Moving from Passion to Purpose:

A STEM-Focused After-school Program's Influence on Purpose Outcomes

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Abstract

Despite efforts to increase diversity in STEM fields, marginalized populations - particularly women and Black and Latinx workers - remain underrepresented in STEM professions. The present qualitative study sought to explore the relationship between sense of purpose and STEM engagement within an after-school, experiential (i.e., involving hands-on learning) STEM enrichment program, called Change Makers. Specifically, semi-structured interviews with racially diverse and predominantly low SES high school students (N = 13, 30.8% self-identified female) and their program instructors (N = 3, 66% self-identified female) were qualitatively analyzed using a grounded theory-informed approach. Results indicate that engagement in Change Makers contributed to youth transforming their preexisting STEM interest into three purpose-related constructs: (1) self-efficacy experiences (general and specific to science), (2) increased willingness to engage in career exploration, and (3) deepened prosocial motivation. These findings underscore the value of connecting youth with experiential purpose curriculum to improve the STEM career pipeline. Finally, these findings represent insightful perspectives regarding the mutable nature of purpose development. Limitations are discussed and recommendations are made for future research and programming.

Keywords: purpose in life, adolescence, STEM education, positive youth development

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Introduction

High participation and achievement in science, technology, engineering, and math (STEM) careers are widely considered to be essential to the United States' status as a global leader. Yet in recent years, there has been a relative shortage of Americans entering these professions (National Science Foundation [NSF], 2017; Wang et al., 2017). This may seem perplexing given that STEM careers have been increasingly promoted to adolescents (Fouad & Santana, 2017) and that these careers offer a host of benefits. For instance, STEM workers tend to out-earn their similarly educated non-STEM counterparts (Fry et al., 2021). And employment opportunities in STEM occupations have risen faster as compared to non-STEM jobs over the last 15 years (Fayer et al., 2017).

This worker shortage is particularly prominent amongst women and people of color - particularly Black and Latinx workers - who remain underrepresented in the STEM workforce despite efforts to increase diversity in STEM fields (Fry et al., 2021). Some suggest that this is the result of a disparity in STEM interest. However, research indicates that underrepresented populations report similar and potentially higher initial interest in STEM careers as compared to their white and male counterparts (Hanson, 2004; Maltese & Cooper, 2017). Instead, there is a steady dropout of women and people of color from preparation for and engagement in STEM careers over time, which many refer to as the 'leaky pipeline' (Blickenstaff, 2005). Much of this dropout and subsequent underrepresentation is rooted in contextual and systemic inequity (Fouad & Santana, 2017; Wang et al., 2017; Xie et al., 2015). Thus, one potential avenue for impacting

change is by improving access to resources that underrepresented youth need to persist in

pursuing STEM careers (e.g., skill-development interventions, supportive relationships with

teachers, etc.; Fouad & Santana, 2017). Indeed, multiple interventions have been developed to

enhance underrepresented adolescents' ability and desire to pursue STEM careers (e.g.,

after-school programs; see Dabney et al., 2011 and Krishnamurthi et al., 2014).

 Adolescence is also a pivotal time in the life course for identity development, which is a

process that often includes an exploration of one's career interests and, ultimately, one's life

purpose (Eccles, 2009). Today, adolescents are exposed to a hugely diverse set of post-secondary

school and career options. These options can be a stressful landscape to navigate, especially as

adolescents aim to connect their school and career goals to a longer-term purpose (Blattner et al.,

2013; Curran & Hill, 2019). Youth purpose research offers valuable best practices on

accompanying adolescents through these developmental milestones. Yet, within STEM

intervention research, few programs intentionally incorporate existing purpose development

techniques (e.g., Bronk et al., 2019; Klein et al., 2019). This paper includes a qualitative analysis

of underrepresented students' and their program instructors' accounts of their experiences in an

after-school program designed to foster awareness of and interest in STEM fields, while

simultaneously fostering students' sense of purpose. Specifically, this study was driven by the

question: To what extent can purpose be intentionally fostered in an after-school

STEM/career/purpose intervention for high schoolers?

After-School STEM Enrichment Programs

 Combating the underrepresentation of marginalized people in STEM fields requires

numerous creative and multidisciplinary initiatives. After-school enrichment programming is one

potentially impactful site for intervention (Schultz et al., 2011). Nearly 8 million youth in the

United States attend after-school programs; typical activities include multipurpose programs

(e.g., with a diverse set of activities) and more specialized programs (e.g., sports, arts, and STEM

enrichment; Afterschool Alliance, 2020). Often these programs include experiential learning

opportunities (i.e., engagement in hands-on activities wherein knowledge is created through

repeated and deepening cycles of action and reflection) which may otherwise be lacking from

traditional K-12 education (Association for Experiential Learning [AEL], 2017; Kolb, 1984).

After-school programs vary widely in their locations, funding, and time commitments, but

nevertheless have a long history of promoting positive outcomes among their participants

(Krishnamurthi et al., 2014). Regular participation in after-school programming - whether it be in

a school, museum, zoo, etc. - is associated with improved health, civic engagement, and

occupational attainment later in life (Philp & Gill, 2020; Snellman et al., 2015), with often

greater effects for low-income youth and youth of color (Mahoney et al., 2005; Morris, 2015).

Yet for millions of American youth, and disproportionately Black and Latinx children,

desired after-school programs are inaccessible due to low availability of programs (Afterschool

Alliance, 2020). For marginalized youth who are able to engage in after-school programming,

involvement is associated with academic gains, positive identity, and interest development, as

well as increased access to caring adults and social capital (Philp & Gill, 2020). Despite pressure

on students to focus on academic benefits, Philp and Gill (2020) called for more research on the

important non-academic benefits of after-school programs for low-income youth of color.

Against the backdrop of the aforementioned national interest in STEM careers, numerous

STEM-focused after-school programs have emerged over the last decade (Krishnamurthi et al.,

2014). Intervention research has found that involvement with STEM-focused after-school programs is associated with increased interest in STEM careers (Dabney et al., 2011), improvement in science identity, especially in more vulnerable populations (e.g., girls; Tan et al., 2013), enhanced self-reported critical thinking skills, and higher science test scores (Noam et al., 2014). Research has also demonstrated that engagement in STEM enrichment programming during college can increase underrepresented students' likelihood of matriculating into STEM graduate programs (Alfred et al., 2005; Merolla & Serpe, 2013). To our knowledge, however, there is limited research on how involvement in a STEM-focused after-school program during high school may be associated with purpose-related outcomes.

Youth Purpose

The Definition and Benefits of Purpose. Youth purpose is (1) a personally meaningful, long-term aspiration that directs behavior, (2) motivates engagement in activities related to this long-term goal, and (3) contributes to the world beyond oneself (Damon et al., 2003). Understanding these three main features of purpose is important. First, purpose is a *personally meaningful* aspiration. Purpose development is often linked to character growth (Damon et al., 2003) and is closely tied to identity development during adolescence (Erikson, 1968). Both purpose and identity development processes involve reflecting on one's core values and on what activities are most intrinsically motivating and aligned with a person's unique constellation of values and strengths (Damon et al., 2003; Liang, White et al., 2017; Waterman, 1992). "Sparks" - or a passion for a self-identified skill or interest - may also provide a sense of meaningfulness (Benson, 2008; Liang, White et al., 2017). Nurturing adolescents' sparks over time is an important part of adolescents' thriving and purpose development process (Scales et al., 2010).

Second, purpose provides a *motivational framework for engaging in purpose-related activities*. Researchers have found that one facilitator of purpose development is one's propensity for said purpose (i.e., the unique combinations of character strengths, skills, and values that make one's purpose a good fit; Liang, White et al., 2017). For instance, one might want to improve people's mental health by becoming a social worker because of their belief that they have good advocacy skills. Closely related to the concept of propensity is self-efficacy, the confidence in one's ability to complete a specific task well (Bandura, 2001). Self-efficacy has been shown to be a significant predictor of purpose in life among college students (DeWitz et al., 2009). Indeed, people with high levels of self-efficacy in a given domain are more likely to approach that area, perform better on relevant tasks, and demonstrate more consistent engagement with that activity over time - just as a person with a strong sense of purpose would (Bandura, 2001).

Finally, most definitions of purpose include a desired *prosocial contribution* (i.e., an intention to contribute to the world beyond oneself; Damon et al., 2003). However, researchers have found that older adolescents tend to describe purpose as a prosocial construct more often than their younger peers (Damon et al., 2003; Hill et al., 2010). This progression from less prosocial to more prosocial may be reflective of the moral and character development processes that also occur during this time period (Damon et al., 2003). Many researchers have found that youth tend to describe intended beneficiaries of their purposes, ranging from close loved ones to society at large (e.g., Bronk, 2012; Liang, White et al., 2017).

Although purpose affords people across the lifespan a multitude of benefits (e.g., better health outcomes; Koizumi et al., 2008), purpose offers particular benefits to adolescents. Developing a sense of purpose can help resolve identity-related issues that are often associated

with adolescence (Erikson, 1968). Moreover, purpose is associated with improved academic outcomes (e.g., higher grade point averages and improved graduation rates) (Damon et al., 2003; Pizzolato et al., 2011), hope (Burrow et al., 2010), and life satisfaction (Bronk et al., 2009). Purpose can help adolescents cope with adversity and make meaning out of difficult experiences (White, 2020). And engagement in purpose development can support adolescents in committing to meaningful careers and in turn reporting higher career satisfaction (Kosine et al., 2008). Having a sense of purpose is a powerful asset which, in the context of the present study, may be particularly protective and promotive for marginalized youth as they pursue STEM careers.

Purpose Development and Interventions. Given that purpose yields numerous benefits for youth, researchers have begun to investigate factors that contribute to the development of youth purpose. Kashdan and McKnight (2009) proposed a three pathway model to purpose: the proactive pathway (i.e., conscious searching, exploration, and mastery), the reactive pathway (i.e., responding to a significant life event with greater clarity about goals), and the social learning pathway (i.e., observing important others engage in purposeful activities and learning vicariously). Liang, White et al. (2017) offered a 4 P's of purpose model, which included four factors that contributed to purpose development: People (i.e., important others who facilitate purpose development), Passion (i.e., strong interest in activities related to one's purpose), Propensity (i.e., the possession of and belief in purpose-related skills and strengths), and Prosocial Benefits (i.e., the desire to meaningfully contribute through purposeful activities). Notably, self-efficacy development is fostered via similar pathways as purpose development. Research identifies mastery experience (i.e., effectiveness in task completion), vicarious experience (i.e., observing the success of others with whom you identify), social persuasion (i.e.,

encouragement from important others), and physiological reaction (i.e., positive feelings that arise from the experience) as catalysts of self-efficacy, which all align well with both the pathways and 4 P's purpose models (Bandura, 2001; Kashdan and McKnight, 2009; Liang, White, 2017; Pajares, 2005). Finally, in another study, (Hansell, 1983) the most purposeful students benefited from repeated engagement in purpose-related activities and social support from role models and mentors that was practical, applicable, and specific to their interests.

This research has informed subsequent intervention strategies aimed at fostering purpose. Specifically, scholars have provided insights about settings and relationships in which purpose development is likely to thrive. Purpose and precursors to purpose (e.g., self-efficacy and prosociality) can be cultivated with the support of friends, mentors, and family (Bronk, 2012; Liang, Lund et al., 2017), as well as in schools (Klein et al., 2019), clinical settings (Bronk & Mangan, 2016), online programming (Bronk et al., 2019), and after-school activities (Worthen et al., 1973). Interventions designed to foster purpose have often been found in the healthcare literature, with people facing cancer diagnoses, for example, experiencing strong positive adjustment effects from purpose interventions (e.g., Park et al., 2019). Fewer interventions have focused on fostering purpose exploration and commitment amongst less specified populations. One study reported positive results of an online intervention targeting purpose development in young adults (Bronk et al., 2019). However, there is a dearth of research on contemporary purpose interventions among youth, including both theoretical/conceptual papers and program evaluation studies (Koshy & Mariano, 2011). One notable exception is the work of Klein and colleagues (2019), who outlined the conceptual underpinnings of their MPOWER purpose intervention, a program they implemented in a high school setting.

In addition to programs intentionally designed to cultivate purpose, experiential learning opportunities (e.g., internships, community service, certain after-school programs) may unintentionally, though powerfully, bolster purpose development (AEL, 2017). These hands-on programs often offer opportunities to positively impact others, cultivate skills, pursue passions, and form social connections, which are the core tenets of the 4 P's purpose model (AEL, 2017; Liang, White et al., 2017). For example, a meta-analysis of research on college experiential learning programs found that experiential learning often results in students deepening their awareness of social issues (which can lead to greater sense of responsibility for and commitment to community challenges), enhancing self-efficacy, and gaining formative personal insight (Burch et al., 2019). This research speaks to the value of experiential learning in promoting purpose development, as there is clear overlap between these outcomes and purpose constructs.

Past research identified influential relationships, settings, and learning formats for fostering purpose development. But research on the efficacy of theory-driven purpose development interventions amongst youth, and particularly marginalized youth, remains limited. And to our knowledge, no past research has evaluated programming that intentionally infuses purpose curriculum into after-school STEM enrichment programming.

Current Study

The current study considered how purpose can be cultivated in an after-school, STEM-focused program. The study includes a qualitative analysis, informed by grounded theory tenets (Corbin & Strauss, 2007), of interviews with students and instructors who were involved in the Change Makers program and corresponding research study: "Seeding the Future with Change Makers." With support from the NSF, the Change Makers program aims to help students

underrepresented in STEM fields become more purposeful and future-oriented, develop stronger

science identities via hands-on experience with science activities, including coding and

hydroponics (i.e., a plant-growing technique that utilizes a water-based nutrient solution instead

of soil and thus reduces environmental damage; National Agricultural Library, n.d.) and to

enhance their commitment to prosociality through engagement with food justice issues.

Adolescents who experience marginalization (e.g., low-income students of color) are

underrepresented in the youth purpose literature (Liang, White et al., 2017; Sumner et al., 2018),

thus highlighting a need to amplify their voices in this body of research. Moreover, adolescence

marks the time when youth of color generally begin to perceive the marginalization they face in

pursuing STEM careers (Hughes et al., 2013). Notably, the initial turn away from STEM among

women often begins before adolescence (Milam, 2012). The underrepresentation of women and

people of color in STEM has been attributed to low STEM self-efficacy and low social support

when pursuing STEM-related educational and career goals (Franklin, 2013; Grossman & Porche,

2014). Thus, this study affords the doubly important possibility of understanding both how a

purpose intervention program fosters purpose-related outcomes, as well as how a purpose

intervention - within the context of a STEM-focused after-school program - may be a uniquely

powerful intervention for vulnerable students.

The Change Makers program included weekly after school sessions and a month-long

summer program for middle and high school students, whereby high schoolers - once they were

comfortable with the science content - taught middle schoolers about science topics through a

cross-age mentoring model (i.e., mentorship between youth and adolescents, at least two years

apart in age, who routinely interact in structured activities; Karcher, 2014). While the

components and theory of change of the Change Makers program are not the primary foci of this paper, broadly, the high school curriculum includes science content, career and purpose development workshops, and a tiered mentoring model of support, (in which high schoolers were mentored by adult instructors and provided mentoring to middle schoolers). Students and instructors earn a stipend for their involvement in the program. The larger research study sought to understand the impact of this science and social justice program on a variety of outcomes among underrepresented high schoolers (e.g., purpose, science identity, career adaptability). The present manuscript considers the question: to what extent can purpose and related outcomes be intentionally fostered in an after-school STEM/career/purpose intervention for high schoolers?

Method

Participants

Study participants were adolescents who were participating in the Change Makers summer program. All students attended public high schools in three cities in the Northeastern region of the United States. Though the Change Makers program included 12-17 year olds, this paper focused on a sample of the high school students' (14-17 year olds; N=13, 30.8% self-identified female) experiences, given their greater exposure to the purpose and career development curricula. See Table 1 for detailed student demographic information. Most high school participants were from diverse lower- to working-class communities, although the sample represented a range of socioeconomic backgrounds (8.3% of parents had a master's or doctoral degree, 8.3% of parents had some college, 41.7% of parents graduated from high school, and 41.7% of parents did not graduate from high school). Of the 10 participants who responded to

this question, 90% reported that they were eligible for free school lunch. Finally, demographic

information was missing for one male participant.

This study also included data from instructors (N=3) who led the Change Makers summer

programs in which student interviewees participated. The instructors had backgrounds in science

education and/or work experience with hydroponics systems. See Table 2 for further

demographic information on instructors.

Table 1

Student Demographics Table

Pseudonym	Sex	Age	Race/Ethnicity	Highest Parent Education Level	Free/reduced lunch eligibility Y/N
Marco	Male	15	Latino/Hispanic	High school diploma	Ineligible
Santi	Male	14	Latino/Hispanic	Did not graduate high school	Eligible
Brandon	Male	14	Black/African American	High school diploma	Eligible
Jaylen	Male	15	Black/African American	Masters Degree	—
Lucas	Male	15	Latino/Hispanic	High school diploma	Eligible
Nicole	Female	14	Latina/Hispanic	High school diploma	Eligible
Wilson	Male	14	Haitian/Caribbean descent	Did not graduate high school	Eligible
James	Male	15	Black/African American	Some college	—
David	Male	17	Latino/Hispanic	Did not graduate high school	Eligible
Lola	Female	15	Latina/Hispanic	Did not graduate high school	Eligible
Tamara	Female	15	Black/Caribbean descent/Asian American/Pacific Islander	High school diploma	Eligible
Cevonté	Male	–	–	–	—

Diana	Female	15	Latina/Hispanic/Brazilian or Portuguese	Did not graduate high school	Eligible

Table 2

Instructor Demographics Table

Pseudonym	Sex	Age	Race/Ethnicity	Time with Change Makers
Enzo	Male	54	Latino/white/Native American	3.5 years
Michael	Male	38	white	2.5 years
Theresa	Female	64	white	4.5 years

Reflexivity

Given the ways in which researchers' biases and experiences can contribute to their interpretation of results, all research assistants (RAs) were mindful of their power, positionality, and expectations prior to and during data collection and analysis (Darawsheh, 2014). RAs engaged in memoing regarding their positionality prior to data analysis and shared their reflections, as well as potential biases that may impact their work, in a team meeting. They returned to these memos throughout the analysis and writing processes and continued to jointly consider and work to mitigate possible bias within the team setting. These practices allow us to better achieve fidelity in qualitative research (Levitt et al., 2018). The principal investigators (two white men and one Asian American woman) of this study have collective expertise in youth science education, youth mentoring, and identity, career, and purpose development. The graduate students (two white women) involved in this study have research and applied experience with youth purpose and qualitative methods. This expertise, as well as a shared passion for this work, serves as a source of potential bias (e.g., there is a risk of being clouded by past research rather than attending to the present data). But, it also enabled the team to be highly attuned to the data

in that we have extensive experience in and commitment to thinking about how youth discuss and experience these processes. In all, the researchers involved with this study sought to be mindful of how their previous experiences and respective positionalities may have informed their interpretations of the data and attempted to represent the students and instructors' voices as authentically as possible.

Procedures

At the onset of the program and research study, the Institutional Review Board (IRB) at the primary investigators' university approved the study. All student research participants and their parents/guardians signed informed assent and consent forms prior to study participation. Students did not receive compensation for their participation in the study, but were entered into a drawing to win a mini-iPad. All participants were asked to complete an approximately 15-minute survey at the start/end of the program, and some were randomly selected to participate in an approximately 30 minute interview at both the start/end of the program. The interviews were conducted in private classrooms at each respective program's site. Though the surveys offered rich quantitative data, their analysis was beyond the scope of this manuscript. Additionally, only the post-interviews were included in the data analysis, as we aimed to explore the impact of the intervention and we did not have corresponding pre-interviews for many of the post-intervention participants.

Survey and interview questions were crafted in an effort to evaluate the aforementioned aims of the study as well as to obtain broad, in-depth responses (Levitt et al., 2018). Trained RAs engaged with students in semi-structured (Seidman, 1991), in-depth (Johnson, 2002) interviews. A two-page worksheet that asked about purpose-related constructs (i.e., core values, character

strengths, skills) accompanied the oral interview (Klein et al., 2019). Interviewers defined these

constructs and then prompted interviewees to reflect on their own via the worksheet (e.g., "Your

core values are the virtues, ideals, and beliefs that matter most to you. Your core values are

usually constant and they shape your decisions, behaviors, and actions. On the worksheet, please

circle your three most important core values"). The interview protocol also consisted of 6

open-ended questions derived from youth purpose research (e.g., "Imagine that, one day, you

successfully achieve the goal you just told me about. What is the desired impact you hope to

make in the world one day with that goal? Who would you help?" Bronk et al., 2018), career

research (e.g., "Can you imagine having a science-related career? Why or why not?"; Crocetti et

al., 2008), and science interest/identity research (e.g., "Do you think about science in any new

ways after participating in this program?"; Weinburgh & Steele, 2000). Student interviews lasted

between 10-35 minutes.

　　　　After student interviews were coded and analyzed, researchers decided to conduct

supplementary interviews with primary program instructors from three sites. The purpose of

conducting these additional interviews was to ensure that there were no gaps in our

understanding of emerging categories and that categories would be "saturated" (i.e., no new

information would emerge after this round of theoretical sampling; Glaser, 1978). These

semi-structured (Seidman, 1991) and in-depth (Johnson, 2002) interviews were conducted by

RAs utilizing an open-ended protocol. Consistent with grounded theory (Corbin & Strauss,

2007), the instructor protocol was informed by findings from student interviews, and the eight

open-ended questions were aimed at understanding instructors' conceptualization of the

program, as well as their impressions of student outcomes (e.g., "What have you taken away

from participating in the Change Makers program?"). Instructor interviewees provided informed

consent before their interviews. Instructor interviews lasted between 15-30 minutes and were

conducted post-intervention. For all interviewees (students and instructors), codenames, and later

pseudonyms, were assigned to ensure anonymity and confidentiality. Finally, a professional

transcription service transcribed the audio files.

Data Analysis

Studying adolescent purpose development within a STEM-focused program is a

relatively novel pursuit, and thus existing theory on the subject is lacking. Therefore, a modified

grounded theory approach was employed, given the desire to systematically develop theory

about purpose development within the context of an after-school STEM program (Strauss &

Corbin, 1990). Analyzing student interviews began with trained RAs immersing themselves in

the data by reading the transcripts multiple times in preparation for coding (Elo & Kyngas,

2008). Then, 10 RAs open-coded five transcripts in teams of two (Creswell, 2013). The teams

open-coded independently and then came to a consensus on their list of codes, with the goal of

demonstrating a form of interrater agreement and enhancing the rigor of the study (Morse, 2015).

The whole team then convened to create a preliminary codebook, which included the name and

definition of codes, as well as example quotes for each code. Thereafter, five RAs divided those

transcripts among them and reread them in order to write short memos (Creswell, 2013) about

the major codes that had emerged (e.g., "purpose," "career," "identity," and "self-efficacy") in

each interview. Of note, the extent to which the researcher should consult the literature prior to

coding is hotly debated among grounded theory researchers (e.g., Dunne, 2011), given the

method's longstanding prioritization of inductively derived themes. As is consistent with a

reflexive research process (Darawsheh, 2014), we acknowledge that, given our knowledge of research on youth purpose and career development constructs, our initial codes were likely informed by our interview questions and, implicitly, prior literature.

Once the initial codebook was established, coding pairs coded the remaining transcripts. In a subsequent process of axial coding (Creswell, 2013), RAs honed in on the data most relevant to students' sense of purpose and the outcomes of the program. This process of inductive axial coding facilitated the development of a visual representation of the data (Morrow & Smith, 1995) to illustrate the three codes (self-efficacy, identity, and prosociality) that comprised the main purpose-related outcomes of the intervention. Of note, throughout the data analysis process, the whole team met regularly to add the new codes as they emerged and resolve coding disagreements.

The analysis of the three instructor interviews included a similar coding process, whereby two RAs open-coded the three interviews and came to a consensus on a codebook, as well as the coding of each interview. Similarly, in a process of axial coding, RAs focused on the three purpose-related outcomes that had been identified in the student interviews to see if the model would be saturated with the inclusion of instructor interview data. Constant comparison (Strauss & Corbin, 1990) between the student and instructor interviews provided support for the model. In a final process of selective coding (Creswell, 2013), after all data had been collected, two RAs finalized the visual model by noting the causal conditions (i.e., an initial spark and/or passion for science and engagement in the Change Makers program; Creswell, 2013) as fostering the purpose-related outcomes of greater self-efficacy, career exploration, and prosociality.

Results

In order to help differentiate between adolescent and adult respondents, the term *student*

describes an adolescent respondent, *instructor* describes an adult respondent, and *respondents*

describes the entire sample of adults and adolescents. Throughout the course of the interviews,

most students voiced interest in pursuing a STEM career. The noted professions included:

"zoologist", "forensic scientist","doctor", "engineer", "electronic engineer", "mechanical

engineer", "marine biologist", and "science teacher." Importantly, all of these students noted that

their interest in STEM careers was sparked before they knew about or pursued involvement in

the Change Makers program. In other words, most of the students who self-selected to participate

in the program already had a "spark" (i.e., marked interest in STEM), and they expected science

to play a major role in their futures (Benson, 2008). Various students shared that: "science used

to always be my favorite subject"; "I've always liked science"; and "I always thought science was

pretty cool." Students spoke about their passion for science as a driving motivator for both their

career choice and their participation in Change Makers. As will become evident throughout this

section, participation in Change Makers enabled this existing seed of interest to grow and

blossom into a more developed sense of purpose. This pathway is illustrated in Figure 1.

Figure 1
Moving from a Seed of Passion to a Sprouting Purpose
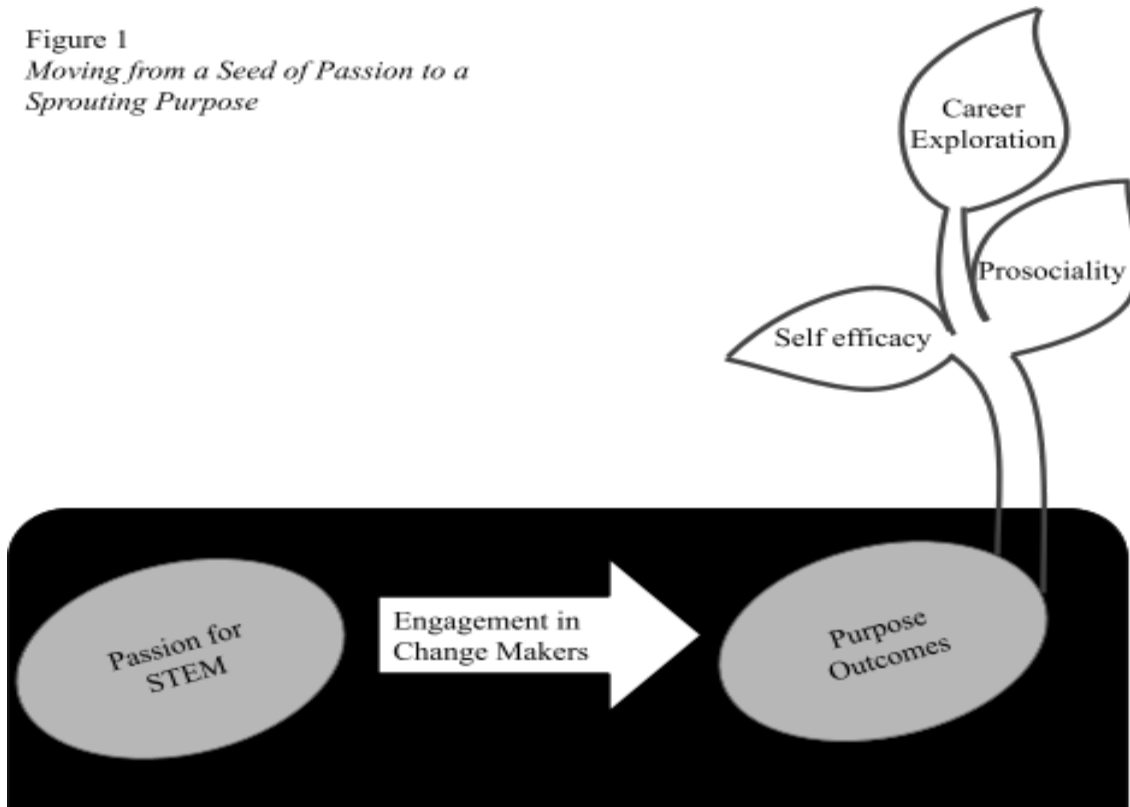
Each purpose outcome - self-efficacy experiences (e.g., Bandura, 2001), engagement in the career exploration process (e.g., Erikson, 1968), and motivation to achieve prosocial aspirations as a result of their involvement with the Change Makers program (e.g., Damon et al., 2003) - is defined and exemplified in Table 1.

Table 3

Definitions and exemplars of purpose components

Purpose Component	Sample Quote
Self-efficacy: Belief in one's abilities	"I feel like I'm going to be able to accomplish my goal no matter what happens in my life." - James
Career Identity Exploration: Process of defining and refining one's interests and strengths while aligning them with employment options of interest	"When I got the opportunity for this, I did it and then I started to like it because it's something new to me, and it really interests me. If something that I didn't like interests me, then maybe there's new opportunities for other things that I don't even know

	that's out there, then I can learn about that and maybe that will interest me, and I like that as well." - David
Prosociality: An intention to benefit others	"He helped me understand…why we're doing it and how it will change the world." - Marco

Self-Efficacy Experiences

A majority of the students described experiencing self-efficacy in relation to their

participation in Change Makers and most attributed this to the overall culture and approach of

the program. Tamara described her mindset while participating in Change Makers: "The first step

is to believe it's not what could you do, but it's, you can do something, and then you figure out

what could you do. So, I like that perspective on it a lot." Theresa, a program instructor, affirmed

this perspective in her description of the "essential" goals for her students: "Knowing a little bit

of science and being able to trust [themselves]." Similarly, David, a student, noted the confidence

he felt in approaching the obstacles he faced:

> It's always a challenge 'cause I have to work for everything. Maybe there's new obstacles
>
> in the way, but I know I can overcome them. Even colleges for financial aid, stuff like
>
> that, it's a challenge in my way, but I know I can overcome it by hard work, talking to the
>
> right people, communicating and then I'll be able to set my goal and then maybe get
>
> where I have to be and improve from there.

Respondents highlighted the impact of this growth-mindset approach in Change Makers. And

participants noted how this value was concretized in the lessons of the program. For example, in

discussing the skills he sharpened within Change Makers, Lucas noted experiencing mastery in

his ability to, "[contribute] to the team. And [gaining] better skills, like interviewing skills like

these, and teaching, and what if I have to speak in front of a big crowd." Wilson described

experiencing vicarious learning and social persuasion when he shared that he, "met a lot of

people, and talked about our careers, what we wanted to do in the future; what do we need to do

in order to achieve [our] goals...you just have to work diligently and be persistent." Michael, a

Change Makers instructor, echoed this while discussing the student growth he had observed:

> [Students] would come to me with things they needed, rather than relying on me to
>
> provide them with those things... seeing the growth and that responsibility and that
>
> confidence in leading the group definitely is a strength too. It's hard to get high school
>
> students to feel confident about anything. They're so unsure of so many things. So having
>
> them be able to go in and lead a group of middle school students. That's where I see the
>
> most growth.

Finally, students explained the impact of participating in the Change Makers community by

imparting its lessons on younger students. Nicole voiced:

> I liked being able to work on your own to build the [hydroponics] systems. And I also
>
> like how we're going to be able to teach other students how to do the same thing we did.
>
> And we also get to teach them that not everything is easy. You're going to have to
>
> troubleshoot to build it.

Importantly, Nicole described both experiencing self-efficacy in working with younger children,

as well as in encouraging them to experience their own self-efficacy as related to the Change

Makers project.

Other students noted specific, science-related self-efficacy experiences as a result of the

experiential learning that characterizes Change Makers. Lola described experiencing a

self-efficacy building physiological reaction when she explained, "It's pretty fun building

something that you didn't know about and you can actually do without instructions. And having a

big team, all of us working together, that's a pretty cool environment." James shared a similar

sentiment and also contrasted the program with previous science-based experiences. He shared

that, "sometimes science is a hard subject for me [because]...in high school there's so many kids

in one class. You can't get your own help. You would have to come after school and stuff."

However, in reflection on his experience in Change Makers, he shared, "I think of pursuing

[science in] my future…I learn more about science than what I do in regular school...I feel like

I'm going to be able to accomplish my goal no matter what happens in my life." David echoed

James' perspective and further highlighted the aspect of experiential learning Change Makers:

> I never really liked science 'cause even, I took biology 10th grade, and it was really hard
> for me, it's not my thing. The Change Makers program has changed my mind a little bit
> because it shows me new things: how it grows, the process from seed to plant. I find it
> really interesting. Doing it myself, watching it grow, it's really interesting and it's a good
> experience. I don't know if I'm probably going to do anything in the science field, but it is
> interesting to have the knowledge and the experience of doing something like that.

Respondents attributed the experiential-based, mastery-oriented, collaborative group culture, and

shift from their traditional classroom structure as key to their science self-efficacy experiences in

Change Makers.

Greater Engagement in Career Exploration Processes

Respondents also indicated that Change Makers elucidated the vast array of career

options they could pursue and motivated them to engage with those options. Nicole remarked,

"Change Makers basically taught me that there's multiple things you can do, and even though you have one passion set ahead, you can do multiple things with that passion, or you can branch off into other things." She expounded, "I'm able to see how there's other things you can do…there's also different perspectives to it because there's regular planting of soil, but there's also hydroponics and there's different branches to each type of science." Nicole's willingness to explore options is based within the self-efficacy she felt by succeeding in Change Makers, or a different "type of science." Instructor Theresa echoed Nicole's perspective: "I think that [the students] have done things that they never believed possible...I don't think the kids would become expert coders without Change Makers. And that's just brightening up a whole career possibility for so many of our kids." Wilson, a student, shared that he, too, had become more engaged in future-planning:

> [Change Makers] has been making me think about it a lot because with all the activities and online career...lessons we've been doing, it made me think more broader. And about... what I want to do in the future...It made me realize if I want to do this certain goal, I have to go through a different type of schooling for it.

Lola valued the opportunity to explore alternative career options:

> I like having my path already set but at the same time, I'm still having different ideas... just in case I don't go into that career path, I also have different options…I like having my mindset in a way to be settled in different ideas for what I want because I'm in high school.

Instructor Enzo explained how he worked to create this culture of exploration:

We would present to them all the different options that they had in their first year [of college], if they wanted to study to be a biologist, or if they wanted to be an astronaut, or if they wanted to be a doctor, or if they wanted to be a fireman or whatever. Or, some of them decided that they wanted to go to the military, and I was there for them too.

Enzo described his role as including both the provision of career-related information, as well as emotional support for students exploring their options. Other students shared an appreciation for Change Makers having helped them explore career options and concretize career and purpose decisions. Diana shared, "When I was younger I wanted to be a doctor. Always wanted to be a doctor, just didn't know which one." Then a Change Maker's activity prompted her to compare her dream job with a similar alternative. She reported that this activity was very beneficial in helping her think more deeply about her career options: "So, at first, I was thinking about pediatric nurse or pediatrician doctor. And I looked more into it, and I think I'm back to pediatrician doctor." James shared this perspective and compared it to his evaluation of where his peers were:

A lot of kids didn't even think about what they want to do. I looked into it: what do people who build cars do, and stuff like that-buses, plane engines... I was just thinking, mechanical engineer is like a good job, and they get paid well.

Nicole explained how activities in the program helped her reflect: "I realized that I can still do what I'm passionate about, which is marine biology, and I can also do things that connect more with my hobbies like art and just combine the two of them." Tamara shared Nicole's sentiment of differentiating hobbies and careers, "I just sort of think it out as, 'This is something that's the

dream' I guess. You know, pursuing something in music, whereas, being a lawyer, that's realistic." Tamara shared Nicole's newfound motivation to more explore the world of science:

> [Change Makers] helped me sort of ease up and chill more. It made me learn new things about myself…I always thought science was pretty cool, so this just sort of ... It does make me a little even more interested. You know, like growing plants indoors...The fact that we can do it this way and it produces healthier food, that's very interesting. So, it makes me [wonder] …what other areas of science are out there that seem to spark an interest in mind?

Tamara explained that a key aspect of this shift is that, what she does in Change Makers, "doesn't feel like work… Yes, it's work, but at the same time, it's play." Program instructor Michael provided insight on Tamara's experience in his description of the program:

> Giving [participants] some exposure to science projects... giving them a chance to do something out of the norm in science; being able to have these resources and explore these concepts and topics. It's harder to incorporate into curriculum standards. So being able to do it as a club and summer program really gives them a chance to do a little less school-like science and a little bit more of the fun aspects of science in some respects.

Michael describes the unique asset of the after-school nature of the program. He describes that participants have greater freedom to explore innovative and engaging topics through hands-on engagement. This was powerful in widening students' perceptions of what science can be, as evidenced by Tamara's reflections.

Prosociality

Finally, Changemaker respondents highlighted the program's impact on participants' prosocial motivations. Participant Jaylen reflected, "[Change Makers has] given me another goal, career goal, like anything to help with kids, like I've been through this whole thing to know that I'm really good with kids and so I could one day do it as a teacher or anything like that." He pointed to the experiential aspect of working with younger students as motivating his new professional aim. Instructor Theresa remarked on her students' prosocial actions: "I had [participants] that really felt like, 'I'd be happy to show whoever hadn't been there before. I'd be happy to show her because I know what I'm doing now.'" Notably, Theresa describes that participants' willingness to help others was rooted in their own mastery of the tasks at hand.

Marco described a Change Makers instructor that left this impact on him. "He helped me understand and ask the question like why the units that we're building, hydroponic units that we're building, are important… Like, why we're doing it and how it will change the world." Marco's comment revealed a manner of reflective thinking that is central to the Change Makers model. More broadly, Lola credited the Change Makers culture for her prosocial motivation: "It's a really healthy environment as well because you're full of positive people and just people that actually want to make this world a better place. So overall I just really like this project." Instructor Michael described how prosociality is embedded in the program's goals and mission:

> The program itself is built off of the idea that we can make a difference in our community with issues of food justice and access to healthy and fresh foods. And that hydroponics is essentially the tool for doing that since it can be grown locally, indoors year round, and then provided either at low cost or donated to organizations around the city.

Wilson also highlighted that prosociality is embedded in the program's culture:

If I were to explain Change Makers, I would just say that it is a really good opportunity to make a change. I guess that's why it's named Change Makers. To basically give your ideas and input on ideas on things because most people, they don't really have a voice. But, I think as you come here, you can talk out, speak your mind and give different feedback.

Change Makers equipped participants with opportunities to benefit their community through hands-on engagement (e.g., mentoring younger participants), as well as scaffolded their reflection on their experiences which motivated their desire to engage in future prosocial action.

Discussion

The current qualitative study considered how engagement in Change Makers- an after-school program designed to foster interest in STEM and a sense of purpose in underrepresented students - contributed to students' purpose-related outcomes. Results suggested that participants initially had a "spark" (Benson, 2008), or interest in science, that prompted them to engage in Change Makers. Thereafter, their involvement in the program, which included experiential learning and reflection about science topics (e.g., hydroponics), purpose and career-development workshops, and a tiered mentoring model of support, ultimately contributed to three purpose-related outcomes: (1) self-efficacy experiences, both generally and as it related to science, (2) engagement in career exploration processes, and (3) greater prosocial motivation. These results suggest that this type of after-school program may offer important purpose-related benefits for youth. These benefits may be particularly important for females and students of color, who historically have been marginalized from STEM fields (Fry et al., 2021).

It is unsurprising that students with initial "sparks" - or interests in science - would choose to participate in an after-school STEM program (Benson, 2008). However, relational opportunities (e.g., people who help nurture a spark) and empowerment (e.g., self-efficacy and community problem-solving efforts) are critical for linking initial sparks to the widest range of positive outcomes among youth (Benson & Scales, 2009; Scales et al., 2010). This study highlights how an after-school program that affords students' experiential learning and social support may help nurture students' sparks, and ultimately, their purpose. Indeed, students with higher ratings on measures of "sparks" also report higher senses of purpose (Scales et al., 2010). This study provides insight into notable, perhaps longer lasting, outcomes of a nurtured spark.

Self-Efficacy Experiences

Levels of self-efficacy, or one's belief in their ability to achieve goals related to their own self and the factors that impact their life, significantly impact motivation and goal accomplishment, even to a greater degree than past performance and true ability (Bandura, 2001; Bandura & Locke, 2003). Change Makers created an environment in which the four central catalysts of self-efficacy (mastery experience, vicarious experience, social persuasion, and physiological reaction) were able to flourish (Bandura, 2001; Pajares, 2005). Change Maker students discuss mastery experiences, or opportunities to practice effective task performance, (e.g., through hands-on and experiential learning) as central to their general and STEM-specific self-efficacy development (e.g., "Doing it myself, watching it grow, it's really interesting"; Rittmayer & Beier, 2008). Students also credit supportive and collaborative peer and mentor relationships for enhancing their self-efficacy beliefs (e.g., "met a lot of people, and talked about our careers"). These experiences likely provided social persuasion (i.e., encouragement from

influential people) and vicarious learning (i.e., learning via observation), which may be uniquely

impactful to women and students of color in maintaining STEM self-efficacy (Flowers & Banda,

2016; Rittmayer & Beier, 2008; Zeldin & Parajes, 2000). Finally, Change Makers students

describe the program as "fun" and "interesting," in contrast to describing their science courses as

"hard." This shift likely reflects a novel physiological reaction (i.e., making meaning of feelings

and bodily reactions) that in turn likely contributed to students' increased self efficacy beliefs

around science (Rittmayer & Beier, 2008). Researchers have called for an increase in STEM

interventions that aim to foster self-efficacy through these mechanisms because self-efficacy is

highly correlated with positive career and individual outcomes (Flowers & Banda, 2016).

Importantly, the purpose construct of propensity as described by Liang, White et al. (2017) is

closely tied to self-efficacy as it involves a belief in one's capabilities to pursue purpose. In other

words, self-efficacy is a precursor to pursuing purpose. Finally, while the present study cannot

claim Change Makers *caused* self-efficacy increases, based on aforementioned existing

literature, it is likely that engagement with self-efficacy-enhancing opportunities via the

experiential learning program design, did indeed positively impact students' science related

self-efficacy.

Research shows that higher STEM self-efficacy positively correlates with better

performance and longer persistence in STEM disciplines, and with higher grades in science

classes (Britner & Pajares, 2006; Rittmayer & Beier, 2008). Additionally, high self-efficacy is a

predictor of college undergraduates having a sense of purpose (DeWitz et al., 2009). And

self-efficacy is critical to developing science identity, which in turn predicts individuals'

commitment to STEM careers (Flowers & Banda, 2016). In contrast, low self-efficacy is a

predictor of underrepresented students dropping STEM majors in college (Seymour, 1995).

Exploring Career Identity

Identity development, or the process through which individuals make sense of themselves

within their cultural and social contexts, is a crucial component of adolescent development

(Erikson, 1968). Given the centrality of work in modern life, finding a career path that aligns

with one's interests and skills while meeting a need in the world is an important component of

positive identity development (Lucas, 1997). Scholars posit that finding career identity requires

exploration (Kosine et al., 2008). Respondents in the present study attribute their growing

awareness and exploration of diverse STEM career opportunities to Change Makers. This

exploration on its own is significant given its connections with identity development and positive

identity development's subsequent associations with markers of thriving (Arnold, 2017; Erikson,

1968).

Participants also identify motivation to find careers they are "passionate about" or that

"spark an interest." These responses likely signify that students are engaging in career search

with their senses of purpose in mind. Indeed, scholars that call for adolescent career counseling

to be more meaningfully infused with purpose development identify active reflection,

engagement in service, and relational support as central to finding purpose-centered work that is

meaningful and satisfying (Kosine et al., 2008). These elements are central to the experiential

aspects of the Change Makers program, and thus it is understandable that participants report

broad career exploration that is infused with purpose motivations. The proactive and supported

career exploration, as driven by participants' senses of purpose, is unique and significant. The

process of identity-related searching during adolescence is inherently stressful, especially when

lacking proper social support (Blattner et al., 2013; Gutowski et al., 2018). Therefore, students'

engagement in exploration within Change Makers indicates an important foray into a vital but

stressful developmental task. Additionally, traditional STEM pedagogical practices do not

typically facilitate identity development processes, particularly in women and students of color

(Carlone & Johnson, 2007). Indeed, STEM education, particularly for female adolescents and

youth of color, has been criticized as lacking focus on systemically cultivating opportunities for

all individuals to find meaning and purpose in their careers (Blustein et al., 2022). Thus, the

unlikely prevalence of career, and by extension, identity exploration, amongst Change Maker

students is noteworthy both from purpose development and STEM engagement perspectives. In

all, people who report high levels of purpose are more likely to report greater life satisfaction and

healthy work practices (Bonebright et al., 2000; Bronk et al., 2009). Therefore, exploring career

and purpose simultaneously may support youth in finding STEM career paths that are sustainable

and satisfying.

Opportunity to Enact Prosociality

Students also described Change Makers as a place where they both found and acted upon

prosocial aspirations. While prosociality holds numerous benefits for the recipients of these

actions, it also holds a host of psychological benefits for the prosocial actors. These benefits

include increasing general well-being, enhancing one's sense of meaning in life (i.e., a central

aspect of purpose), improved self-worth, and protection against adolescent depressive symptoms

(Klein, 2017; Padilla-Walker et al., 2020; Weinstein & Ryan, 2010). Prosocial motivation also

improves persistence, productivity, and performance when moderated by intrinsic motivation

(Grant, 2008). Thus, the enhanced intrinsic motivation discussed above may augment the benefits students reap from acting on their prosocial motivations within Change Makers.

Importantly, the prosocial outcomes of Change Makers may be exceptionally important in supporting the STEM pursuit of underrepresented individuals. For example, Jackson et al. (2017) reported that STEM education must demonstrate compatibility with culturally relevant careers goals for underrepresented undergraduates to maintain motivation to pursue STEM careers. In particular, first generation underrepresented participants who identified that a STEM career could enable them to help their communities subsequently reported higher science identity over time (Jackson et al., 2017). Similarly, McGee and Bentley (2017) reported that high achieving Black and Latinx undergraduate STEM students are particularly motivated to help others in their career pursuits. They conclude by recommending that STEM programming targeted at underrepresented students should expose students to STEM career options that integrate social justice and equity opportunities (McGee & Bentley, 2017). Change Makers may be uniquely powerful in that it offers experiential (i.e., hands on and reflective) evidence to its students that STEM can and ought to be a prosocial endeavor.

Finally, there is reason to believe that enhanced self-efficacy, engagement in career exploration, and prosociality are not disconnected outcomes but rather interact with one another to produce positive outcomes for student purpose development and motivation to pursue careers in STEM. Notably, research shows that intrinsic motivation (i.e., component of identity exploration) can play a mediating role between self-efficacy and environmentally responsible behavior (i.e., prosocial action) (Tabernero & Hernández, 2010). In other words, prosocial actions may be more likely to come from those who have self-efficacy to complete those actions

and see them as inherently connected to their intrinsically-derived identity. Thus, the combinations of these outcomes may be particularly supportive to participants.

Limitations and Future Directions

Results of the present study indicate that a STEM-focused after-school enrichment program contributed to participants' purpose-related outcomes. While these findings are promising regarding the integration of STEM enrichment and purpose development, future research is needed to better illuminate interaction between these developmental processes and subsequent best practices. Given the present study's small sample size, the study findings cannot be generalized. However, the findings may be transferable to programs in similar contexts. Notably, the gender imbalance in the present study may reflect the larger reality of girls' involvement in STEM as program participation occurred via self-selection (Fry et al., 2021). Future research should include a larger, more geographically and gender diverse sample. Additionally, research that follows participants longitudinally to assess long-term impacts is recommended (e.g., follow-up with the present sample of youth in 10-15 years to explore whether participation in a Change Makers buffered against the aforementioned leaky pipeline phenomenon).

Additionally, while qualitative research can formatively push theory forward, a collection of mixed methods and quantitative data would serve to deepen the field's understanding of the impact and mechanisms of STEM and purpose integrated programming. Finally, this program engaged youth whose pre-existing high STEM interest (i.e., a spark) propelled them to engage in Change Makers. While the present data strongly indicates that program participation positively impacted participants, due to the cross sectional and non-experimental nature of the study, it is

also possible that highly self-efficacious, other-oriented, and career-exploring youth were more likely to self-select to participate in the program. In other words, causality cannot be determined, and experimental study designs (e.g., with a control group) would help strengthen the suggested relationships between program components and student attributes. Further research is also needed regarding identifying youth with high STEM interest who are unlikely to initiate engagement in after-school programs.

While these limitations inform the implications of our findings, the findings nevertheless are a meaningful contribution to the study of both adolescent purpose development and STEM enrichment programming best practices. Future practitioners and scholars are advised to consider these outcomes in their development and evaluation of youth purpose and STEM programming. The results of this study highlight the value of infusing after-school STEM programs with purpose curriculum, as purpose development interventions seem to offer meaningful contributions to the development and maintenance of STEM career pursuit. Change Makers provided support in facilitating identity development via career exploration, which also fostered a growth mindset. This finding is noteworthy given the challenges of engaging in a meaningful exploration amongst adolescents and particularly those with fewer resources. The present results also provide insightful perspectives about the development of purpose, underscoring the mutable nature of this process and furnishing directions for future program development. Other after-school programs may find that pairing hands-on learning with purpose curriculum into their existing practices is doubly beneficial for participants, given the range of benefits associated with having a sense of purpose (e.g., Damon et al., 2003) and engagement in STEM after-school programming (e.g., Allen et al., 2019; Krishnamurthi et al., 2014). The purpose lens, which

focuses on personal meaningfulness and prosocial contribution (Damon et al., 2003), can help

youth reflect on the intersection among their unique values, interests, strengths, skills, and

prosocial motivations, as well as the demands of STEM careers (Liang, White et al., 2017). By

extension, students who benefit from both purpose and STEM interventions may go on to pursue

STEM careers that are personally meaningful, sustainable, and prosocial in intent, which may

yield greater benefits to both the youth and society at large (Bronk, 2012; Kosine et al., 2008;

Liang, White et al., 2017).

Conclusion

Against the backdrop of nationally-insufficient availability of after-school programs

(Afterschool Alliance, 2020), the present study documents how engagement in an after-school

STEM enrichment program contributed to youth transforming their STEM interest into three

purpose-related outcomes: (1) enhanced self-efficacy, both generally and related to science, (2)

an increased willingness to engage in career exploration, and (3) greater prosocial motivation.

When considering the pervasive shortage of women and people of color from STEM professions,

these findings highlight the importance of connecting marginalized youth with experiential

opportunities to engage with and reflect on their interests in the pursuit of strengthening the

STEM career pipeline. As reflected in this study, there are countless youth who hold a spark for

STEM. Change Makers constitutes one intervention that can support youth in transforming their

passion into purpose, as well as help practitioners combat inequity and promote needed

innovation via elevating and educating the diverse leaders of tomorrow.

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