resourced schools have on the students' perceptions of opportunities after high school as well as their career choices. Implementing structured and rigorous STEM programs in urban settings may help the students make more informed and realistic choices, possibly leading to more equitable opportunities in post-secondary education regardless of gender and other individual characteristics. Although specialized programs like the YTA provide quality STEM instruction with qualified instructors, they are implemented depending on unstable and limited funds. Likewise, urban district schools that include mandatory STEM subjects in the curriculum may lack the necessary training and/or resources to facilitate meaningful learning in STEM subjects.

Recommendations

Given the fact that a significant number of federal programs such as the National Science Foundation and National Aeronautics and Space Administration, among others, prioritize STEM educational projects as grant funding recipients, it would be ideal for urban school districts to partner with other local educational institutions to design grant proposals with the aim to promote teacher training and structured STEM programs for their schools. For instance, the Department of Education plays an important role in improving P-12 STEM instruction by supporting partnerships among school districts and universities, science agencies, businesses, and other community partners to facilitate teaching and learning.

Policy makers need to make sincere efforts to effect an equitable distribution of quality STEM learning opportunities as well as more opportunities for training talented teachers who can ensure that all students have the chance to study and be inspired by STEM. As social justice advocates, our ultimate goal is to help in the identification of practices that promote social injustice and to influence social, economic, political, and educational policies to promote better and more effective education for urban students and open post-secondary opportunities and career choices for this important student group.

There is also the need for a practical approach when monitoring the implementation of STEM programs, directing the focus on learner outcomes, particularly with views to future opportunities for the students in urban areas. One such approach could be through project-based learning (PBL), which provides a feasible way to incorporate situated learning in the classroom. According to The Buck Institute for Education (2003), PBL is "a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process, … authentic questions and carefully designed products and tasks" (p. 4). The use of PBL in a curriculum that is designed to address STEM subjects, and that is facilitated by trained educators may make a difference to empower urban students self-efficacy, improving their career options, and providing more realistic and equitable opportunities for this student population.

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