Youth Radio's DO IT! Initiative Summative Evaluation

Final Project Report

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Rockman et al
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Executive Summary

Rockman et al (REA), a San Francisco-based research and evaluation firm, conducted the external evaluation for Youth Radio's DO IT! program, which was funded by the National Science Foundation. Building upon Youth Radio's previous Science and Technology Program, the DO IT! initiative consisted of three primary components that promoted STEM (science, technology, engineering, and mathematics) learning by training underserved youth in cutting-edge digital technologies:

- <u>Brains and Beakers</u>: Young people hosted a line-up of investigators and inventors for demo-dialogues at Youth Radio's studios and produced media documenting these unexpected encounters with science in action.
- <u>Mobile Action Lab:</u> In partnership with professional engineers and designers, young people developed new digital technologies and applications for online and mobile platforms.
- <u>Youth Radio Investigates:</u> Young people collaborated with scientists to carry out original data collection and reporting for major media outlets.

The DO IT! evaluation included formative elements designed to provide feedback on the program, and summative elements intended to measure STEM-related outcomes – specifically how participation in grant activities affected the youths' STEM skills, knowledge, and attitudes. Over the course of the project, evaluators gathered data on the implementation and impact of program activities, as well as the cumulative effects of the program, through such means as observations, surveys, interviews, and focus groups.

The data suggests that the DO IT! activities were consistent with Youth Radio's overall training model, but offered the added benefit of making science and technology content accessible and appealing. The youths' STEM journey through DO IT! was unique, differing greatly from their interactions with STEM in school. In particular, the youths described their Youth Radio experiences as being more hands-on, in-depth, collaborative, personally-relevant, and applied.

Consequently, the program had an extremely positive impact on the youth participants' STEM skills, knowledge, and attitudes. The youths learned new STEM concepts and about the scientific and app development process. They also acquired a variety of technical (e.g., programming and design) and soft skills (e.g., communication, collaboration, and persistence). The youths expanded their views of STEM and increased their STEM confidence and interest. They also shifted their perspective in terms of how they interacted with technology, moving from being a consumer of others' technology tools to being an active and informed creator and user. Finally, as a result of their DO IT! experiences, the youths were more career-ready, learning many of the skills and tools required of digital media professionals while also acquiring more generalizable work habits (e.g., self-presentation and networking).

Evaluators recommend that Youth Radio continue to expand its STEM programming model within and beyond its organization. Curriculum around the development and use of Youth Radio's STEM media products, for instance, would broaden the organization's impact and enable other youth media groups to learn how to integrate STEM programming into their training.

Introduction

Program Overview

With funding from the National Science Foundation, Youth Radio, a 22 year-old media production and training organization, has established an ongoing initiative to engage young people in innovative science and technology learning experiences. In its first NSF grant (2006-2009), Youth Radio developed a Science and Technology Program consisting of a Digital Technology Institute, a Science News Desk, and a STEM presentation and reporting series (Brains and Beakers). Building on outcomes from this grant, in September 2010 the DO IT! initiative launched or extended three complementary projects that promoted STEM learning by training underserved youth in cutting-edge digital technologies:

- <u>Brains and Beakers:</u> Young people hosted a line-up of investigators and inventors for demo-dialogues at Youth Radio's studios and produced media documenting these unexpected encounters with science in action.
- <u>Mobile Action Lab:</u> In partnership with professional engineers and designers, young people developed new digital technologies and applications for online and mobile platforms.
- <u>Youth Radio Investigates (YRI):</u> Young people collaborated with scientists to carry out original data collection and reporting for major media outlets.

Young people participated in these three initiatives at different points in their Youth Radio career. Brains and Beakers typically took place during the introductory, nine-week Core session, when young people attended an interactive presentation by STEM professionals and produced media about the experience. That program offered youths some initial exposure to science and technology which they could then pursue as Interns for the Mobile Action Lab and Youth Radio Investigates.

Evaluation Overview

Evaluators from Rockman et al (REA) performed DO IT!'s external evaluation. Their work capitalized on REA's earlier study of Youth Radio's Science and Technology Program, which highlighted the organizational and staff growth process as Youth Radio discovered how to design and implement successful and sustainable STEM programs within their youth-driven media production model. The DO IT! evaluation focused on the logical next step – an in-depth look at how participation in grant activities affected the youths' views of science and technology. The evaluation included formative elements designed to provide feedback on the program, and summative elements intended to measure a number of STEM-related outcomes for the youths participating in the program (National Research Council, 2009):

- Youths' perceptions of themselves as producers/creators of science or technology;
- Attitudes toward science and perceptions of scientists;
- Understanding of the process of scientific inquiry and research;
- Science and/or technology skills development; and
- Understanding of/interest in careers in science or technology.

Over the course of the project, evaluators gathered data on the implementation and impact of each activity (Brains and Beakers, Mobile Action Lab, and Youth Radio Investigates). They observed program events and administered surveys. They conducted interviews and focus groups to document the youths' experiences in their own words. Evaluators conducted a number of these interviews with young people who had participated in DO IT! for an extended period of time (i.e., several years), asking the youths to retrospectively look back at their experiences. Evaluators also spoke periodically with Youth Radio staff to document their perspectives on the program's vision and accomplishments. Collectively, this data uncovers what young people took away from the program, and the activities that appeared to have the greatest effect on them.

This report is organized around DO IT!'s three initiatives: Brains and Beakers, Mobile Action Lab, and Youth Radio Investigates. For each of these program activities, we first outline our evaluation methodology, and then describe the implementation of the activity, including participant feedback. This is followed by an analysis of youth outcomes. While we include some program activity-specific findings from the youth retrospective interviews within each corresponding initiative report section, we also present a standalone retrospective interviews section. We conclude by summarizing key findings and identifying specific program characteristics that likely contributed to DO IT!'s overall outcomes. Copies of instruments used for our evaluation are not included in this report but are available upon request.

Brains and Beakers

Youth Radio's Brains and Beakers series invites Bay Area STEM professionals to demo their work live with young people at Youth Radio. These highly engaging, interactive events proved successful during the previous NSF grant, prompting Youth Radio staff to expand the initiative for the DO IT! Program. Over the course of DO IT!, Youth Radio held roughly 20 Brains and Beakers events.

Evaluation Methodology

Event-specific Mini Surveys

During all three years of the program, youth participants who attended the Brains and Beakers sessions completed either an online or paper-based mini survey at the end of the

events. Evaluators developed the mini survey in order to gather participants' feedback about the quality of the events, as well as information about immediate STEM knowledge and attitude outcomes. In total, 260 participants completed surveys across 17 events (Table 1). (Note: Mini-surveys were not administered after a handful of events for varying reasons.) In Year 3 of the program, mini surveys were administered at more events ($n = 8$) and to more youth participants (48%, $n = 124$) than in each of the initial years of the program (Year 1: 5 events surveyed and 26% or $n = 68$ survey respondents; Year 2: 4 events surveyed and 26% or $n = 68$ survey respondents).

Table 1: Overview of Event Mini Surveys ($N = 260$)

Program Year	Event Name	Session	# of Survey Respondents
1	Re-inventing Musical Instruments	Fall 2010	17
	DIY Robot Hands	Winter 2011	16
	Sifteo	Spring 2011	6
	Lead Testing: Heavy Metal Science	Spring 2011	9
	Ants	Summer 2011	20
Year 1 Total:	**5 events surveyed**		**68**
2	Preserving Dead Animals to Study the Web of Life	Fall 2011	9
	The Color of Green Chemistry	Winter 2012	20
	The Science of Taste	Spring 2012	20
	The Science Behind "Seeing" Sound	Summer 2012	19
Year 2 Total:	**4 events surveyed**		**68**
3	Build Your Own Speakers	Fall 2012	6
	Gamifying Air Pollution	Winter 2013	7
	How Long Until a Drone of Your Own?	Winter 2013	26
	Digital DJing Looks Good on Paper – And it Works	Winter 2013	12
	Raps on Science	Spring 2013	23
	Secrets of Science Reporting	Summer 2013	11
	A DIY Dollhouse for Girls	Summer 2013	10
	The Art and Science in a Pixar Animation	Summer 2013	29
Year 3 Total:	**8 events surveyed**		**124**
Overall Total:	**17 events surveyed**		**260**

For Years 2 and 3, the survey was modified slightly to include a question to gather information about which program the event participants were currently in at Youth Radio (i.e., Core, Bridge, Internship, Project Associate, or Match). The majority of respondents were either in Core (47%, $n = 90$) or were Interns (41%, $n = 78$). Almost 10% were Project Associates (9%, $n = 17$), and only a few participants were in Bridge (2%, $n = 4$) or Match (1%, $n = 2$). For most events, the majority of survey respondents were in Core, however, the Core group did not complete surveys for the following events (of which the majority, or in some cases all, of respondents were Interns):

- Gamifying Air Pollution
- Digital DJing Looks Good on Paper – And it Works
- Secrets of Science Reporting
- A DIY Dollhouse for Girls

Various factors may have influenced which youth completed the survey, and therefore we cannot necessarily assume for all events that the survey respondents were representative of the entire group of young people who attended the event. For instance, sometimes the Core youth had to leave immediately after the event to produce a radio show and did not finish their surveys.

Program Implementation

Key findings regarding program implementation include:

- Across the 17 Brains and Beakers events surveyed, youth participants gave extremely positive feedback about the events and the presenters.

    o Overall, participants rated the events a 7.9 on a scale from 0 (ice cold) to (10 red hot).

    o The vast majority of young people agreed that the presenters answered their questions, were easy to understand, and made the topic(s) interesting.

- Participants gave significantly more positive ratings of the events in the final year of the program compared to the events in the initial program year, which may have been influenced by the hiring of a Science and Technology Producer in Year 2 who took charge of leading event prep sessions.

- The majority of participants did not find anything about the event or content covered confusing. However, some had difficulty understanding specific STEM concepts or content presented (e.g., how the devices presented worked or were made) or the terminology used.

- Participants favored events that were hands-on in nature (compared to those that were more theoretical or lecture-oriented) and led by relatable, engaging presenters.

Below, we detail participants' overall feedback about the Brains and Beakers events and presenters, followed by feedback about factors that differentiated the best-received sessions from the least popular.

Overall Feedback about Event and Presenters

Overall, the Brains and Beakers participants gave positive feedback about the events and the presenters. On a scale from 0 (ice cold) to 10 (red hot), participants gave the Brains and Beakers events an average rating of 7.9 (SD = 1.98). Table 2 displays a rank ordered listing of events by respondents' mean ratings. There was a significant increase in participants' event ratings from Years 1 (M = 6.8, SD = 2.37) to 3 (M = 8.4, SD = 1.58) of the program, $t(185)$ = -5.41, $p < 0.001$. That is, from the beginning of the program to the end, participants' ratings of the events were significantly more positive.

The top ten rated events took place in Years 2 or 3, while the initial program events tended to receive lower (though still positive) ratings. The Ants workshop received the lowest average rating (M = 5.3) perhaps because the participants did not find the topic of ants to be relevant or engaging or because the workshop lacked a hands-on activity. The Science Behind "Seeing" Sound event may have received the second lowest average rating (M = 6.7) due to the didactic format of the first half of the event or the highly technical language and content.

Table 2: Overview of Event Ratings (*N* = 255 surveys)

Rank Order	Event Name	Program Year	*n*	Mean Rating*	SD
1	Digital DJing Looks Good on Paper – And it Works	3	12	9.8	0.62
2	The Science of Taste	2	20	8.9	1.31
3	A DIY Dollhouse for Girls	3	10	8.7	1.83
4	Preserving Dead Animals to Study the Web of Life	2	9	8.6	1.01
5	Raps on Science	3	23	8.5	1.62
6	Secrets of Science Reporting	3	11	8.5	1.92
7	The Art and Science in a Pixar Animation	3	29	8.3	1.31
8	The Color of Green Chemistry	2	20	8.1	1.68
9	Build Your Own Speakers	3	6	8.0	0.63
10	How Long Until a Drone of Your Own?	3	23	8.0	1.76
11	Lead Testing: Heavy Metal Science	1	9	7.9	1.17
12	DIY Robot Hands	1	16	7.6	1.41
13	Gamifying Air Pollution	3	7	7.4	1.81
14	Re-inventing Musical Instruments	1	15	7.3	2.90
15	Sifteo	1	6	7.3	1.21
16	The Science Behind "Seeing" Sound	2	19	6.7	2.14
17	Ants	1	20	5.3	2.57
			Overall:	**7.9**	**1.98**

*Scale: 0 (ice cold) to 10 (red hot).

Across all events, over 90% of participants agreed that the presenters answered their questions (93%), were easy to understand (92%), and made the topics interesting (92%). Comments regarding the presenters included:

[What really surprised me was] how relatable the presenter made the information. She answered in a way that was simple for us to understand, yet she did not take a condescending tone.

[I wasn't confused by anything; the presenter] made everything very clear.

[The presenters] were really nice. They seemed really passionate about what they wanted to do.

[The presenters] were awesome!

In each survey, youths answered a few short open-ended prompts, one of which was "I was confused by…" The majority of those surveyed did not find anything about the event or content covered confusing (58%, *n* = 152). Most of the 108 participants who expressed confusion had difficulty understanding specific STEM concepts or content presented or the terminology used (e.g., *"some of science jargon," "some of the undefined terminology that [the presenter] used in her answers"*). Other examples of youth responses to the "I was confused by…" prompt included:

…how the ethanol and acidic acid could reverse each other so the colors went back to normal. (The Color of Green Chemistry)

…how the drone was being controlled by an iPad. (How Long Until a Drone of Your Own?)

…the table thing and how fast sound travels through solid objects. (Build Your Own Speakers)

…the umami spice. (The Science of Taste)

Favored Events Were Hands-on and Minds-on

A variety of factors differentiated the best-received Brains and Beakers sessions from the least popular. When interviewed retrospectively, participants noted that their favorite Brains and Beakers events were hands-on in nature and that their least favorite were less active or lecture-oriented. They also favored events with engaging and relatable presenters.

I really enjoyed Brains and Beakers. My favorite one was when people from the Exploratorium were teaching us how to make our own speakers [the Build Your Own Speakers event]. I like that one the most because it was really hands on, and it was taught by people roughly my age. It was easy to relate to, and they talk just like me…and we made our own [speakers].

The [Brains and Beakers] that didn't make my [favorites] list are the ones that weren't hands on because then you end up just sitting there and listening to someone talk, which is informative but not as interesting if you don't get to touch stuff and put stuff together.

The majority of [the events] had prototypes or demonstrations, but there were some when it was just lectures and talking of what could be improved. And, it'd be better to see an actual object that they did improve. So, acting and not just talking.

It was the [presenter himself] that I enjoyed about the whole [Secrets of Science Reporting] presentation. He made it more fun than if someone else would have done it.

Additionally, program staff made significant changes to the Brains and Beakers curriculum in response to evaluation feedback. During Year 1 of the program, evaluators made the following observation in their annual report:

On the science/technology side, Brains and Beakers successfully captures students' interest and exposes them to a broad range of research, inventions and scientific professionals…On the journalism side, however, evaluators feel that there may be some missed opportunities to introduce students to the practice of science reporting. When researchers observed prep sessions this year, they noted that staff members did not provide students with much context for the events themselves or for the task of reporting…Evaluators observed that students seemed at a loss when it came to researching and preparing questions [for the events] and could have used more guidance from staff…The Brains and Beakers events remain highly successful at engaging students with scientific topics. With some additional direction and focus in the prep sessions, they can more successfully be leveraged to introduce students to the process of science reporting (Hazer & Bass, 2011, p. 15).

In Year 2 of the program, program staff implemented changes to specifically address this recommendation. Youth Radio hired a science journalism professional in a new full-time role as Science and Technology Producer. This person has a strong background in science, teaching, and journalism – she majored in biology, has a Master's in Public Health and in Journalism, and taught chemistry and math to high school students. The Science and Technology Producer took charge of leading the Brains and Beakers prep sessions, and actively worked with the youths to give them context for the event and structured support in preparing science journalism questions. She commented:

[To prep the youths for the Brains and Beakers event,] I meet with the students…to go over some background of the speaker. They generate questions, like meaningful journalism questions, for the event. I work with them specifically on how to ask questions to scientists if you are not a scientist and ways to begin researching a topic that you may or may not have background in.

Shorter-Term Outcomes

Key findings regarding shorter-term outcomes include:

- In terms of STEM knowledge gained through the Brains and Beakers events, participants:

    o Learned new science and technology concepts and were exposed to new devices, products, and tools;

    o Developed an understanding of how accessible technology can be (e.g., how devices such as speakers and turntables could be made using everyday objects); and

    o Gained a more realistic understanding of who STEM professionals are and what their jobs entail.

- In terms of the impacts of participating on STEM attitudes, Brains and Beakers events:

    o Increased participants' interest in STEM (particularly in the topics presented) and the process involved in making the devices presented, causing them to want to learn more about and/or personally create or do something similar to what was presented.

    o Strengthened participants' personal connection with STEM, through enhancing their awareness of how the STEM topics and tools presented were relevant and applicable to their lives.

Below, we detail the shorter-term impacts of the Brains and Beakers events on the young people who participated, focusing first on STEM knowledge outcomes followed by STEM attitudes outcomes.

STEM Knowledge

Learned about Science or Technology Concepts and Devices

Participants showed what they had taken away from the various Brains and Beakers events by completing the sentence, "What really surprised me was…" Their answers suggest that they learned new science and technology concepts and were exposed to new devices, products, and tools. See Table 3 for example comments regarding this type of learning by event. For instance, participants learned about lead testing, ant species and behaviors, green chemistry, air pollution, the five tastes, sound waves, and the process of making an animated film. They were also exposed to new technology or devices (such as robot hands, drones, and apps/games) and discovered that many different creations were

possible using technology, such as creating a turntable using paper and displaying sound waves on a TV.

Table 3: Example Comments about STEM Learning for Selected Events

Event Name	Example Comments: "What really surprised me was…"
DIY Robot Hands	…the facts about glass & how dense something is. …glass is made by sand.
Lead Testing: Heavy Metal Science	…how lead could be in so many common items.
Preserving Dead Animals to Study the Web of Life	…that people actually take out the guts and try to put the bones back together.
The Color of Green Chemistry	…that you can make dye from vegetables. …that using more organic dyes are harder to control than synthetic dyes.
The Science of Taste	…We only have 5 tastes and every other thing that we "taste" is a flavor. …some things have no specific taste when you cut off your smell sense by plugging your nose.
The Science Behind "Seeing" Sound	…the way sound could be seen on the [TV] screen in different wave lengths.

Learned about the Accessibility of Technology

The participants were often surprised by the accessibility of the technology presented. For example some of the devices, such as speakers and turntables, could by made using everyday objects (e.g., turntables made from paper or TVs used to display sound waves) or programs available for free to the public. Youths expressed surprise at:

…how [the presenters] turned random objects into some dope stuff!

…how [the presenters] were able to take something as simple as a video game controller and turn it into a musical instrument.

…how you can make art [and music] out of trash.

…how easy [drones] are to make…drones can be made by yourself.

…the program unity is free…how easy they made making the game sound.

Expanded their Understanding of STEM Professionals and their Jobs

Through their experiences and interactions with the Brains and Beakers event presenters, the young people gained a more realistic understanding of who STEM professionals are and what their jobs entail. For example, participants were surprised to find that the STEM

professionals who lead the events were so young, social, interesting, passionate about their work, and from varied backgrounds. Comments included:

[I was surprised by] how open he was and talkative.

[I was surprised by] that she's able to have a social life.

[I was surprised by] how young the app developers were.

[I was surprised by] the level of passion he had for his work.

[I was surprised by] how much background he had outside of tech.

[I was surprised by] the amount of information she was responsible for collecting.

STEM Attitudes

Increased Interest in Science and Technology

The Brains and Beakers events increased participants' interest in the science and technology topics presented, causing them to want to learn more. See Table 4 for example comments by event. Several example general comments included:

I wasn't expecting it to be so amazing. This makes science much more interesting.

[I was surprised by] how interesting it was.

[I was surprised by] how fun it was, and I love science.

In addition to increasing their interest in the STEM topics presented, participants also increased their interest in finding out more about the process involved in making the devices presented during the events – at times noting that they wanted to personally create or do something similar.

Table 4: What Participants Wanted to Know More About by Selected Events: Example Comments

Event Name	Example Comments: "I want to know more about…"
Re-inventing Musical Instruments	*…how programming these devices work. They mentioned that they "coded" the computers to work as instruments, and I would like to know how that works.* *…the work process that goes into making something like that.*
Sifteo	*…how you go from a research project to a marketable product.*
Lead Testing: Heavy Metal Science	*…how lead gets into the everyday use's of our everyday life tools.* *…I want to know more about how we can find out immediately if there's lead in an object before buying it?*
The Color of Green Chemistry	*…green chemistry and how it affects the market.* *…how to make my own dyes.*
The Science Behind "Seeing" Sound	*…how to make different frequencies to make a light move a certain way.*
Gamifying Air Pollution	*…the digital designing process.*
How Long Until a Drone of Your Own?	*…building my own drone.*
Digital DJing Looks Good on Paper – And it Works	*…the process and programming.*
Secrets of Science Reporting	*…the things that make up the Google glass.*
The Art and Science in a Pixar Animation	*…how to animate.* *…moving drawn objects to the computer.*

Personal Connection to Science and Technology

In some cases, the events also strengthened participants' personal connection with STEM by making them aware of how the STEM topics and tools presented were relevant and applicable to their lives.

[I was surprised because] I didn't think this was actually possible. This opens the door to many, many possibilities in normal life use. Great to be educated about this. [DIY Robot Hands]

[I was surprised by] how [many] items that we usually use on a day-to-day bases for "fashion" [that have] lead in [them].

[I was surprised by] how applicable drones are to everyday life.

[I was surprised by] how almost everything I use on a daily basis comes from simple processes like the ones they showed us. [Green Chemistry]

[I was surprised] that we have taste [receptors] in our stomachs.

Longer-Term Outcomes

When interviewed retrospectively, youth who had taken part in Brains and Beakers events described the longer-term impacts of the events on them. Key findings include:

- After the events, participants retained STEM learning from the events (e.g., about new technology; the accessibility and applicability of technology; and various STEM concepts) and a wider understanding of what STEM entails.

- In terms of longer-term effects of the events on the youths' attitudes, the young people developed persistence and increased confidence in themselves, through the positive examples and messages shared from the STEM professionals who had presented.

STEM Knowledge

Participants explained that the events exposed them to innovative technology and expanded their understanding of what STEM means and entails.

I really just enjoyed seeing all these different, new exciting things…It was amazing. It was all perfectly new to me. I felt like a kid in a candy store…all these innovative technology or products that are being created…I loved [the event on drones] because it was innovative and about new technology.

I feel like [taking part in the Brains and Beakers events] did affect me in a scientific-y way. I like learning about science in itself. So, going through these workshops…it helped influence me and taught me things that I didn't know…it did teach me quite a few things.

[The Brains and Beakers events] told me that science and technology can really be combined. Science does not mean biology or physics - it could be more than that. For example, how computer science is somewhat a type of science that you can use to do other stuff.

Participants often mentioned that the Build Your Own Speakers and Secrets of Science Reporting events were influential in helping them understand how accessible and applicable STEM can be in their personal lives.

The [Brains and Beakers] that I remember the most was [Build Your Own Speakers]...with a woman who had made speakers out of paper. She used paper and connected all of these things to it, and made it work…What I really liked about hers, it was so simple. When I was younger, too, I thought science and technology were…you

had to have these incredibly complicated ideas and a lot of money. She kind of proved that you could do it with very little resources and one simple idea. I think the young people who saw her were very impressed by that. It was an idea that you might have in passing that she turned into real life thing, and also getting a lot of exposure for as well.

[The presenter from the Build Your Own Speakers event] turns the tabletop into a speaker where they learn how to connect motors and generators. That was really cool because I didn't think that you could use everyday objects and transform it into something else entirely, and make speakers out of it.

From the [Secrets of Science Reporting event], I learned that...I can find stories all around my house. I can make a story pretty much out of anything – that was really cool. Now when I write my commentaries, I just remember what [the presenter] does to get ideas.

Examples of other STEM concepts that participants remembered and retained included pollution, taste, and computer programming:

[Through the Raps on Science event,] I got to learn some things that I didn't know that were happening on our earth like the dangers of putting stuff in the ocean and how that affects the fish and polluted water.

[In The Science of Taste event, the presenter] taught us about the five senses…we found out about and focused on our five keen senses and finding the differences between them.

[Through the Gamifying Air Pollution event,] I got to learn a few basics of computer programming that day which is cool.

Effects on Attitudes and Motivation

The Brains and Beakers events also had longer-term impacts on participants' attitudes and motivation. The events had shown the youth participants examples of successful STEM professionals who had overcome obstacles, as well as worked doing something about which they were passionate. These positive examples helped participants gain confidence in their own abilities to succeed and motivation to persist when challenges arise in their work.

I've taken away the fact that anyone can really be anything that they want to be…I feel like I could be that person [like the presenter] someday...All the people that came to us [and presented at the Brains and Beakers events]…they are doing what they want to do. And, that helped me know that I can do what I want to do or be what I want to be, no matter how different the job is or how unique. Whatever I take interest in and am

passionate about, I can do it…I saw that through the people that came, like the [animator for the Pixar event]. He really took interest in doing that and it's not a normal 9-5pm job but made it work. And, the [presenter from the Raps on Science event] that was into saving the earth and recycling, he has an afterschool program with children to teach them to recycle and teach them about global warming.

I liked all the Brains and Beakers…There is always someone coming in with their successful stories, telling us how they went through their trials and tribulations…It's a good reminder. [From the presenters' standpoint, they are saying,] we've been through this, and now we're here, so you can go through something worse and be even higher. Proving that you can do anything at some point…[For example,] the reason [that the event on paper turntables] was most memorable to me, is because [the presenter] had this saying which sticks with me to this day. It goes like this, "You know you've won, when you pushed pass the point where wanted to give up or quit, since others have already quit."

In the next two sections, we report the implementation and outcomes of DO IT's two other initiatives – the Mobile Action Lab and Youth Radio Investigates – which were for advanced Youth Radio participants.

Mobile Action Lab

Youth Radio launched its Mobile Action Lab (App Lab) to expand science and technology offerings for youth and to leverage the potential of mobile platforms to create high-impact digital projects. As part of the App Lab, advanced participants, who were Interns or Project Associates at Youth Radio, worked as a team and with professional developers to conceptualize, develop, create and disseminate online/mobile apps serving youth and community needs. Additionally, young people created additional apps for learning purposes through weeklong workshops facilitated by professional developers.

Over the course of DO IT!, Youth Radio App Lab participants created a total of more than 25 apps, ranging from simple tutorials designed to introduce young people to the basics of specific programming tools and platforms, to more ambitious apps involving multiple features, use cases, and iterations.

Evaluation Methodology

Mobile Action Lab-specific evaluation activities included: 1) interviewing youths who participated in the App Lab, 2) surveying the youths who attended weeklong Mobile Action Lab workshops, and 3) interviewing users of apps that had been developed by the App Lab.

Youth Developer Interviews

Over the course of the program, evaluators interviewed a total of 14 youths who participated in the Mobile Action Lab (Table 5). Specifically, evaluators conducted a focus group in Years 1 ($n = 6$) and 3 ($n = 7$) of the program with a total of 13 young people – one participated in both groups. In Year 3, evaluators also conducted a joint interview with two developers (one had previously participated in the Year 1 focus group) as well as two individual retrospective interviews (one interviewee had also taken part in both focus groups).

Table 5: Overview of Interviews with Youth Developers ($N = 14$*)

Program Year	Interview Type	Session	# of Participants
1	Focus Group	Summer 2011	6
3	Joint Interview	Winter 2013	2
3	Focus Group	Summer 2013	7
3	Retrospective Interview	Summer 2013	1
3	Retrospective Interview	Summer 2013	1

*One participant took part in both focus groups as well as a retrospective interview, and one participant took part in the Year 1 focus group as well as the joint interview.

The youths who took part in the focus groups had a wide range of backgrounds and experience levels with the Mobile Action Lab program, from just beginning the program to having been a part of the program for several years (e.g., since its inception). The youths interviewed individually (i.e., the retrospective interviews) or via the joint interview were all experienced App Lab members, with three having been in the program for at least two years and one having been in the program for nearly a year at the time of the interviews.

Overall, the purpose of the interviews was to gather information from the youth developers about their:

- background;
- apps developed as part of the App Lab program;
- process for developing STEM apps;
- perceptions on how the App Lab program had influenced them (e.g., knowledge, skills, and attitudes); and
- feedback about the App Lab program.

After conducting the interviews and having them transcribed, evaluators analyzed interview notes and transcripts using a grounded theory approach (Strauss & Corbin, 1990), deriving

codes, concepts, and categories from the data in order to identify patterns or themes. They first analyzed each individual discussion and then generated themes that cut across multiple discussions.

Workshop-specific Mini Surveys

Youth participants who attended weeklong Mobile Action Lab workshops in Years 1 and 2 of DO IT! completed an online mini survey at the end of the events. Based on the Brains and Beakers' mini survey, evaluators developed the Action Lab mini survey to gather participants' feedback about the quality of the events, as well as information about immediate event outcomes. Specifically, the survey examined participants' STEM knowledge and attitudes at the end of the event. In total, 36 participants completed surveys across six events. Table 6 provides an overview of the number of survey respondents by workshop.

Table 6: Overview of Workshop Mini Surveys ($N = 36$)

Program Year	Workshop Name	Session	# of Survey Respondents
1	Fortune Teller	Fall 2010	4
	All Day Play	Winter 2011	6
	Job Search App	Summer 2011	8
Year 1 Total:	**3 events surveyed**		**18**
2	App Inventor Workshop: Professor-Led	Fall 2011	4
	App Inventor Workshop: Student-Led	Winter 2012	9
	Photoshop	Winter 2012	5
Year 2 Total:	**3 events surveyed**		**18**
Overall Total:	**6 events surveyed**		**36**

For Year 2, the survey was modified slightly to include a question to gather information the participants' current program at Youth Radio (i.e., Core, Bridge, Internship, or Project Associate). All participants were either Interns or Project Associates, with roughly equal numbers of each participating ($n = 8$ vs. $n = 10$ respectively).

User Interviews

During Year 3 of the program (Winter 2013 session), evaluators also interviewed two "users" of apps that had been developed by Youth Radio's Mobile Action Lab. These

"users" had a need for an app and had worked with the youth developers to relay these needs. The purpose of the interviews was to gather user feedback about the app, interactions with the Youth Radio youth developers, and perceptions about any impacts of the program on the youth developers.

Similar to process for analyzing the youth developer interviews, evaluators conducted the user interviews, had them transcribed, and then analyzed interview notes and transcripts using a grounded theory approach (Strauss & Corbin, 1990).

Both user interviewees worked at Youth Radio. At the time of the interviews, one had worked full time at Youth Radio teaching music for approximately three years, while the other had been teaching health communications at Youth Radio for approximately three months. Both interviewees had previously participated in Youth Radio as youths.

Program Implementation

Key findings regarding program implementation include:

- The Mobile Action Lab program evolved over time, with an increased focus on coding and working individually (or in smaller groups) on apps during the final year of the program.

    o Factors that influenced these shifts were evaluation findings regarding youth feedback as well as the hiring of a new App Lab supervisor.

    o Veteran App Lab members were extremely pleased with these changes.

- The youths praised the App Lab supervisors, and in turn, the supervisors and app "users" praised the youth developers.

- The App Lab was a supportive, team environment, in which the youths' voices were heard and they felt comfortable to be themselves. The youths collaborated, peer taught, and learned at their own pace.

- Suggestions for improvements for the App Lab centered on additional resources (e.g., a bigger workspace, better computers, and increased one-on-one time with supervisors).

- Across the six weeklong Mobile Action Lab workshops surveyed, youth participants gave positive feedback about the workshops and the presenters.

Next, we present the findings regarding the implementation of the Mobile Action Lab, followed by findings specific to the implementation of the Weeklong App Lab Workshops.

Mobile Action Lab

Below, we detail the evolution of the Mobile Action Lab; feedback about the App Lab supervisors and youth developers; the App Lab environment and collaboration; and suggestions for improvement to the App Lab.

Evolution of the Program

The implementation of the Mobile Action Lab program changed over time in that there was an increased focus on coding and working individually (or in smaller groups) on apps during the final year of the program. In Years 1 and 2, the youths worked with a tool called App Inventor that allowed them to build apps with limited knowledge of programming languages through a graphical interface. Several youths described the initial years of the program:

> *We work[ed] exclusively with coding blocks [in App Inventor]. We [hadn't] done any straight coding because none of us [were] trained in programming languages.*

> *When I first joined [the App Lab], it was a lot more the marketing side of apps. We learned to write pitches and designed stuff…we actually did not get into any of the development part…it was more conceptualization and designing what the apps would look like and creating it in App Inventor…but there was no real coding or programming.*

However, in Year 3 the focus shifted to teaching the youths coding languages such as HTML, CSS, JavaScript, and Python. One major factor that influenced this change was the hiring of a new App Lab supervisor who was an experienced coder. Several youth developers described the transition:

> *I think of the App Lab as having two different time periods: one before [the new supervisor] came…when it was all Photoshop, designing, marketing...And, then when [the new supervisor] came [in Year 3], I learned my first language - HTML - which I really, really like. And, then we started learning CSS. And, it was kind of amazing - how other app members have said, too - you could create something with your own hands, which was really cool.*

> *Before, we didn't have an in-house coder/programmer, so therefore, most of the projects, we'd have to outsource them. But, now, we have an actual coder / programmer…so now we're actually learning how to create the apps. At first we were learning things but focusing on App Inventor and the design part and how everything runs and the user side. But, now it's - let's get in the back end of this and start creating with coding…It's been a struggle and a challenge, but it's been good.*

[Our new supervisor] is the one that helped us code because if it wasn't for him, we wouldn't have known about any of this. He puts us on the platform, and he helps us whenever we need help…there are a lot of different programs that he taught us about.

Based on feedback from youth developers gathered during Year 1 of the program, evaluators recommended that individuals or subgroups work on one particular app, instead of the entire group working on multiple apps. This would help make the experience less overwhelming for the youths. Youth feedback from Year 1 included:

Sometimes it's fun. Sometimes it's stressful…it's challenging to go to the meetings and figure out what would be best for the app, and we always have to make changes and stuff. Having to remember everything is hard, too, because we jump around a lot. We have a lot of apps going on…so remembering everything we did. We'd get so far with one app and jump back to another one – and it's like what are we talking about?

During the later years, the program made this shift to individuals or pairs working on their own apps, in addition to working on one or two apps as a whole group. This new format was especially beneficial given that the app development and refinement process can be lengthy, and due to Youth Radio's structure, there was often turnover and shifting of participants. Veteran App Lab members gave extremely positive feedback about this change, describing how new members were able to dive into app development and take ownership of a new project immediately, without the confusion of trying to join the creation of an app mid-development.

I'm really glad that we made a shift towards smaller projects that are a little bit more individual to develop programming skills…Then maybe one big project that everybody is [working on together]…That is actually a good thing. I'm glad about that.

As someone who has been in the App Lab for some time, I like how [during Year 3] everyone had to do their own apps. That was the first time that we've done that, before we've worked as a team, all together. Seeing [the new members] do their own app, and it's their first three months…I didn't do that my first three months…It would have been cool to learn to make an app right away…I could be like, "I made that, and I have it. That's cool."

Feedback about Supervisors

The youths gave extremely positive feedback about the App Lab supervisors, appreciating the support, inspiration, and entertainment that they provided.

[The App Lab staff supervisor] strongly encouraged me to join the App Lab, and I wasn't so sure about it. And, he's right…it is pretty cool. [The App Lab supervisor] is professional, but he also knows when to joke, keep it at a level where you don't get too

bored…and we get to be ourselves…Our supervisors are entertaining…they are not completely professional, and that's what makes them great because they know how to balance that out and keep us awake and keep us motivated.

[The App Lab staff supervisor] definitely inspires you to think bigger and out-of-the-box…so think bigger…there's a lot going on in the world.

Feedback about the Youth Developers

Evaluators gathered feedback about the youth developers from their staff supervisors as well as the "users" of the apps (i.e., those who had a need for an app and had worked with the youth developers to relay these needs).

Staff supervisors praised the Mobile Action Lab youths:

I was really proud of our students, understanding the whole [app] development cycle, and then coming up with their own app projects or ideas, and implementing them up to a beta…[The youths] really chose what it is that they wanted to work on, and they were able to apply what they were learning directly into their own project…I really liked that. And then just on an individual level, there are things with each student that I was pretty proud of…They were on top of it.

Additionally, user feedback about the youth developers was highly positive, both about the quality of the apps created and the responsiveness of the developers to the user's needs and requests. The users also mentioned the high level of professionalism and engagement of the youth developers.

[The youth developers] have definitely met my expectations, and sometimes exceeded them…the fact that they've been able to address these things that were problems on the launch site in a matter of months is impressive. And the fact that we were able to get an app so that people could streamline and have had thousands of downloads of it is awesome.

It was really wonderful how professional [the youth developers] were. They all asked me questions about what my vision was...they were all taking notes, and what I really wanted the [app] to look like.

Environment and Collaboration

The youths praised the Mobile Action Lab for its supportive, collaborative team environment, in which their voices were heard and they were comfortable to be themselves. Youths appreciated this teamwork, where everyone's input was valued and used:

My favorite thing about working specifically in this department [is that] we're all part of a team. We all put input into the meetings, and it does all get used. Sometimes we'll say that we shouldn't keep this in the app, and if we give a good enough reasons, it doesn't go into the app.

What I liked most about working with the apps, all of our voices are heard, all of our opinions are incorporated into the ideas. Also, the simple fact that we all work together.

[One of the highlights of the Mobile Action Lab team is] just being able to communicate with other people doing the same thing. Before I [joined the team], I had an idea, and I was like, I don't think I should tell anybody. On my first day [in the Action Lab] I explained it, and it was more comfortable. I liked the environment.

We're all like puzzle pieces coming together. We all came up with the ideas.

The youths felt comfortable getting support from peers and supervisors and appreciated their technical and moral support. In terms of peer teaching, the young people described how veteran App Lab members taught new members, as well as how members who had strengths in a particular area shared their expertise with other members.

It's been a lot of peer teaching…[More experienced App Lab members] go through the process and show [newer members] the process step-by-step, so [the new members] can learn the process of how to start making [their] own apps. From there, the older members taught the newer members and then the next.

I'm getting support from my co-Interns as well as my supervisor, but they also give me room to figure stuff out on my own as well. But, if I need help, I'll ask them, and they are there to help me.

I think the community [in the App Lab] is really good…[our supervisors] are really helpful. Everyone here is also just nice. There [aren't] really any interpersonal conflicts.

However, one youth described a challenge with collaboration as a result of App Lab members being in the program for varying amounts of time (e.g., from veteran members to newbies) and therefore having a range of experience levels with app development.

Everybody [in the App Lab] is at different levels. When you have one person who knows HTML and Java and then another person who's never see it before, it's kind of hard to work with them…it's going to take that person way longer.

Overall, the young people were able to learn at their own pace, in an open-minded and pleasant environment.

I do like how it's open-minded because everyone learns at their own pace, and coding is a whole new language to us, so it takes time.

[I would describe my experience with the App Lab to a friend by saying that] you'll have a good time and won't get stressed out…this one is pretty neutral, and it's not a lot of tension, and that's the kind of environment that I like.

Suggestions for Improvement

The youths' suggestions for improvements for the App Lab centered on additional resources, such as a bigger workspace and better computers, as well as increased one-on-one time with supervisors.

I would like to improve is the workspace, so to have a bit more space...[our current workspace] is kind of cramped.

I feel like the location is a big issue. When we are downstairs, it's the choice between having the door closed and being hot, or getting to listen to loud music [since the Bridge program is learning to DJ].

There are some issues with the computers…sometimes they work and sometimes they don't.

I can't wait until some more of these computers are updated. We have a cool lab downstairs but just being able to get some more hardware stuff would be cool.

On improvements, more one-on-one time in case you do need help, because a lot of times [the staff supervisor] is busy with other stuff, and [another supervisor] knows a lot but there is some stuff that [that supervisor] can't solve. Coding is a lot of one-on-one on the computer, but sometimes you need the external help.

Weeklong App Lab Workshops

Overall, the Mobile Action Lab workshop participants gave positive feedback about the weeklong workshops and the presenters. On a scale from 1 (very bad) to 5 (very good), participants gave the workshops an average rating of 4.6 ($SD = 0.55$). Table 7 displays a rank ordered listing of workshops by participants' mean ratings. However, given the small number of respondents for each event, comparisons across events should be made with caution.

Across workshops, all participants agreed that the presenters answered their questions, while over 90% agreed that the presenters made the topics interesting (94%) and were easy to understand (92%). Participants gave mixed feedback about the difficulty of the

workshops (Table 7). Overall, participants were almost evenly split between whether they felt that the workshop was more difficult than expected (31%, $n = 11$), as expected (34%, $n = 12$), or easier than expected (34%, $n = 12$). However, besides the All Day Play workshop, this trend varied particularly depending on the workshop. A majority of participants found the Student-Led App Inventor workshop to be easier than expected (62%, $n = 5$), while a majority found the Job Search App workshop to be more difficult than expected (88%, $n = 7$) which may help to explain its low ranking. Example comments included:

[What really surprised me was] how easy the workshop went and how everyone was really interested in the blocks editor. –Student-Led App Inventor Workshop

[What really surprised me was] how much extra work you have to put in to make your app work correctly. –Job Search App Workshop

Table 7: Overview of Workshop Ratings ($N = 36$)

Rank Order	Event Name	Program Year	n	Mean Overall Rating*	SD	Workshop Difficulty Rating for the Majority**
1	Fortune Teller	1	5	5.0	0	As expected (75%)
2	App Inventor Workshop: Professor-Led	2	4	5.0	0	As expected (75%)
3	App Inventor Workshop: Student-Led	2	9	4.7	0.50	Easier than expected (62%)
4	Photoshop	2	5	4.6	0.55	As expected (60%)
5	All Day Play	1	6	4.3	0.82	NA (even split)
6	Job Search App	1	8	4.3	0.46	More difficult than expected (88%)
			Overall:	4.6	0.55	NA (even split)

*Scale: 1 = very bad, 2 = bad, 3 = neither good nor bad, 4 = good, and 5 = very good.
**Categories: more difficult than expected, as expected, easier than expected.

For the most part, the youth participants found the workshops to be clear. However, when asked about what they found to be confusing, most noted some component of the app development process, particularly coding or using the App Inventor program to create apps.

[I was confused by] some of the steps it took to make the apps.

[I was confused by] the straight coding.

[I was confused by] some functionalities of App Inventor.

Outcomes

Key findings regarding outcomes include:

- The youths gained a big picture view of the entire app development process, and in gaining this more accurate understanding, realized that the process was more complicated than they expected.

- The youths also learned about and gained hands-on experience with each component of the app development process: idea generation, research, design, development, and testing and demoing.

- Through their participation in the App Lab, the youths acquired technology skills, including programming and design skills. They also critically evaluated the tools they used to create apps, giving mixed feedback about App Inventor.

    o Specifically, the youths learned coding languages, such as HTML, CSS, JavaScript, and Python; used app creation tools, such as App Inventor; and used design tools, such as Photoshop.

- Programming was challenging, and encountering glitches was a typical part of the development process. As a result, the youths learned persistence (i.e., increasing their ability to identify and use strategies to keep working when they encountered problems), which they applied not only to their App Lab work but also to other areas of their lives.

- The youths gained a variety of other soft skills from the App Lab, including professionalism, networking, collaboration, patience, focus, and critical thinking.

- As a result of the App Lab, the young people became more interested in app development and more confident in their ability to create apps.

- The youths also shifted their perspective in terms of how they interacted with technology, moving from being a consumer of others' technology tools to being an active and informed creator and user.

- Through their App Lab experiences, the youths increased their knowledge of, interest in, and preparation for technology careers, such as app development.

    o Overall, participants wanted to continue doing technology work (e.g., developing apps) either as a hobby or as part of a career.

    o The App Lab provided the youths with new experiences that they would not have otherwise had and opened doors for their future.

- The youths described their App Lab experiences as being different from their school experiences in that they chose to participate in the App Lab because it was hands-on, engaging, and informative.

- The youths saw their App Lab work as both similar and different to what professional app developers do in their jobs. The youths used a similar process and similar skills, but did so in a collaborative and supportive learning environment, on a smaller scale.

Below, we detail the impacts of the Mobile Action Lab and the weeklong app lab workshops on youth participants. After describing participants' backgrounds and motivation for joining the program, we illustrate the Lab's effects on youths' STEM process knowledge and skill development followed by changes in STEM attitudes and self-identification. We portray our findings in two ways: by specific outcomes, and through elaborated cases of selected young people.

Participant Backgrounds

None of the youth developers had previous experience developing apps but most had a great deal of past experience with Youth Radio, having participated in a variety of departments. The youths had little to no experience with coding. Comments included:

I didn't know how to code or anything about [creating apps before joining the App Lab].

I used Python for an hour a few years ago [before joining the App Lab].

I did not have experience in app developing before joining the App Lab…I learned a bit of coding from playing with a website [that teaches on to create a website].

Overall, the youths had chosen to be a part of the Mobile Action Lab program either due to their interest in apps in general or because they wanted to learn more about creating apps and about technology, with an eye on how these skills could help them in their future.

I decided to join the App Lab because I wanted to learn how to create apps and do my own HTML and learn more interesting fundamentals about the computer and technology in general.

My dad talks about the future a lot, and he said apps are going to be a really cool thing and you should probably get involved with it if you want a future that involves technology.

[I joined because I thought the App Lab] would help me get to my long-term goals and my careers - things that I want to do in life…One of the reasons why I am staying is because [the supervisor who leads the App Lab] is a good programmer, and he can help me follow my dreams. I actually want to create a social network and be a fashion designer at some point, so I'm going to need Web design.

I have a smart phone, and I wanted to know behind the scenes of the apps I use and give me ideas…when you download applications on the phone, you don't know the behind the scenes or what you go through to create the app.

One of the youth who joined the Action Lab at its inception noted that part of her reason for joining was to be a part of something new:

I was really excited because this was something brand new to Youth Radio. Developing a product is something that you're going to know how to do no matter what your product is.

STEM Process Knowledge and Skill Development

Since the youths had no experience with app development prior to their involvement with the App Lab at Youth Radio, all of what they learned about app development came as a result of the program. Through participating in the program and their hands on experience building apps, the youths learned about the app development process and developed skills associated with app creation.

In the following sections, we detail their learning of the overall app development process, as well as the specific components that make up this process. We also describe the skills gained, including technology skills (i.e., programming and design skills), persistence, and other soft skills such as networking and collaboration.

Big Picture View of the Development Process

The youth gained a big picture view of the entire app development process, learning about all the elements involved and about the scientific process. In acquiring a more accurate understanding of what app development entailed, the youths realized that the process was more complicated than they expected. Two App Lab youths summed up the process as follows.

It seems easy at first, when you say app development. All you have to do is think of an idea and code it and you're done, but it's not that simple. It's much more complicated. Conceptualization is the easy part, thinking about what you want your app to be, but then it goes to the user and market research, and that's when you realize that some things will work and some things won't work. And, it's not about being your app anymore, when you put an app [out to the] public, it's the public's app. It's the user who has to like it and not personally what you want it to be. So, it gets harder when you get to the development cycle. It's a lot of coding, and it takes more than just one or two languages. It's a combination of some languages to make the app that you want.

I would say that app development is just like making another product…I would say app development is problem solving. App development is being a researcher, working with a team. You have to do a lot of market research, and before you can [finish an app], you do research, design, programming, testing…It's not that easy because then you still have launch and marketing and engaging users.

Components of the Development Process

In addition to gaining a big picture understanding of the entire app development process, the App Lab youths also learned about and gained hands-on experience with each component of the process: idea generation, research, design, development, and testing and demoing. Sample youth developer comments about each of these components are included in Table 8.

In terms of their experiences with the app development components, the youths described the initial steps as generating an idea for an app and doing research. The youths typically came up with ideas for the apps they developed through personal experience or interests and/or in response to a Youth Radio or community need (Idea Generation). Once the young people had their basic app idea in hand, they conducted user and market research to inform its design and development. They also researched and repurposed snippets of code from the Internet for elements of their apps, and in some cases, gathered information to populate their app (Research). When designing their apps, the youths created mockups of how the app would look and function and used programs such as Photoshop. The youths applied various design principles when creating their apps to make their apps easy-to-use, current, and appealing (Design). The App Lab young people used a number of coding languages and tools to construct their apps, including HTML, CSS, JavaScript, Python, and App inventor (Development). Once a prototype of the app was created, the youths performed user testing to demo the app and gather feedback (Testing and Demoing). They described the development process as iterative – often editing their apps to address and incorporate user testing findings and feedback.

Table 8: App Development Process Components and Youth Developer Comments

Component of App Development	Sample Youth Developer Comments
Idea Generation	• *The idea [for my app]…that downloads information about emergency contacts…when you don't have Internet…I came up [with the idea] because I was in [an emergency] situation where I did not have Wi-Fi or Internet, and I wasted a lot of time turning the Internet on.* • *An app that [the two of us] have been working on is called Cola Fact of the Day…it's supposed to pop up with a daily interesting, good, or bad fact about Coca-Cola…[We came up with the idea for the app because] I was reading up on all the alternatives use of Coca-Cola, and I thought it was interesting. There were websites that listed them, but there weren't any apps that did them.*
Research	• *Once you have your idea, then you try to figure out what would be the pros and cons of your app…last time we did this research, we found about ten apps that were similar to the idea that we had and did pros and cons about them and built ours off there. I remember looking at some and the colors or functionality was bad…One looked boring…One looked like it was for older people.* • *[We sent] out a survey for the user research.* • *I had to make a whole fusion table and then connect it with code, so it would work. It was complicated. I didn't know what I was doing but I just looked it up and asked Google questions and Google helped me.*
Design	• *The first thing we did was we actually bought a [Tumblr] theme that we thought looked cool. We wanted a really cool looking front, infrastructure, something that was really simple and sleek.* • *I designed the logo [for my app] in Photoshop because I like designing…Photoshop is something that I picked up in the App Lab.* • *[I'm] creating my own images that allow the user to click on [a] button [in the app]…I'm using images off of the Internet, but I'm creating my own visuals for the game itself, using Photoshop.*
Development	• *Right now, there were several central components for getting a working prototype of [our app called Better Safe]: the GPS location signal, the querying the APIs from Google places, getting all of the information and addresses, and the UI (user interface)….[What I] have to do is code for different pages that I want. Now, we're starting the process of User Interface using HTML and CSS.* • *We've been making [our app] in App Inventor.* • *I've been programming in Python mostly, and then HTML and a little CSS.*
Testing and Demoing	• *Once we get the prototype [for our app], we'll do user testing and iteration, going back and forth between them.* • *[The users] wanted a different picture because they didn't like the original picture for the banner. I had to edit that and had to edit some content that was in the search bar…So I modified that and added some text that [the users] wanted.*

Programming and Design Skills

Even though youths agreed that app development was more than just coding, they also acknowledged that they gained significant programming and design expertise. They also learned how to critically evaluate the tools they used, such as App Inventor.

In terms of programming skills gained, the youths learned coding languages such as HTML, CSS, JavaScript, and Python.

> *[From participating in the App Lab,] I've gotten way better with my HTML and CSS...I'm way more confident in my HTML and my CSS. Designing a website is not intimidating at all. I'm learning Python. [Another youth member of our team] is learning JavaScript.*

> *I've learned about coding. I knew a tiny, small amount of HTML before I came, but now [I know] HTML, CSS, Python. It's been really good learning experience.*

> *[What I have found most valuable about my experience with the App Lab is] coding and learning HTML, like a hard skill for on my resume. I could say that I know HTML now. Picking up a hard skill is pretty cool.*

An app "user" also commented on the programming skills of the youth developers:

> *In terms of having a department and an App Lab where actual literal code is being taught, seeing the terminal windows up and seeing people compiling code is pretty freaking awesome. And people take to it...they're just jumping right into it...It's very fun to see. And I haven't seen a single person involved in it who wasn't pretty excited to be doing it...One of the [students], he's working on writing a player for us. Everyone else has to use plug-ins or go to the widget thing...[but this youth developer] is literally coding us a player from scratch that can do all of the things we want it to do.*

Additionally, the youths learned to use tools, such as App Inventor, to create apps. Participants gave mixed feedback about App Inventor. On one hand, App Inventor allowed newer App Lab participants to build apps with limited knowledge of programming languages through a graphical interface. The young people described App Inventor as easy to learn and intuitive:

> *I picked up on the App Inventor stuff really fast. It wasn't that difficult to learn...I thought it was going to be difficult to work with App Inventor, but it's like putting a puzzle together and knowing where everything should go and how you want it.*

> *It's cool because App Inventor is really intuitive. It's designed that the blocks of coding you are creating fit together only the way that they should fit together. You can't put*

two things together that wouldn't function – so physically on the program, you can't put them together. The pieces that would interact with the piece you are using, looks like it would fit together. You can instantly check if it's going to work, and before you build a big chain of coding, you can see where the problem is.

However, App Lab members with more experience described App Inventor as overly simplistic and preferred to use coding to build apps, noting that coding had greater value and relevance for them in the long-term.

App Inventor is a shortcut if you don't know what you are doing, but if you already know regular coding, then App Inventor is a detour. The reason why we don't enjoy App Inventor is we like to over think. Coding you have to over think, but App Inventor is too simple for us.

Furthermore, the youth developers learned design skills and gained familiarity with design tools such as Photoshop.

Since being in [the App Lab], I've been able to use some Photoshop skills that I already had and get more used to using it, since I'm expected to create apps with it…I could create images to incorporate through the app…We learn[ed] about contrast and alignment and repetition and how to use that with everything to see how people design things.

Persistence

All of the App Lab participants agreed that programming was challenging and at times frustrating, with some enjoying it more than others.

I feel like programming is a cool thing that I've been doing here…it's a good skill, and I enjoy it…[I've worked with] HTML to start. I'm thinking of moving into Python after this project…I wasn't really surprised by the difficulty level [of programming]. It's challenging. I've had to go over stuff again, but it's not overwhelming.

It's definitely been a challenge coding. [My peer App Lab member] said he likes coding, but I don't like coding. It's cool to learn, and it's a good skill to have, but I don't enjoy the process of it…It's really frustrating.

I just like to be able to create something and then run it, and 99% of your time you are pulling your hair out or yelling at your computer, which makes you look kind of insane. But, when it runs and it works, you are really happy.

They discovered that encountering problems and glitches was a typical part of the development process.

Programming is like you're in another world and you learn there are these obstacles that you have to push through them and get better at it…if you want to create something you have to go through this whole process.

As a result, the youths learned persistence, increasing their ability to identify and use strategies to keep working when they encountered problems. They applied this skill not only to their App Lab work but also translated it to other areas of their lives.

[The App Lab has changed the way I think about technology because now I am] more persistent and able to take down tasks better when coming across problems. There [are] problems all the time. [Before] I'd be like…I can't do this. [Now, I feel if] I get to work…I can do it.

I've learned to be more direct…like if there's a problem you have to solve it yourself. You've got to keep going after it. You can't just sit there, and it won't fix itself. Just learn to keep going on anything, not even just programming but just keep going.

[The App Lab supervisor] told me not to give up and to keep striving and to do my best. He said, "How bad do you want to do something?" And, if I really want to do it, then to keep going at it.

Other Soft Skills

The youths also gained a variety of other soft skills from the App Lab. For example, they networked and gained experience working with STEM professionals.

One of the things I love [about being a part of the Action Lab] is getting to meet all of these technology people and getting to know these marketing people and getting to meet all of these programmers and designers and developers and educators and people doing cool stuff like that. I love that…I've been able to meet a lot of people and make contacts with a lot of people. I've meet two or three black women who do project management or engineering and who have reached out to meet to offer to be mentors. For me, now is the time to be making those relationships.

The youths also developed skills in collaboration, patience, focus, and creative thinking. Youth comments included:

I learned to collaborate with other people to come up with an app or a certain idea.

I think I am getting some more professional skills, as well, but mostly just staying focused and having patience because it does take time to create something and get it to the way you want it. It doesn't happen all at once or in a certain amount of time that you expect it to happen.

What I've gotten out of the App Lab is seriousness. I've become more focused.

I would say that we're pretty innovative...it takes a lot of thinking outside of the box.

Additionally, an app "user" commented on the professional development skills that the youths gained:

I feel like [the youths are] learning a lot…It's really cool. It's exactly the kind of trajectory that we want them on…I see a lot of the soft professional development skills for sure. That is very apparent…The soft skills that I've seen was that they were all engaged, taking notes during the meeting, asking questions that were very specific and had me think about what I really wanted so they really were able to help me flush out my vision for the [app] which is like a really advanced professional skill in my opinion…then also, just the turnaround was really quick and the communication of it too…their response in email was really great too…They were eager, and they're excited about it, which is really nice…They've been totally receptive to every single piece of my feedback and working really hard towards that.

STEM Attitudes and Self-Identification

In the following sections, we describe the effects of the program on youths' STEM attitudes and self-identification – specifically on their: (1) interest and confidence in app development, (2) perspectives on their technology interactions, (3) career knowledge/interests/preparations, and (4) comparisons to school and STEM professionals.

Interest and Confidence in App Development

As a result of their hands-on experiences and knowledge gains, the young people became more interested in app development and more confident in their ability to create apps. Without the App Lab, the youths mentioned that they likely would not have explored app development.

I never thought about making apps. I thought it was going to be something that I would never get a chance to get into…I didn't think I would be that engaged.

I think [the App Lab is] really, really interesting. I think it's a good opportunity to learn a lot about something I wouldn't normally know very much about. I think it's pretty important to stay up to date. I think the more tech-savvy you are in this modern age, is very important.

Comments regarding participants' increased interest and confidence in app development include:

I think it's rewarding to be able to look at your project and to be able to say that this is mine and I made it. It feels good.

I have an interest in being able to do things on my own instead of depending on others to do it. And, when it comes to creating HTML or an app, [now I know] that I can do this and can talk to other people about the technical side of it.

Moving forward, participants expressed interest in learning more about app development.

[I want to know more about] the development process and the business side of it.

[I want to know more about] how to build more complex apps on my own.

Perspective on Technology Interactions

The young people's App Lab experiences also resulted in the youths having a perspective shift in how they interacted with technology. Specifically, the youths moved from being a consumer of others' technology tools to being an active and informed creator and user.

I love how much I've learned. I learned so much since I've been [a part of the Action Lab]…I'm just way more critical now. I'm just not the person downloading the app…I'm a player and can be an actor in this world, in the tech world. I can see how you can apply it to all sorts of things. It's made me way more aware of when things go viral of why they're going viral and recognizing that things like Instagram are really popular because they're so simple.

I feel more tech-savvy. You understand when you are on an app and you do anything – like push a button or do a gesture – you understand that took hella long to create, though as a user, you are thinking that it's really simple. But, if you look at the backend and code, you appreciate it a little more that that took a little while for someone else to do.

Everything I know about programming, I've definitely learned here. I definitely feel like I have more control over technology because I can build things, and I can understand a lot more things that I definitely didn't know. There's an entire community for technology and computer programming, and you can even go more specific than that, and I did not realize that that all existed before I came here.

Career Knowledge/Interests/Preparations

Overall, through their experiences with the App Lab, the youths increased their awareness and understanding of technology careers, especially app development careers. The effects of this increased awareness varied for the youths. As a result, some of the young people

were more interested in and planned to incorporate technology into their future careers, in some instances having already taken steps to pursue additional technology experiences outside of Youth Radio.

Before [joining the App Lab], I was going to be a starving journalist, and my plan was to go to undergrad and then go to grad school for journalism at Colombia…even though that's kind of still the plan for me, I'm now looking at colleges with minors in computer science, and I'm looking for a way to combine the two things. It opened up a whole new type of world for me to work in and do things in…I didn't know anything about the subject, and I didn't really care to know anything about the subject until [the App Lab supervisor] wrangled me in [to the App Lab]. It's been a lot of time learning new things, and I feel like I can definitely use them in the workforce and possibly make more money than a starving journalist.

I'm a communication major right now, and it's a very open major that could take you anywhere. But, since I've been involved with the App Lab, I could see myself using my major in the tech field. I just applied for a social media training program in San Francisco, that I probably wouldn't have gone after before the App Lab and being introduced to coding and tech and everything that the App lab provides...[I applied because of what I got from the App Lab which was] all the tech skills and the introduction to the tech world and what it's all about and some of the major players in it and how anybody with a good idea can come and take over.

One youth described that, while she was not interested in incorporating programming in her future career, she wanted to continue doing it as a hobby.

Youth Radio has made me know that coding is not something I want to do…I have a love / hate relationship with coding. Sometimes I really like it when things are going right, but when things are going wrong, I really don't like it. Programming would probably not be my choice for a career. It'd probably be something that I'd do for fun on the side, like making apps or something like that.

Others were still unsure of their career goals but felt their App Lab experiences were beneficial and helped to prepare them for the future. They described the App Lab as having provided them new experiences that they would not have otherwise had and having opened doors for their future through such means as increasing their skills and confidence.

I want to learn something new. It's always good to learn new things and have new talents. [Being a part of the App Lab,] you are given this experience, and why not take it. I'm still in the process of figuring out what I want to do and where my career is. Apps are really difficult, and there are a lot of things you have to remember, but it does open

doors. I'm not sure of long term. Anywhere you go, it's not really hands-on like [it is at Youth Radio] or people don't have the patience to take you step-by-step like here.

I think it helped me realized that there were a lot of jobs out there that were affiliated with app development and/or HTML, and it just gave me some opportunities to have more confidence in finding something that I'm actually interested in as far as a career…Confidence as to just feeling like I have some experience and am able to apply for jobs in general, because I used to think that I wasn't able to apply for much because my skills were so limited. But, now I feel that I have a bit more skills.

I look at [coding] as a good thing to know because it can help me when I want to create my own personal projects – things outside of the [App Lab] department that I want to do. So I think it's good that I'm learning how to do coding.

Comparisons to School and STEM Professionals

The young people compared their experiences with the App Lab to their school experiences, as well as to their perceptions of professional developers' work experiences. The youths described their App Lab experiences as being different from their school experiences. As opposed to school, their involvement with the App Lab was not required. The youths chose to participate in the App Lab because the work was hands-on, engaging, and informative.

I like [the App Lab]. It's a cool experience…It's definitely really informative in a different way then a classroom in school would be. It's interactive and fun…You don't have homework, but I have done things before at home because I wanted to finish something, and not because I had to. I'm not [in the App Lab] because I have to be here, so there is something keeping me here. It's not that you sit around and get lectured all day. We almost learn by doing, as we go along, which is a good way to keep it in your memory, so the next time you have to do it, you're pretty much already there.

The youth developers saw the work they did in the App Lab as both similar and different to what professional app developers do in their jobs. The youths felt that they utilized similar skills and a development process as professionals, but did so on a smaller scale. Additionally, the App Lab participants benefited from working collaboratively in a supportive team environment with their peers, as opposed to facing pressures (e.g., competition, budget, and time) that professionals do.

I would say [the work that we are doing at Youth Radio with the Action Lab] is similar and different from what [professional app developers do]. I would say that it's similar because we're learning similar languages. We're learning and researching the similar things…and developing…But, it's different because we have a team. I think we have

someone who understands your frustration…We're working on separate projects, but we're still problem solving. We're supporting each other, and when it doesn't work, we can run through our problems with [our staff leader]. I think that if we were in a different environment it wouldn't be like that…I think it would be just way more competitive…I don't have to really worry about [money or the budget side of app development] right now because I'm learning and it allows you to learn without having that pressure…It does seem like a lot because we're learning every aspect of [app development], whereas typically you'd have a career in one of these aspects, maybe two. One person was a programmer, one was a UI designer, and one was a graphic designer.

In my opinion, it's the same to an extent. [The App Lab supervisor] says this all the time, that with coding you'll be sitting at a computer for 23+ hours wondering why this little piece of code isn't working. It's similar, but at the same time, we don't have to work as much as [professional coders]. Right now, this is child's play. But, at some point we could end up working 23+ hours on the same code or design or trying to get a color…We're just mainly learning how to code or creating things for [Youth Radio]. We're focusing in on certain projects or ideas…we're coding, but we're not focusing on such huge areas. [Mozilla] has so many people. What we're doing right now is micro, and they are on a whole bigger scale. It's the same to an extent, but we don't have as much pressure. We're focusing on certain code languages right now, so we can hone our skills. These coders nowadays work on eight or nine languages.

I would have to say that entrepreneurs do have to struggle a lot more than we are right now because as the young person learning the language we have an infrastructure that facilitates that and that's important.

Special Cases

Below, we detail several special cases of how the App Lab influenced the youths who participated. The impacts of the App Lab program were somewhat varied depending on the members. Specifically, those who were in the program for longest and/or who were particularly motivated experienced the greatest impacts. One youth described how the App Lab participants' level of investment and drive helped determine what the they gained from the App Lab:

The App Lab in a way is what you make of it. You can kind of coast participating in the group project, and you don't really have to do anything of your own. You do learn some things, but you can learn as much as you want to in the App Lab. So, I feel like it's how you take advantage of the situation mostly.

For example, two female App Lab members participated in a mentorship with two professional female programmers at Ask.com. The App Lab supervisor described this mentorship and how it developed.

Getting two of our students to work with mentors from Ask.com for the summer, that's a direction that the App Lab hadn't taken yet, and it was definitely a test case for us, but it was definitely a test case that we're going to refine and try to figure out as we move on. And I think if we can do it properly, it could be a blueprint for how the rest of the organization deals with that….A friend of mine at Ask.com came and said, hey, we really want to work with community organizations now…is there anything that you can think of that we can do. And I said, well, yes, two of my more advanced students might be interested in having a couple of mentors, if you happen to have two female mentors that they could pair them up with…And from an optics perspective, it worked out for Ask.com because they care about community engagement now but…they have a lot of women high up in their engineering department. So…it matched up perfectly as something that they would at least experiment with…And so right now what we're seeing is that the App Lab is becoming kind of this test bed for new ways to interact not just within the organization but outside of the organization as well.

The two App Lab members who participated in this in-depth, added element of the App Lab described their Ask.com mentorship experiences and how beneficial they were:

Ask.com is something that [our App Lab supervisor] brought up over the summer…He wanted us to be really into programming, so there could be more female programmers out in public. So, he asked us if we wanted to do a mentorship with them. So, we meet every other week on Thursdays from 3:30-4:30pm. Basically what we do, is if we have any questions about the Better Safe app that we are [developing] right now, we can ask them, or about other things in the app field…There are two female programmers and there are only two of us youth developers, so it's more one-on-one. They spend time all of their time and attention on you for that hour and that helps you a lot in moving forward in the app. In Youth Radio, [our App Lab supervisor] has other stuff to do and it's a bigger group, so there's less time. And, you can't ask as many questions as you want to because you have other stuff to do.

At Ask.com, it was my first experience working one-on-one with any professional…and it's really worth it. They have the experience that you don't have, and they have knowledge that can help push you forward and a lot of questions that you have, they can answer…you know that you have someone that you can rely on if you have questions you want to ask.

Furthermore, for the more veteran of the two Ask.com mentorship youths, the App Lab supervisors specified how she had transformed over the course of the App Lab, coming "out of her shell" and gaining confidence and leadership qualities.

We've definitely seen changes in [the App Lab youths'] confidence. I remember when we first started working with one of our students, she was very quiet, very reserved…over the course of six months, or the last year that we've been working with

her, she's really come out of her shell. She's not afraid to say what she means anymore. She's very, very, willing to stand up for herself and why she makes certain decisions…It's been great to see actually.

So every student has their own little anecdote…She's kind of become a leader in the [App Lab] department as well, just because, one, she's been with us for a while. I think she's one of our most [senior participants] right now…and her design is just on point, and so some of the other students can see, oh man, well if we get [her] to design it then I'll program it. And you can see themselves learning to work together, to form little teams, and just that collaboration is really nice.

This youth echoed this feedback, describing how she had become more outspoken and comfortable with public speaking as a result of Youth Radio.

[Youth Radio] helped me speak in public. Before I came to Youth Radio, I was a really shy person, and I had a lot of trouble talking in front of people, especially groups…I've started public speaking [at Youth Radio], and I've gotten better at it…it started with the soft launch of the Forage City [app], and we had to speak at the Code for Oakland event.

The App Lab had also greatly influenced another veteran member who had participated in the App Lab since the time of its inception. As a result of his App Lab experiences, he matured and gained leadership qualities. An App Lab supervisor and the youth himself described his transformation:

[As an App Lab supervisor,] I've just watched him mature and grow up over these last [few] years, which when I think about it it's like that's not that long…And just last session, he really stood up and took a leadership role. We were giving him a lot of like it is time for you to be a leader, you're the oldest person, you're the most senior person in the App Lab…And he did it well. He led, he's on App Inventor workshop by himself. He designed…he used HTML and then learned to do a couple of scripts on a widget…he got his scholarship money…he's like I've got to get a MacBook Air so I can program…And he started taking up Python on his own. He's like I want to go to the next step…And to just see him transform from when he was 14 and very silly, and he's a class clown, and not all that serious, to see him now he's a young man. He's 18. He's in college now. –App Lab Supervisor

The most valuable or beneficial experience [that I had at Youth Radio was] anytime that I was put in a leadership role. For instance, I hosted a [Brains & Beakers event and taught an App Inventor Workshop]…[being placed in that] leadership role basically [forced me] to mature. I had to step my game up….Maturity…You want to present yourself as someone who is professional, mature, and humble. When you are younger, you are loud and don't care, but at some point, you have to calm down and become

leveled. I basically used the App Lab to become leveled. At some point, I changed…It was a result of Youth Radio period. The fact that Youth Radio has changed, and it's maturing, and I didn't want to be left behind…I'm kinder because of Youth Radio. I think more about different things...I've become more open-minded on a lot of different things and take in more ideas. Even as far as fashion, I've changed up my look. I don't look thuggish, and I'm more presentable and wear more bright colors. Youth Radio has kind of changed my whole appearance. I've seen so many people have come through Youth Radio, who are older than me, so I try to keep up because I want to be up there with them. –App Lab Youth

While some Interns refined their technology skills through the Mobile Action Lab, others tried their hand at science journalism by participating in Youth Radio Investigates. In this next section, we triangulate interviews and media products to document how the reporters created their stories and what they learned about their ability to communicate STEM ideas.

Youth Radio Investigates

Evaluation Methodology

Interviews of Youth Reporters

Over the course of the program, Youth Radio staff and Rockman evaluators conducted 18 interviews with 13 different youth reporters and one staff producer focusing on 18 of their YRI science journalism stories – see Table 9. Of these youth reporters, nine each worked on a single story, three reporters each worked on two stories, and one reporter worked on three stories. For the What's in a Leaf story, two youth reporters collaborated to co-produce it.

Table 9: Overview YRI Interviews (*N* = 18)

Program Year	Story Name	Brief Story Description	Session
1	My Brain on Ads	Examined what's going on in people's brains when they watch TV commercials, by consulting various neuroscientists and having the youth reporter under electroencephalography.	Spring 2011
	Getting Water in School	Looked into why California public schools have difficulty providing fresh tap water to their students through interviews with high school principals, students, and health experts.	Summer 2011
	Lead Tests	Looked at various environmental sources of lead and the science that is used to find trace amounts of poisonous metal.	Summer 2011
	What's in a Leaf*	Aimed to calculate what levels of atmospheric carbon dioxide were like during the Miocene epoch using 15 million-year-old leaves preserved in clay.	Summer 2011
	Trafficked	Shed light on the people, policies, and business practices at work in Oakland's thriving child sex industry.	Summer 2011
Yr 1 Total:	**5 stories with interview data**		
2	The Psychology of What Makes Teens Thankful	Examined the research finding that teenagers are ungrateful through surveying teens and interviewing scientists and teens.	Winter 2012
	Students Grossed Out by School Water Fountains	Examined the water quality of a California public school by doing multiple microbial and lead tests.	Winter 2012
	Signs of Stress in a Teenage Body**	Looked at the latest PTSD research from a personal angle, including visiting a Stanford lab to watch a fMRI study tracking the effects of trauma on the brain.	Summer 2012
	The Role of Jealousy in Teen Dating	Used a jealousy questionnaire to gather self-report data from teenagers in Oakland about where they fell on a 100-point jealousy scale compared to the norm, as well as interviewed a variety of scientists such as a polyamory therapist and evolutionary psychologist.	Summer 2012
	Violence, and Anti-Violence, in Youth Sports	Looked into the association between participating in sports activities and violent behavior, through interviews and examining statistics and data from previous studies.	Summer 2012
Yr 2 Total:	**5 stories with interview data**		

Program Year	Story Name	Brief Story Description	Session
3	The Science of Hypnosis	Examined what hypnosis is and how it is used, through reviews of scholarly articles and interviews with scientists and a psychology student who uses self-hypnosis.	Winter 2013
	Do Parents Really Know What Their Kids Are Eating	Investigated if youths' actual eating habits lined up with the results of a poll as well as their parents' perspectives on what they eat, and included collecting data from teens, their parents, and food diary.	Winter 2013
	Snapchat App Destroys Photos Seconds After Sending	In order to examine how young people are really use a photo sharing app called Snapchat, developed and administered a survey for high school students and compared the results with preexisting data from a Survata online poll.	Spring 2013
	Double Charged***	Investigated the fines and fees beyond being court-involved and how this math interacts with young people's experiences in the criminal justice system by interviewing a variety of sources (such as lawyers, a DA, a financial hearing officers, an collection agency, a national evaluator), and collecting and analyzing data about these fines and fees.	Summer 2013
	Finding and Controlling Teen Shopaholism	Examined teen shopaholism through an interview with a psychiatrist who specializes in the topic and a personal look at the diagnosis.	Summer 2013
	A Deeper Look at Teen Narcissism	Examined the validity of a survey assessing narcissism (the Narcissism Personality Inventory) for young people growing up in today's world through interviews with psychologists.	Summer 2013
	Teaching Puberty Ed Early	Investigated early puberty and its possible causes and effects through interviews with a variety of experts in the field, teachers, and children.	Summer 2013
	The Ugly Side of Lipstick	Looked at possible harmful substances found in lipsticks and lip glosses and their effects through work with scientists in the field (e.g., a toxicologist), as well as surveying product usage.	Summer 2013
Yr 3 Total:	**8 stories with interview data**		
Grand Total:	**18 stories with interview data**		

*This story had two youth reporters.
**A staff producer was interviewed, in lieu of the youth reporter, due to the sensitive nature of the content of this story.
***This story was in production at the time of the interview.

The interviews gleaned behind-the-scenes information about how YRI stories came to be – for example, how the reporters and producers selected the initial topics and chose the direction of the final piece, or the kinds of sources reporters consulted and the discoveries

they made along the way. Through their reporting, young people engaged in many of the Next Generation Science Standards' (NGSS Lead States, 2013) practices of science (Table 10). We used these practices as a framework to describe the opportunities that the youths had to engage with and learn STEM content and processes. We also document the youth reporters' reflections about the shifts in their attitudes toward STEM.

Table 10: Next Generation Science Standards' Science Practices

1. Asking Questions
2. Developing and Using Models
3. Planning and Carrying Out Investigations
4. Analyzing and Interpreting Data
5. Using Mathematics and Computational Thinking
6. Constructing Explanations
7. Engaging in Argument from Evidence
8. Obtaining, Evaluating, and Communicating Information

Program Implementation

Key findings regarding program implementation include:

- YRI stories covered a variety of topics, and the story question-asking process was a give-and-take between the youth reporters and Youth Radio's staff producers. The youth reporters' personal experiences typically drove their initial questions, which were then later refined.

- With the help of producers, youth reporters identified credible sources, reviewed and evaluated those sources, and translated their findings to frame their investigations and reporting.

- The young people collected primary and secondary data and/or consulted with scientists and other experts for help interpreting findings. Sometimes, the youths encountered analysis and interpretation challenges, such as difficulty getting clear and digestible responses from experts.

- The youth reporters applied mathematics and computational reasoning when organizing, analyzing/synthesizing, and extrapolating on the various forms of quantitative data collected for their stories.

- In order to report their stories in a compelling and cohesive fashion, young people often needed to find a good angle for their narrative and translate technical language into something more audience-friendly. Compared to their previous journalism experiences at Youth Radio, the YRI process required considerable time and effort.

Interviews reveal the nature of reporters' experiences asking questions, carrying out investigations, and analyzing data to construct evidence-based stories. It is important to note that while the practices are presented as a step-by-step narrative, the process was far from linear. Reporters often found themselves asking new questions in light of the results of their investigations, or doing additional follow-up research to support claims in their stories. With that in mind, there were some common themes in the ways in which reporters engaged in science practices, many of which highlight the partnership between reporters and producers that was necessary to bring a story to fruition.

Asking Questions

YRI stories covered a variety of topics, with most being related to health and the environment. The staff producers typically suggested the stories based on something they had read or seen, and then found a youth reporter to cover the topic. The reporters came up with their own questions and angles, often seeking answers about something they had personally experienced. In fact, they sometimes titled their article with the primary question they had investigated.

- I love to shop, but do I have a shopping problem?

- Is there lead in my phone case?

- What's in a leaf?

The question-asking process was a give-and-take between the young reporters and Youth Radio's staff producers. This excerpt from a producer interview demonstrates how one reporter took a producer's pitch and made it her own ("Signs of Stress in a Teenage Body" story):

In the very beginning, when I was first hired at YR, there were a couple of articles - [that other Youth Radio staff] had pulled - originally [the story topic] was on early childhood adverse experiences and their impact on health. So, a little bit of a different topic. My background is on public health, so I thought they were interesting. So, I suggested that we talk to the Interns and see if anybody would be interested in covering this topic. There were four or five Interns, and [the reporter] was probably the second person I talked to, and she said that she was really interested in this topic. So, I gave a New Yorker article to read. She came back after a few days, and she felt like the article told her a lot about her life and things she had experienced. What the article was hinting to was that the physical symptoms that one of the characters had in the article was related to traumatic events earlier in life. That was the early premise for the story was looking at ACEs (adverse childhood experiences) and quantifying those and that sort of thing.

But, it became clear from the beginning that because this was going to be a sensitive story and when you have a reporter talking in first person, we wanted to tread very carefully about how much of the reporter gets put in the story. Because even though you say you want to do it, it can be jeopardizing because your name is out there linked to something. It started this long process about what is the story and what is [the reporter's] question for the story. When it came down to it, she was really interested in the effect on the brain - like what is going on in the brain that could be causing all these different health effects that are linked to what she and other people have been through. She had shared with us that she had a PTSD diagnosis and that she was really interested in the brain...

In terms of where the line is between producer-led and reported-led stuff, when she said, "This is my question." In terms of the central question of the story, she was interested in what PTSD was doing to her brain and how it was actually physical changing her body.

Sometimes reporters asked follow-up questions related to their initial empirical investigation. They typically consulted scientists or practitioners (e.g., doctors, therapists) with relevant expertise in the area. For instance, the reporter on the "Lead Tests" story initially wanted to know whether her bright yellow cell phone holder posed a threat to her health. After learning the case was lead-free, she became interested in knowing more:

[A research director] came in and she had other people from the Center for Environmental Health. They came in and told us what things they had found that had lead in them. And then we were asked to research and come up with questions. I basically wanted to know what lead was, so I went on Wikipedia and typed in "lead." I got an overview: What is lead? And where does it come from? And what effects does it have?

Her producer made a similar observation about the reporter's burgeoning interest:

Plus, she became very interested in lead contamination, which allowed us to report about the topic from an interesting perspective – that of a teenager just learning for the first time about lead poisoning and then going deeper by teaming up with scientists.

Similarly, another reporter progressed from wondering about a personal experience – in this case, the ability to resist the subliminal influences of advertising – to wanting to delve into the science behind it:

I've always been interested to see if I can really resist ads, but I also was interested in the science part of it – in neuroscience and to see how that works basically.

As the youths refined their questions, they consulted articles and experts to gather background information. This relates to the next practice presented.

Obtaining and Evaluating Information

The Next Generation Science Standards state that "Being a critical consumer of information about science and engineering requires the ability to read or view reports of scientific or technological advances or applications (whether found in the press, the Internet, or in a town meeting) and to recognize the salient ideas…" (NGSS Lead States, 2013, p. 64).

Reporters did just that by reviewing multiple sources, including academic journal articles, in order to find people to interview and then prepare for those interviews. Examples include:

> *Students Grossed Out By School Water Fountains. We talked to different researchers in various fields; we had Dr. Patel who has done interventions at schools in L.A. where they had found lead in the water. Then we had Darlene Franklin of SF State who had done microbial testing in public areas, like BART seats. So we consulted with her before testing the water. We researched different schools throughout the U.S. who had tested the lead in their water. We also did a lot of research on the actual legislation that was being put through, national and statewide stuff that had been or was being implemented as we were reporting.*

> *The Psychology of What Makes Teens Thankful. I took the survey that we used in the story. Then I read about the professor, Robert Emmons, who came up with the survey, and I watched some of his video lectures where he's talking about how being grateful can change your life. I also read articles by a few other psychologists studying gratitude.*

> *The Role of Jealousy in Teen Dating. I interviewed people. I did extensive Internet research – I read polyamory sites, blogs. Academic research on it was few and far between – the Kinsey Institute does research on it, and there were several polyamory researchers at universities. I also interviewed David Buss and read much of his book. He doesn't do research directly on polyamorous couples, although he is familiar with the topic.*

In at least a few cases, producers and reporters teamed up to identify credible sources and make sense of the information they had gathered. The producers had the knowledge and experience to be able to find the right kinds of sources, but the reporters were responsible for translating that work into a set of questions to frame their investigations. In this quotation, the producer of the PTSD story described how she helped the reporter find information on how PTSD affects the brain:

Because I come from public health and health journalism, I was able to direct her to the search engine where we could look. Let's look at this together. I sent her a bunch of articles, and some of them were way too technical, but those essentially led to us contacting some of the researchers who become key in the story or background of the story.

Reporters' background research informed their collection of empirical data, as we explain next.

Planning and Carrying out Investigations; Analyzing and Interpreting Data

The NGSS notes that "Students should design investigations that generate data to provide evidence to support claims they make about phenomena." (NGSS Lead States, 2013, p. 54). This includes selecting appropriate tools to collect data. Reporters demonstrated this standard by using a variety of methods to answer their questions, and interacting with scientists in a number of ways. In all cases, reporters collected primary or secondary data, and/or consulted with scientists and other experts to help them make sense of what they had found.

In seven stories, youths worked directly with a scientist to collect data (from themselves or others) or witness an experiment. For example, in "Students Grossed Out by School Water Fountains," the reporter collected water samples from his school and took them to a lab to test for microbes and lead. In another story, a reporter spoke with an undergraduate who had self-hypnosis through her involvement in a Stanford research lab. The reporter then tried the technique on herself:

Yeah, I tried self-hypnosis. I Googled self-hypnosis on YouTube and a lot of videos popped up. I clicked one. I tried doing it myself, but it didn't really work. But, it was fun to try. The videos weren't as informative. It was fun to listen to them and watch them.

In four other stories, reporters collected their own survey data and contacted experts in the field to help them make sense of their findings. For example, "A Deeper Look at Teen Narcissism" began with Newsroom Interns taking the Narcissism Personality Inventory to test the claim that young people are more narcissistic than their generational predecessors. One reporter contacted a psychology professor for guidance interpreting her results:

The process started with me taking all these tests and seeing my scores and then researching the tests to see how they all oppose each other. Adolescent and Vulnerability is how teenagers think that they are invincible, and I scored really low on that but it's probably because, as I talked about it with the guy who had made these tests, I had gotten into a car accident. And, when you go through these traumatic life experiences, you change and you feel more vulnerable to things that happen around

you, then teenagers who feel invincible. The Personal Uniqueness scale, which I scored kind of high on - I scored in the average range of teenagers - it's how you feel about how unique you are compared to the rest of the world and do people understand you…So, those two tests were kind of in opposition. He said that these tests really measure your narcissism, and he doesn't necessarily agree with Dr. Twenge's claim that our generation is more narcissistic than other generations. He was the opposing expert, and I'm coming in as not an expert at all and just my opinions. Dr. Twenge is the other side of it.

In other stories, reporters reviewed secondary data (e.g., public records) and consulted with scientists and other experts. These stories addressed broader, sociological issues that did not lend themselves to direct data collection. For instance, one component of the "Trafficked" piece involved researching the number of victims of child sex trafficking. In the "Double Charged" story, reporters combined reviews of court bills and fee documents with interviews of lawyers and financial hearing officers to assess the costs billed to parents with a child in the Alameda County, California juvenile justice system.

Analysis and Interpretation Challenges

When reporters relied on STEM professionals for assistance interpreting their data, they sometimes had difficulty getting straight answers. While they appreciated the depth of the experts' knowledge, they had to press for explanations that they could understand and that they could communicate to a lay audience. The reporter on the narcissism story described her encounter with this exact scenario.

The only thing about talking to scientists though is that they talk in the vocabulary of their job. They use a whole bunch of technical terms. It's your job as a journalist to translate the scientific and technical terms into real life talking. That part is difficult. But, they are usually very friendly. I kept asking the psychology professor the same question – what's the difference between a narcissistic person and narcissism? At first, he'll explain it in very technical terms. But, then I asked him to explain it to me the way that he would explain it to a five year old. He'll keep breaking it down for me, and I appreciate that a lot because I'm no psychology major, and it makes it a lot easier to put into the story.

Also, a lot of the times, besides all of the psychology and science, the researchers have these worldly views and they come with these simple answers after they get comfortable and they don't have to put their degree on audio, pretty much, by saying that this is this and this. At the end of the interview, he said, if you think that your generation is narcissistic, you should meet some of my staff at my college. It's stuff like that this is really easy to relate to that you can put in audio.

Reporters and producers also found contradictions, irregularities or gaps in their data which required further investigation. The next practice explores the reporters' experiences with data science.

Using Mathematics and Computational Thinking

In all of their stories, reporters worked with data in various forms. They got to experience the complexity and messiness of quantitative data; learning to organize, analyze, and extrapolate while determining the types of claims they could make with the information they had at hand. This work required the application of mathematics and computational reasoning, another of the NGSS practices.

Two of the most data-heavy stories were extensive investigations conducted through Youth Radio's Juvenile Justice department, "Trafficked," and "Double Charged" (aka. The Mathematics of Restitution, which was in production during DO IT!). While they had originally not been conceived as pieces for Youth Radio Investigates, it became apparent that they required applied mathematics and other scientific inquiry processes. The producer of "Trafficked" explained:

This reporting was not originally conceived as part of our STEM-focused Youth Radio Investigates series, which is why it didn't follow our usual YRI strategy of partnering a youth reporter with a scientist or expert investigator. Yet as we finished producing the stories, we realized that we had relied heavily on statistics and demographics, consulted several social science experts and reviewed a number of scientific papers – STEM-based information gathering that was crucial to our final stories.

As noted earlier, the "Trafficked" team wanted to include data about the number of victims of child sex trafficking. As the lead reporter noted, this information was very difficult to track down.

We looked at the way the numbers in this story can be used to show how police shifted their strategy when it came to dealing with youth trafficking. I learned about population size and the best way to calculate those numbers – that while the best way to calculate a population size is to line them up and count them, in reality, and in this particular story you have to find ways to estimate. Since [Commercial Sexual Exploitation of Children] victims are really hard to count. And there are different ways to calculate that data. It's really difficult, but it can be done scientifically.

The story's producer took the lead on this aspect of the story, reviewing papers, conducting interviews, and sharing what he had done and learned with the reporter.

As a producer for Trafficked, I conducted the majority of this STEM research, including interviewing Janis Wolak, senior researcher for the University of New Hampshire's

National Juvenile Prostitution Study, and analyzing the Oakland Police Department's statistics on anti-trafficking. After the story was produced and we decided it should be included as part of Youth Radio Investigates, I reviewed my statistic-based reporting process with our youth reporter. We focused on two elements: how to report the size of a hard-to-reach population and how to analyze police statistics to learn something about changes in policy and effectiveness. In the end, I think the reporting for this story, both during and post production, has made us a more STEM-literate newsroom, particularly with respect to statistical analysis.

In a later investigation, "Double Charged," reporters documented the fines and fees levied on juveniles in Alameda County's justice system. While the story was in progress, one of the reporters described the diligence required to gather and compile the kinds of data necessary to generate defendable conclusions.

It's going really well. It's a lot. It's a really good story because there are a lot of layers to it, but it also means that we have to be extra diligent about how we organize our numbers. [A Youth Radio staff person] was talking to me about what would be called in a math class - showing your math. So, figuring out how you got to a certain number. So, we've been doing a lot of that – making sure we show, not only for other people, but for ourselves what that process is. So, we can figure out where we are getting these numbers and what they mean…

At this point, we're doing a lot of organizing of the numbers to figure out what they mean and where they are coming from. And, then I think, after we've gotten everything we need, we'll start to analyze them and figure out what they mean and where they are going and looking at it in the national and local context of California and Alameda county as well.

This same reporter had also worked on the story about school water fountains. When asked about the differences between the two pieces, he mentioned the ambiguities of the juvenile justice data.

For instance, when we tested the water for the school. We had these definitive numbers behind it saying that there's this much bacteria and this much lead. With [the Double Charged] story, it's less of that because it's very individual. It comes down to the offenders and the crimes and their specific cases, so there is no real hard and fast numbers…but that makes it more interesting because we're looking at a range of data as opposed to definitive data.

Eventually, the "Double Charged" team synthesized all of their fines and fees data and visualized it in several ways. The reporters, producers, and Mobile Action Lab members put together an infographic and an interactive app, both of which detailed the typical costs of court involvement.

Reporters reasoned about data in shorter investigations as well as long ones. The author of the narcissism story explains how she had to calculate and interpret her personality test scores before discussing them with others.

> *I had to learn how to read the scores. It's a very complicated way of reading scores for the [Narcissism Personality Inventory], as well as these other two tests. You have to learn statistical derivates. Luckily I'm taking AP stats now, so it wasn't as hard as it would have been a few months ago. So, you have to calculate your score, and each test has three different scores that go to it. I wish I had it in front of me. The NPI score - when you do it online, it comes with graphs and compares how you are with the rest of the population – and which you score higher on.*

Finally, in these quotations from "The Psychology of What Makes Teens Thankful" and "The Role of Jealously in Teen Dating" stories, the reporters acknowledge the limitations of the small, convenience samples they surveyed.

> *I wanted to know how these teens would do on the GQ6 [Gratitude Questionnaire - 6]. I started handing it out to people I know from work and from my church youth group. Obviously, it's not a random sample. And it's not a big enough group to be considered scientific.*

> *I'm no scientist, but I did an informal survey and handed out a standard self-reported jealousy questionnaire to 21 fellow teenagers in Oakland, Calif. Obviously, I'm not about to submit my findings to an academic journal – my sample was small and non-random, so it may not have been representative of teens in general.*

The sum total of reporters' investigative work came in their final media products. In the next section, we revisit the practice of obtaining, evaluating, and communicating information, focusing on the challenges youths encountered when preparing a quality story.

Communicating Information

One of the first things novice YRI reporters had to learn was that writing a science story was very different than other kinds of writing they had done at Youth Radio. Young people quickly realized that they could not just express an opinion about their chosen topic; they had to put the evidence front and center. Consider the following reporter's reflections:

> *It's interesting because it's been a challenge for me. Looking back at the very beginning, the first thing on my mind was, "How do you write a science story? Do I have to go look in the encyclopedia? What do I do?" I had no idea how to go about starting it. I like that challenge.*

I remember that the first type of journalism that I did was writing commentaries, which is basically just writing your opinion. You needed no evidence or facts. It was just how you felt. Then, you go into Features where you put in your world evidence, things that are happening, to back up most of your opinions. But science, you need cold, hard facts, and you need a lot of them, and you have to back that up. Your opinion matters to a certain extent but not nearly as much as all of the evidence that you have to back up your opinion because there are so many differing opinions about things, especially in science and psychology.

Even though the facts had to drive the stories, the information still had to be organized into a compelling and cohesive narrative. Reporters acknowledged that one of the most challenging aspects of writing their stories was finding a good angle. The following quotations are typical.

The Science of Hypnosis. The challenging part was putting it all together because it was a lot of information and a lot of it required explanation. It was trying to put together the story in a way that made sense and where it all followed one organized line.

Teaching Puberty Ed Early. The most challenging thing was definitely figuring out what to keep and what not to keep and placing it right. We did a lot of interviews and everybody had a lot to say, but you can't keep everything or use everybody. So, finding the most important things that people said and then incorporating that and making it flow, was definitely the hardest part of it.

The Role of Jealously in Teen Dating. Picking a direction really. It's why the story took as long as it did. It evolved into many different things, the goal was often vague and we weren't really sure what we were trying to accomplish. I ended up learning a lot more about the topic because of it. But it was difficult to frame all the knowledge I learned into the piece. I ended up being a lot more familiar with the topic than I would have been if I worked on it for just a couple of weeks. At one point it was going to be a radio story with a different angle, then it shifted. We brought in the whole jealousy component. It ended up being really fascinating.

Finally, reporters sometimes had difficulty translating the technical language of the scientists into something more audience-friendly. They relied on their producers and information from the Internet to help them explain complex ideas in simple terms.

It was hard to get what I wanted and something interesting out of the interview because she is a scientist and is super smart. But the way that she talked, it was so dry, and it was hard. Her responses were pretty short and to the point and used a lot of technical terms that I didn't understand, so finding a way to make it make sense not only to me but to the people that would hear it was a challenge.

If you can catch key words in the audio that didn't make sense to you but you know that you need to know what they mean, the thing that I usually do is go look it up in a dictionary – and then I'll go look it up on a newspaper or magazine. There are these studies – then I look up those studies and go on the New York Times and look up things about it. If another journalist has already talked about it, I can usually understand it and speak their English. That's pretty much what I've done. A lot of stuff, the dictionary explains it perfectly fine, and I almost just laugh because I think, "Why couldn't he have just said it this way?"

All told the post-story interviews suggest that, true to Youth Radio Investigate's intent, youth reporters engaged in authentic science inquiry to create original media works. The next section describes what the youths felt that they gained from their YRI participation.

Outcomes

Key findings regarding outcomes include:

- The youth reporters gained in-depth awareness of selected physical, biological, and social science content and deepened their understanding of scientific methods and habits of mind.

- As a result of their YRI experiences, the youths developed more positive attitudes about and resonated more with science. They discovered that science journalism was different from school science but similar to other types journalism, driven by questions and supported by evidence.

- The youth reporters increased their confidence for communicating science to the community and learned persistence through working on extensive investigations.

Our interviews revealed demonstrable qualitative gains in YRI participants' STEM knowledge, skills, and attitudes. In the process of learning about STEM content and processes, youths came to see that science was more interesting and accessible that they had originally believed. Contrary to what they may have learned in school, through YRI, reporters realized that science was a way of thinking, not just a collection of facts, and that the scientific process was not that far removed from what they were already doing at Youth Radio.

Content and Process

First and foremost, young people gained in-depth awareness of selected physical, biological, and social science content and deepened their understanding of scientific methods and habits of mind. Selected examples include:

I learned about how the brain works when we are consuming media and different things like that. We have parts of the brain – they are called the cognitive parts – they have a self control region and all this different stuff. These are the things that are going off when we see an advertisement or are just watching TV.

I never even thought of hypnosis as being a normal function of the human body. That part was really new to me, but it made a lot of sense to me.

I learned that testing for lead is actually a really simple process, it just costs a lot to get the materials and equipment. They put whatever they think has lead in the machine and then in 30 seconds, it not only tells you if there's lead in it, but it tells you whether other elements are in it.

I learned about trial and error all year. From the beginning [of the investigation] there were a lot of errors. But every time you change something, it will help you to come up with something else. Every try, you better yourself, you come up with something, and it helps you on.

One reporter learned first-hand about a dilemma faced by many evaluators or social scientists – measuring a psychological concept with limited time or resources. In his case, the reporter administered a survey about dating-related jealousy as part of his piece on polyamory. Since the survey had been normed on Midwestern college students, he was not sure it was quite appropriate for his purposes, but recognized that he did not have the time to make it better.

It was interesting to see how [scientific research] works. We were working with psychology, which is often called a soft science. And as a journalist or someone reporting on it, I wasn't able to get as true a thing as I would have liked if I was a scientist. Sometimes we had to do the best we could to say something – like with our survey with {name}, we had to do the best we could to give our best interpretation of it. However we had no way of proving it or testing it for sure or confirming all these things…I feel like we did a good job starting a survey for the piece, but I don't feel like it was perfect. I feel like to get it perfect we would have had to test it for ages – it would have been difficult to get it to a place I would have been happy with.

Attitude and Identity: I'm Not a Science Person, But…

Reflecting on their stories, many youths sought to reconcile their previous perceptions of science with their recent YRI experiences. The following quotations demonstrate how youths who had not resonated with science before began to see the field differently.

This is the first real scientific piece I've done. And I'm definitely not a "science person," but this sparked my interest. Like, it really got me, because it touches down so close to home.

That [information about neuroscience] was really interesting because I don't really know that much – I'm not a sciencey person, but being able to understand it was pretty cool.

I did feel in high school…I didn't excel grade-wise in math or science in school, and I never considered them to be my strong points. I've realized that it's not necessarily about remembering every little detail about science – that doesn't make you a scientific person. It's really about the process that you go through, and how you go about finding information and answering questions for yourself and other people.

One reporter discovered that not only was science journalism different than school science, but that writing a compelling story required thinking beyond the classroom.

I would like to continue doing [science journalism] in the future. Science journalism is so much cooler than science for me. At school, I'm not big into science, so when I first heard the term "science journalism", I didn't get super excited because science isn't my thing. But, with the work that I've done on both of these stories, I've learned that you don't necessarily have to know a lot about science to actually make a science story. I think it's cool because I learned something in the process, and it's not a miserable process.

[Advice for someone else interested in science journalism?] Don't start thinking about it first as a science story because it's not like something that you find in a science textbook – have a conversation with somebody about things that you find interesting, and I guarantee you that one of those things can have a science angle that you could go further into.

Furthermore, some of the reporters also made connections between their YRI work and the activities of science and media professionals. They concluded that science and journalism are both ways of knowing, driven by questions and supported by evidence.

If anything, I've learned that the scientific process is exactly if not very similar to the process of a journalist. I almost feel like a type of scientist in a way, which is really interesting to me. You go into this with a hypothesis, and you experimented. You take these tests, and I got people around me to take this test. And, then after the experiment, you turn it into data – you read these graphs, and you look up what the graphs mean and how they and the tests were developed. And, then you make your own observations and draw your own conclusions. And then, you talk to research experts about it, such as the people who developed the tests, who have majored in

this and studied it their whole lives. You draw the conclusion based off of the science part of it and also an internal conclusion.

When you go into a story, whether it's juvenile justice or science, it's the same basic process. Having your question and going out and trying to get the answer, asking the right people, gathering data, organizing it, and analyzing it. It's the scientific process and also the journalistic process as well. So, I definitely think it was because of my experience at Youth Radio that I see science differently, and my confidence with it has changed because I see it differently. I've realized that science is more than just memorizing chemistry or physics. It's also about the basic process that you go through to answer questions for yourself. There's a format and a way to go about it, but it's actually a lot more simple. I think I used to think that science was a lot more complicated and a lot more about facts, and really it's about going about asking the questions in the right way and trying to answer them for yourself in the right way.

Confidence and Persistence

Finally, participants' involvement in YRI increased their confidence for communicating science to the community.

I feel more confident now after doing the story. I thought it was going to take a long process, which it did. I thought it was going to take longer – because I heard that we were on a deadline, and I was like, "Oh, I came in late. I can't do this." But, once I got started, I was like, "This isn't as bad as I thought it would be." And, it turned out to be a success. I am more confident now in doing science stories. [What helped to boost your confidence?] Just having the people here to support me when I need help, and knowing someone here can answer your questions, even if they are simple questions, they are there. [Having those resources to provide you with feedback or answers?] Yes.

Now, I feel a lot more confident about [being able to do a science story]. Because even if I was going to go and do [another science story] a feature story on, say, testing the air quality of poor neighborhoods vs. richer neighborhoods, I feel like if I needed to find out who's the expert on it and really research and write down facts and graphs and data. I feel like that I know how to do that, and even if I don't know how to do that, I can convince myself that I do because I've done it before. I have another experience under my belt as far as investigative reporting goes, especially science journalism. I know how to incorporate my thinking process with my writing process with the scientific process, which I like a lot.

The following example from a Youth Radio producer (interviewed instead of the reporter because of the sensitive nature of the story), traces another reporter's growing self-assurance. This young person, who did not normally speak in science class, eagerly probed her teacher about something she had learning while preparing her YRI story.

I'm trying to think of specific things that [the youth reporter] told me. One is the story of being in her class at school and bringing up something that the teacher hadn't brought up and having the teacher be like, "Wow, how do you know about that?" They way she expressed that to me, was that it was a really exciting experience for her. She had said, "What about cortisol?" And the teacher was like, "Wow, how do you know that?" Having that confidence and expertise to make that link. That was early on in the process, when we had just finished doing the "what is this pathway, you need to read all of these articles" thing. That was a good moment from my perspective. She does understand the science of it, and she can express it in her own words and make those connections. That's what we've been pushing for.

After the story aired…she told me she wanted to do more stories, and I asked what kind. She said, "I really like science stories, and I want to keep on doing science stories." And, I asked her why, and she said something like, "I like explaining stuff that is difficult for people to understand."

Two other reporters observed that working with STEM professionals on extensive investigations taught them patience and persistence.

[I learned] to reach out to people and get as many different opinions as possible, because I think it rounded the story out for me. Also, to be patient – waiting for results and going out and getting interviews. Trying to piece the whole thing together was a very long process, and I definitely learned how to be patient with finding out results and piecing the story together.

I learned that you have to be patient. There's a lot of waiting with the journalism aspect of it – waiting for the experts to respond to our interview requests. It takes professionalism and patience. And good questions.

Up to this point, we have presented results from DO IT!'s three initiatives independent of one another. By the end of the project, we became interested in the cumulative effects of these activities. We spoke with several young people who had and had not been heavily involved in DO IT! to obtain a longer-term perspective on the grant's outcomes.

Retrospective Interviews

Evaluation Methodology

At the end of the DO IT! program (Summer 2013 session), evaluators conducted seven retrospective interviews with youths involved in STEM programming at Youth Radio to varying degrees (i.e., with four heavily engaged youths and three less engaged youths). The purpose of these interviews was to gather information about youths' STEM journey during their time at Youth Radio, as well as feedback about how the organization's programming had influenced the youths' STEM knowledge, attitudes, and identity.

On average, the high STEM engagement youths had also been involved with Youth Radio for longer than the low STEM engagement youths. Specifically, three of the high STEM engagement youths had been a part of Youth Radio for four to five years (with the remaining youth having been involved for approximately two years); while the three low STEM engagement youths had been involved between one to three years.

At the time of the interviews, the majority of the youths were working as Project Associates in Youth Radio's Newsroom department, although two of the high STEM engagement youths were working in the App Lab. Previously, the youths had worked in various other departments at Youth Radio, including the Education, Tech, MATTER, and Web Radio departments. Several also specified that they had worked as Peer Teachers.

Outcomes

Key findings regarding outcomes include:

- Youth Radio and the DO IT! program had a variety of impacts on the youths' STEM knowledge, skills, and attitudes. Factors that mediated these outcomes were Youth Radio's supportive environment and the opportunities provided that the young people could not get elsewhere.

- The youths acquired a variety of technical skills, gained familiarity with technology tools and equipment, and learned about the scientific process.

- The youths enhanced their communication and collaboration skills with peers and professionals, as well as developed a network.

- The young people described their learning and work experience as applicable to their future, in that they learned actual skills and tools used by professionals in the field as well as professional development skills.

- The youths gained a variety of other soft skills from Youth Radio, including project management, critical thinking, teaching, leadership, and patience.

- As a result of their Youth Radio experiences, the youths expanded their views of STEM and increased their STEM confidence and interest.

- The youths described their Youth Radio experiences as being different from their school experiences in that they chose to participate in Youth Radio and felt their Youth Radio experiences were more hands-on, in-depth, collaborative, and applied.

- Through their hands-on Youth Radio experiences and work with STEM professionals, the youths increased their knowledge of, interest in, and preparation for STEM careers.

Below, we detail the overall impacts of Youth Radio and the DO IT! program on youth participants. We present: (1) an overview of these outcomes, (2) STEM process knowledge and skill development outcomes, and (3) STEM attitudes and self-identification outcomes. In some cases, it is difficult to separate the unique contribution of DO IT! from Youth Radio's general model of youth-driven media production. We present the results anyway to illustrate the benefits of the culture in which DO IT! has been embedded.

Overview

Through their participation in Youth Radio, the youths gained a variety of technical and soft skills. The program also influenced the youths' attitudes towards and self-identification with STEM. One youth summed up her feelings about the program as follows:

Youth Radio in general: I definitely 100% recommend it because it has changed my life. It has opened up so many doors for me. I've had so many opportunities. It's a place of business but at the same time, it's not just a place of business - it's a place where learning takes place, where a whole bunch of people get to meet new people, discover new things, and they get to accomplish many things that they probably wouldn't have the opportunity to do by themselves. And, all that with it being a free, non-profit program - that's just amazing. The whole program is amazing for youth like myself - getting a job now-a-days when you are young is really, really hard. And, Youth Radio provides you with materials that help you learn and get skills that people pay for and spend a lot of money just to grasp certain skills, and they give that all to you for free and then, on top of that, also offer you a job opportunity. That is just truly amazing and a blessing to a whole bunch of people who don't have that opportunity. I would strongly, strongly advise them to sign up and try to get a part of Youth Radio because once you are a part of Youth Radio, you are always going to be a part of Youth Radio forever and that's also very nice.

In examining factors that mediated these program outcomes, the supportive environment and unique opportunities that the program provided stood out. Specifically, many youths described the nurturing, collaborative, and family-like environment that existed at Youth Radio.

I recommend Youth Radio to everyone and tell all my friends about it…There are all these things that you can do and learn and you are learning, but they make it fun…They are really friendly and nice, and you just feel loved by everyone.

My experience [at Youth Radio] has been amazing and awesome and perfect, and [others] should join because you are part of a family that knows how to do a lot of things. If you have a problem, you can come to Youth Radio and talk to them about it. You get experience in things that you would have never gotten experience in otherwise.

Everybody [at Youth Radio] is amazing. Everybody has a talent. We all have great staff helpers and supporters. All the youth here are very unique. We were always thinking of ways to make Youth Radio better, and we're still trying because there's always something that can be better or newer. Me personally, I love the fact that I can come here, and even though I'm in college, I can see all the faces and people who know you. It's like your home away from home. And, it's like an island away from Oakland, but in the middle of Oakland.

They also described the unique and accessible (e.g., free) opportunities that Youth Radio provided that, as young people, they could not get elsewhere.

I feel like nobody ever gets to be on the radio until you are an adult. The fact that Youth Radio affords that opportunity to students in high school and college is super different…Being able to learn different things in media that you wouldn't be able to learn anywhere else or if you did, you'd have to pay for them. Also, just being here around people who want to do similar things as you or at least [are] in the same field is really motivational because you know the person next to you is interested in what you want to do, too.

It is an experience that not many young people get. I am very intrigued by it, and it is interesting to me. It's like a rush you get almost. Most young people do not get opportunities to do things like this – to research and do journalism–- at my age. Just being able to work with equipment and record different interviews and report from your perspective is something big. Getting your voice heard and writing a story from your perspective is cool.

STEM Knowledge and Skill Development

Through their participation in Youth Radio, the youths gained a variety of technical and soft skills, as well as learned about the scientific process. Overall, the young people described how applicable their learning was to their future, in that they learned actual skills and tools used by professionals in the field as well as professional development skills. General comments about learning and skill development include:

In terms of what I gained from Youth Radio that I didn't get from school was more technical…learning to use technology and learning the techniques that people who are already in a field of work are using. I feel like school is very basic like math and English and things like that but nothing that I felt applied in the long run…I think Youth Radio did a good job of that. In terms of technology for example, [at Youth Radio] I learned how to use and run a soundboard. I know how to record people in a professional studio. I know how to use ProTools, email, organize things online, and how to take advantage of social media for media sake. I also learned general research…The research side was different from school. If you are in English class and you are doing an essay, you are given the sources or an idea of what you want the sources to say. With a story, it's a little bit more in flux, and you have to be willing to reach out to a whole bunch of different people and get a lot of different opinions as opposed to them being already presented to you. So, learning to go on the Internet and figure out what's reliable and what's not, and figuring out who the experts are in the field, and then, beyond that, being able to organize all of the information and research you have.

I've learned a lot about technology and about how to work with certain software and use high technology equipment. I've learned to use a whole bunch of programs that are universal that people use throughout the world. I've learned how to teach and to interact to with people. I've learned to be professional, and I'm still learning as well. I've learned a whole bunch of skills that can help me in any field that I choose to go through.

In the following sections, we detail the STEM skills youths' gained, including technology skills, communication and collaboration, professional development, and other soft skills such as project management and critical thinking.

Technology Skills

Through their participation in STEM programming at Youth Radio, the youths acquired an array of technology skills and became more knowledgeable about technology in general. For example, in addition to app development, they learned about recording equipment and programs, beat making, and sound editing. They also gained familiarity with professional-grade software programs, such as ProTools, Reason, and Final Cut Pro.

I know how to use Reason to make beats…DJ-ing, because I did that for Bridge…If I went to a party, I could set up some turntables and an amp, and I could play a set. That's a pretty cool skill. I learned how to use a recorder properly and how to hold a microphone.

Definitely, I gained tech skills. We have professional equipment that people in the field would use. So, you learn to use different types of microphones and recording system

and learn to use sound editing software. Those are two things that I had no idea how to use before. And, I now feel like I'm pretty expert on at this point.

Learning how to use ProTools…I had never heard of that before I came [to Youth Radio]. They taught me how to use it and what you use it for…I found that really beneficial because…I found out that so many people use [ProTools]. I had an internship at a news station, and I saw that they were using it, too. And, I was like, "Oh, I know how to do that." And, they were like, "Where'd you learn that?" And, I said, "At Youth Radio." And that's cool to be able to use the same programs that other places are, too.

Communication and Collaboration

Through their Youth Radio experiences, the youths became more skilled at written and verbal communication with peers and professionals. Several young people specifically described the public speaking skills that they developed through the program.

From Youth Radio, I've gained] the ability to talk to people better, not only in a professional setting, but also in a causal setting. Because before coming here, I feel like I was a pretty awkward person…[Youth Radio has] helped me become a better person socially and business-wise…I've gained friends here definitely and life skills that are going to help me with whatever I choose to do…I've learned how to write professional emails that I had no idea how to do before. I've also learned how to talk to people in a more professional way.

[Youth Radio] was good for public speaking because you are sharing what you are doing with your other co-workers and getting feedback.

Through working with peers and professionals, the youths branched out, developed a network, and enhanced their ability to collaborate.

I think when I first came to Youth Radio, I didn't know anybody really. It helped me branch out. I'm pretty outgoing, but I think it helped me become even more outgoing and willing to talk to anyone. It helped me become more comfortable with people my own age and get really close to them…You are [at Youth Radio] every day with the same people…We all go to dinner and stuff. It's really cool.

As a result [of Youth Radio,] I have a larger network to pull in. Whenever I have a question about something, I already have an idea of who I should call or get in contact with or someone who could point me in the right direction for who can answer my questions.

Professional Development

Youth Radio provided the young people with work experience and a great deal of professional development training transferrable to any number of fields. In particular, the youths learned how to write a resume and cover letter and how to carry oneself in a work environment.

The most valuable and beneficial takeaway that I've gotten from Youth Radio is that they really, really help train young people such as myself to go into the working field and be ready for the working field. They really set us up in a way that once we go out there, we are really, really prepared. Usually just going to schools, you don't get that training, and you don't understand how to dress or what's a presentable resume. Being here at Youth Radio, the biggest takeaway is developing as a young lady ready to go out into the work field. You can't get the training in too many places...but how they set it up as a whole at Youth Radio, there's no way that any of their participants will leave Youth Radio and have had an internship without going through some type of professional development training. How they organize it, is that everybody gets it.

Overall, just being at Youth Radio, this is my first real job, and it teaches me about the work environment – how to dress, speak, and they have people to help with how to send a professional email and do your resume and it covers a lot of bases that youth really need.

The youth described this professional training and experience afforded by Youth Radio as unique, rare, and invaluable.

I felt there was a lot of professional development [at Youth Radio] that I hadn't ever really experienced in any other program that I had been in or at school…a lot of opportunities to do things that people my age don't normally get to do, like go to conferences and report for large radio outlets and talk about and write about things that most of the time you don't have a large outlet to speak to people about…[Through Youth Radio,] I've been given a lot of opportunities to do things that normally I have never had the opportunity to do before…you're an Intern, but you are treated as a professional journalist while you are [at Youth Radio] which is kind of rare for the youth-involved things I was doing – especially at school, where you are a young person and student, and you are not considered as an adult in that arena. I think in a lot of ways Youth Radio looks at their young people as adults and fully capable of doing things that professionals who work in the program are also doing.

[Youth Radio] definitely [influenced my professional development.] We have trainings monthly about being professional and what's appropriate for the workplace. Nowhere else have I gotten that piece.

Other Soft Skills

The youths also gained a variety of other soft skills from their experiences at Youth Radio. For example, they developed skills in project management, critical thinking, teaching, leadership, and patience.

I've learned a lot. But in terms of what's going to carry over after I've left here, is being invested in long-term and bigger projects, learning to work in groups with other people, and learning to organize my thoughts. Another really big one for me is taking things with a grain of salt and being able to question my own assumptions about things…just learning to step back and look at the big picture has been a big one for me.

I've learned the importance of being on deadline…that when you are teaching something or trying to teach a group of people something, not everyone learns the same way…[my experience at Youth Radio has] also made it easier to deal with the different types of people that you come in contact with everyday.

[Youth Radio] helped me with my patience to take my time and have pride in what I do, and not always go fast…It taught me a whole bunch, and if anything, it made me more aware of everything…Out of creating these stories, it taught me a lot about what I do and what I use and what I wear.

Several youths mentioned learning time management skills, partially through needing to balance the added responsibilities of their Youth Radio work with their schoolwork and other extracurricular commitments.

Being at Youth Radio, it makes you use your time more wisely. Because you are here and working, you don't have a lot of time to mess around. When you get home, you have to manage your time to do homework and other extracurricular stuff. So, it made my time management better.

I've learned time-management skills…how to better manage my time. Having 3-3.5 hours less on school days definitely makes you manage your time better when it comes to homework and studying and stuff.

STEM Attitudes and Self-Identification

In the following sections, we describe the effects of Youth Radio on youths' STEM attitudes and self-identification – specifically on youths': (1) perspectives on science and technology, (2) comparisons to school and STEM professionals, and (2) career knowledge/interests/preparations.

Perspectives on Science and Technology

As a result of their Youth Radio experiences, the youths viewed science and technology differently. Mirroring the themes in the Mobile Action Lab and YRI results, young people, expanded their views of what science entailed, realizing that it was more than their school experiences of memorizing facts and studying subjects such as biology and chemistry. They learned about the scientific process and saw the application of science and technology in a variety of interesting and personally relevant situations. Consequently, the youths' STEM confidence and interest increased.

I do think differently about technology and science, since coming to Youth Radio. [Before,] science was usually the subjects like biology and stuff like that…In school, science is very much like biology, chemistry, physics is science. Here [at Youth Radio], science is not about those fields. It's not rigid. It could be a multitude of things where science is involved, but you just don't know it. Youth Radio introduces you to that…Now, I know that science is more than math and stuff like that. It is more interaction with people and other technology, like watching something you make with your own hands could also be science.

I know I didn't like science before coming to Youth Radio, but I have had some things that I have liked about it since coming to Youth Radio because science in school is different than doing a science story at Youth Radio. Science in school is a lot of memorizing and formulas and math and stuff, but here at Youth Radio, one thing I like is that you learn something that is interesting...I learned a lot of stuff that was pretty cool that fits into the category of science.

We had to go to a science fair for a story, and I got to see a 3D printer, and I had never seen a 3D printer before. And, it was printing things out of plastic that eventually made objects and that was pretty cool to me.

Comparisons to School and STEM Professionals

The young people compared their experiences at Youth Radio to their school experiences, as well as to their perceptions of STEM professionals' work experiences. The majority of the youths described their Youth Radio experiences as being different from their school experiences. As described earlier, the youths learned technology and professional development skills at Youth Radio that they had not learned in school. The youths typically had greater access to technology resources at Youth Radio, which facilitated this learning. Youth Radio also pushed the youths to explore technology in a more in-depth and applied manner than had their schools.

My experiences at school and at Youth Radio were dramatically different because the school that I went to was poorly funded and the area that we were in was not taken

care of pretty well, so I'm pretty sure that everything in the school was not taken care of too well. So, as far as I'm concerned, learning anything technology-wise was not a big priority outside of Youth Radio. But once I came into Youth Radio, it was full of technology, and let me play with everything! 80% of my time with technology was at Youth Radio, and it helped me hone my skills and everything. Outside of Youth Radio, there's not too much for us to use in Oakland that is technology. We really didn't have the resources at all, and it was limited. But, here at Youth Radio, I have complete and total access.

With technology, I've definitely [used it] a lot more at Youth Radio than at school because at school, a lot of times, it is the same thing over and over…Whereas here, you do a lot more things with computers than just going on the Internet.

As opposed to school, their involvement with Youth Radio was not required or guaranteed. The youths chose to participate in Youth Radio and had to earn their positions, which resulted in a high level of investment in their work. Furthermore, the youths greatly enjoyed their work at Youth Radio, due to factors such as the positive environment and peer teaching. They also described their Youth Radio experiences as being more hands-on, in-depth, and collaborative than their school experiences.

In school, you learn everything because you have to and you are being taught. Here at YR you are being taught, but you are being taught by people around you who are close to your age and that makes a world of difference. It's your peers teaching you, and that's the best part. You are not afraid to ask questions, and you can talk to them normally. Here are Youth Radio, you are learning something because you want to, and you don't have to be here. It's really fun. It's an organized playground for bigger kids.

If you are slacking at Youth Radio it really shows in your work…You have to earn your place [at Youth Radio]. It's not like in school where you get to go no matter what degree or how hard you try is…if you are able to get a [Youth Radio] internship, and you're not really hard working, then you must have cheated.

Youth Radio is a little more hands on than [my school]. [My school] was hands on, but [we] weren't going too in depth. Especially if you are in the science department at Youth Radio, you are going more in depth…In Youth Radio, you can choose what you want to do. At school, you have projects assigned do you, and you have to do them or you don't pass. At Youth Radio, it's more free, and I can express more of my feeling as I want to.

At school you can sit in a classroom and go the whole year without knowing the name of the person next to you, whereas here you end up talking to everyone…It's more of a family setting. It's very relaxed, and it's not like school where it is very strict most of the time.

Career Knowledge/Interests/Preparations

Through their hands-on Youth Radio experiences and work with STEM professionals, the youths increased their awareness and understanding of STEM careers, as well as increased their skills and confidence in being able to pursue their interests. These experiences helped them prepare for their future careers.

> *I feel like Youth Radio has influenced me to want to take or get into other careers, such as science and tech fields, because there are many more career choices then I thought. Since they've given me so many skills, I'm now able to venture off into those careers. They gave me an optimistic feel about technology and technical engineering and technical work. They broadened my eyes a little bit…At one point and time, I felt that the basic jobs kind of careers that were out there were the only careers. But from being a part of certain workshops and being taught certain things at Youth Radio, I now know that there are other career choices and other things that I can do related to tech or science…They've taught me that there is so much more out there…I've taken away the fact that anyone can really be anything that they want to be. And, all [professionals] that came to us [at Youth Radio]…a lot of people throughout their life, they are doing what they want to do. And, that helped me know that I can do what I want to do or be what I want to be, no matter how different the job is or how unique. Whatever I take interest in and am passionate about, I can do it. I saw that through the people that came [to Youth Radio].*

Additionally, their Youth Radio experiences influenced the youths' career interests and goals by giving them exposure to new careers or a deeper understanding of what various careers entail. For example, several youths who wanted to pursue journalism careers as a result of Youth Radio commented:

> *Right now, I'm decently set on journalism because it seems like a really fun career….[my involvement at Youth Radio affected this decision because] I would have never really encountered journalism [if not for Youth Radio].*

> *Before I came to Youth Radio, I had no idea what I wanted to do with my life. I was floating around between a whole bunch of things. Youth Radio has definitely affected the trajectory, in terms of where I see myself in the future and in terms of having a career as well. It's given me a solid idea of what I'd like to get out of a job or the work that I do, which is being able to do things that I've done here [at Youth Radio] which is digging into stories, telling stories, uncovering issues, and sharing those experiences and stories with other people.*

Several youths described how Youth Radio had altered their career trajectories by helping them realize that certain careers were not a good fit.

I've always wanted to become a lawyer since I was a little kid. When I did a [Youth Radio] piece when I interviewed a lawyer, I did change. I did want to become a defense attorney, but after doing this piece, I realized that wasn't really what I wanted to do.

All of the experiences [I've had at Youth Radio] are educational and useful. All of the information [Youth Radio] gives me, I take in, and I use it as a guide to what I'm going to do in the future…In the beginning, I wanted to be a game designer…[but through my work on Youth Radio], I realized that I don't want to do that because I don't have the patience…[now,] I'd like to pursue everything – business administration, fashion, communication, and engineering because I want to create my own Web design.

For others, their Youth Radio experiences helped to reinforce and make their career goals a reality by building their skills and career readiness.

In high school, I was influenced by science, and I feel just getting more "sciencey" type and interesting things while I'm here at Youth Radio just reinforced my thought of going into the nursing field. It all just comes together.

From knowing what I wanted to do and then coming [to Youth Radio], it made it a reality because it's a taste of what it's going to be like just on a smaller scale. If anything, it only makes me more motivated. For example, I was looking at an internship…I could go somewhere and say that I know how to do this, and I've actually done this before and look at my resume. I have it on paper, and I know that people my age haven't done that. So, it's only made me want to do it more.

Summary

Building upon its previous Science and Technology Program, Youth Radio's DO IT! initiative consisted of three primary components that promoted STEM learning: Brains and Beakers, the Mobile Action Lab, and Youth Radio Investigates. Our evaluation gathered data on the implementation and impact of each of these activities as well as the cumulative effects of the program. A summary of the key program implementation and outcomes findings across the program follows.

Program Implementation

- The youths collaborated with peers, Youth Radio staff, and STEM professionals to create STEM media content and products, often drawing upon their personal experiences and unique youth perspectives to drive their work.

- The youths gave extremely positive feedback about their DO IT! experiences (e.g., about the events, presenters, staff), and in turn, Youth Radio staff praised the youth participants. The youths valued the program's supportive environment.

- The DO IT! program evolved over time (e.g., the hiring of a Science and Technology Producer and a new App Lab supervisor; changing the format Mobile Action Lab), and these adjustments had positive effects on the youths.

Outcomes

- The youths learned new STEM concepts and about the scientific and app development process. They also acquired technical skills (e.g., programming and design skills) and gained familiarity with and were exposed to technology tools and equipment.

- The young people enhanced their communication and collaboration skills with peers and professionals, as well as developed a network. They also gained a variety of other soft skills from DO IT!, including project management, critical thinking, teaching, and leadership.

- Challenges often arose when creating their STEM content and products (e.g., programming glitches or creating compelling and cohesive narratives), and the youths learned persistence, increasing their ability to identify and use strategies to keep working when they encountered problems.

- As a result of their experiences, the youths expanded their views of STEM, realizing how accessible and personally relevant it is. They also increased their STEM confidence and interest.

- The young people shifted their perspective in terms of how they interacted with technology, moving from being a consumer of others' technology tools to being an active and informed creator and user.

- The youths increased their knowledge of, interest in, and preparation for STEM careers. They described the program as opening doors for their future.

Overall, the data suggests that the DO IT! program had an extremely positive impact on the youth participants' STEM skills, knowledge, and attitudes. As a result of their experiences, the youths were more career-ready, learning many of the skills and tools required of digital media professionals while acquiring more generalizable work habits (e.g., self-presentation) valuable in any field.

The youths' STEM journey through DO IT! was unique, differing greatly from their interactions with STEM in school. Specifically, the youths described their Youth Radio experiences as being more hands-on, in-depth, collaborative, personally-relevant, and applied. They also described the opportunities provided through Youth Radio as something that they could not get elsewhere.

Specific characteristics of DO IT! that likely contributed to its success – that is, its positive impacts on youths' STEM skills, knowledge, and attitudes – include:

- Engagement in hands-on, authentic STEM work, using processes and skills similar to those of STEM professionals;

- Incorporation of youths' personal experiences and interests, which likely increased their level of investment;

- Collaboration with STEM professionals, which not only increased the youths' networking but also gave them a more realistic understanding of who STEM professionals are and what their jobs entail; and

- Support from peers and Youth Radio staff.

In short, we found ample evidence from DO IT! that Youth Radio staff members successfully continued the STEM programming journey they had begun with their initial NSF funding (Bandy & Bass, 2009). By integrating new STEM activities into their existing mission and training model, Youth Radio staff made science and technology content more accessible and appealing to traditionally marginalized groups. One of the keys to their success was helping young people see that STEM was as much about process as it was about content – that science and technology were not just nouns, but verbs.

Moving forward, we recommend that Youth Radio continue to use and build upon the program's training model, expanding and scaling its STEM efforts to reach a larger number of youth. To do so, additional resources will be needed to provide these additional youths

with the tools and support needed for authentic and collaborative STEM work. For example, as already recommended by the Mobile Action Lab participants, funding will be needed to provide one-on-one time with supervisors and/or a low student to supervisor ratio, as well as additional technical resources (e.g., better computers) and bigger workspaces. Curriculum around the development and use of Youth Radio's STEM media products would also broaden the organization's impact and enable other youth media organizations to learn how to integrate STEM programming into their training. We encourage Youth Radio staff to share their ideas widely, so that other instructors and young people nationwide might experience similar gains.

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