Teens Becoming Researchers: Pedagogical Considerations When Designing Coresearch

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Abstract

Young Researchers is a multiyear research project that works with Illinois teenagers to collaboratively develop research and informal learning materials. The project examines how teens interact with science, technology, engineering, and mathematics (STEM) topics, as well as their everyday technology use, with youth-driven research studies. The current stage of the project is working with a group of teens from a small community. These teens, or Young Researchers, are learning about how to conduct research by actively participating in study design, participant recruitment, data collection, and the analysis and reporting of research findings. In the future the project plans to work with additional groups of teens from around Illinois. The Young Researchers are building literacy skills, becoming researchers, and contributing to scholarship while exploring their potential to pursue research careers. This paper discusses the development of Young Researchers' first collaborative research project, with a focus on the teaching strategies used in encouraging the teens to engage with the research process. The paper highlights the considerations for conducting this approach with such teens, including a discussion of methods and pedagogy.

The Young Researchers Project

The Young Researchers project is a multiyear research project that works with teenagers as coresearchers and study participants to examine science and technology learning and the technology use of such teens. Coresearch is an approach that recognizes the knowledge of community members, and purposefully adjusts power relationships to involve those community

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members in the design, running, and analysis of research studies. In our project, teens from diverse areas around Illinois participate in camp-style introductions to social science research, and collaboratively develop and conduct research examining the technology use of youths. These camps also allow us to examine the participants' familiarity with and understanding of STEM (science, technology, engineering, and mathematics) and STEAM (science, technology, engineering, art, and mathematics) topics, as well as their information behaviors, in an informal setting. Through the camps, the teens recruit additional participants, with the ultimate aim of the involvement of approximately 200 individuals in the four planned iterations of the project. These youths will work collaboratively with us to analyze the data resulting from their research studies, and participate in presentations and publications about the work. They will also visit the University of Illinois at Urbana-Champaign, where they will present their work to the university community, thus increasing their experience and exposure to a variety of research methods and fields.

At the time of this writing, we are entering the final stages of the first camp in which the youths are analyzing and preparing to present their findings. Our initial group of participants has conducted a survey that we collaboratively developed to assess teens' social-media behaviors and familiarity with STEM/STEAM. In this paper we focus on the design of the project, specifically as it relates to the pedagogical approach we have used in order to accomplish two goals: to build relationships with and among the youths that promote trust, collaboration, and openness to disagreement and discussion; and to ensure that they engage meaningfully with and synthesize the new understandings of research, including human-subject research ethics and methods, that have been presented to them in the camp.

While we are in the early stages of this project, our focus here is two-fold and represents the areas in which we have been able to generate meaningful understanding. First, we want to determine whether and to what extent teens conduct professional-level research *collaboratively*. Second, what factors facilitate or impede developing high-quality research in this structure? We have used a constructivist pedagogical approach to support them in developing their research design and understanding of the ethics involved in human-behavior research. In this paper we examine whether the constructivist pedagogical approach is effective in mentoring and teaching participants to do this. Did they engage meaningfully with the material? Did their discussions demonstrate new knowledge?

Youth, Technology, and Scientific Literacy

The importance of scientific literacy and exposure to science, technology, engineering, mathematics, and computing education for youths from diverse backgrounds has been an area of focus for educational institu-

tions for some time. According to the National Science Board (2010, p. 1), "to ensure the long-term prosperity of our Nation, we must renew our collective commitment to excellence in education and the development of scientific talent. Currently, far too many of America's best and brightest young men and women go unrecognized and underdeveloped, and, thus, fail to reach their full potential." In 2009 President Obama launched the "Educate to Innovate" initiative, which aimed at increasing science and math achievement for U.S. students. In a 2010 report, the President's Council of Advisors on Science and Technology stated, "We must prepare students so they have a strong foundation in STEM subjects and are able to use this knowledge in their personal and professional lives. And we must inspire students so that all are motivated to study STEM subjects in school and many are excited about the prospect of having careers in STEM fields" (n.p.). Since then, numerous initiatives have been undertaken by not-for-profits, after-school organizations, and educational institutions to promote STEM learning, and to encourage students, particularly those from marginalized populations, to pursue careers in related fields.

Meanwhile, technology and social media are increasingly central to teens' development of independent identities and their exploration of topics of both academic and personal interests. There are "a diversity of ways in which U.S. youth inhabit a changing and variegated set of media ecologies" (Ito et al., 2010, p. 30) Digital interactions "may serve as a playing ground for important developmental issues from online lives" (Subrahmanyam & Šmahel, 2011, p. 34). Influenced by social factors, as well as by the increasingly available technology and media, the blurring of technology-use contexts has myriad implications. One is that for those interested in educational outcomes, accounting for nonacademic contexts of technology interaction is important and revelatory. More broadly, information practices are increasingly not bounded by location, technological constraints, and timing, meaning that research examining youths' lives and experiences needs to take this flexibility into account.

New approaches to teaching STEM subjects to youths are being explored and implemented by organizations around the country, as the value of unstructured and non-school-based learning is gaining recognition and support. Historically, approaches for this type of learning have been focused on conventional contexts, which have limited the kinds of learners who can access them. Initiatives aimed at engaging more diverse learners and different cultural contexts are needed, as is a more holistic approach to STEM learning in general. To bring this about, researchers must consider STEM learning within the context of an effort to enable "people to access, interpret, and make use of science and engineering to address practical human needs" rather than to replicate the practices of disciplinary experts (Dierking & Falk, 2016, p. 7). One vital element of this is developing approaches that engage young people and incorporate their

viewpoints, thus allowing them to apply learning and research to their own lives and experiences. Roth and Lee (2002, p. 51) put it bluntly: "It is more important that citizens care for and are engaged in these scientific conversations than whether and how many do well on some individualized test of scientific literacy."

In the years since STEM became a focus of governmental and educational agencies, many have argued for the addition of a fifth letter to the acronym—"A"—representing the arts and design. Arts contribute "problem-solving, fearlessness, and critical thinking and making skills" to the STEM fields (Maeda, 2013, p. 1), and artists think philosophically not just about where humanity *can* go, but also where it *should* go. The arts comprise a significant portion of the U.S. labor force, and a growing body of research demonstrates that the study of visual arts and music results in measurable gains in verbal ability and nonverbal reasoning, as well as in observational and analytic skills (Piro, 2010). The study of arts has other benefits as well, including "better questioning skills, more focused periods of intense concentration, and greater understanding that problems can have multiple answers" (p. 3). Incorporating the arts into the push for STEM education means developing stronger skills and greater problem-solving abilities in our young people, as well as validating a wider range of interests that will lead to greater engagement on their part.

Access to technology is an important part of STEM/STEAM education, and researchers have learned that there are gaps both in physical access and in terms of broader conceptualizations, including the maintenance of access, proficiency, and social supports. The term *digital divide* originated in discussions of computer access during the 1990s (Williams, 2011), but more recent scholarship suggests a more nuanced understanding of the term. Nemer (2015) challenges the term's traditional conception, stating that it "does not necessarily offer nuanced understandings of socioeconomic conditions under which the marginalized live" (p. 1). He suggests that digital-access gaps exacerbate existing inequalities in society, and data certainly bear out this claim. Among teens, while 73 percent have smartphones, only 68 percent of rural teens do; African American teens are the group most likely to have a smartphone (85 percent), but least likely to have a laptop (only 79 percent do, compared to 87 percent of all teens (Lenhart, 2015). But physical access does not give us a complete understanding of teens' access to digital literacy. Rideout and Katz (2016) report on a variety of measures of difficulty that low-income families encounter in using technology, including too many people using the same device, the lack of consistent connectivity, and data limits, all of which were substantially more common complaints for those living below the poverty line.

Generally, those who use the internet and communication technologies "have more schooling, higher incomes, and higher status occupations than those who do not have access" (Nemer, 2015, p. 1). Social support

for developing technological proficiency also plays an important role in access: people with low socioeconomic status are disadvantaged, both because they lack the rich networks of people who already use the internet and because they are less likely to gain awareness and training through social contacts (Chen, 2013). Teens with access to the hardware of laptops and smartphones are more likely to have the support networks to use them, to have uninterrupted access, and to own their own devices. Teens of color and rural teens, as well as low-income teens, on the other hand, are less likely to benefit from these factors, thus fostering a gap in access that goes far deeper than simply being able to get their hands on a device.

The Young Researchers project is working with youths in a collaborative setting for them to develop collaborative, participatory research studies. In our first camp we have worked with teens from closely located small towns in the rural Midwest, an area where we found that STEM was in many cases an unfamiliar concept. Only about half of the teens had their own computing devices or regular access to the internet. By working with these individuals from socioeconomically, ethnically, and geographically diverse areas, we hope to bring STEM/STEAM programming to communities that might otherwise not have access to it and to better understand how digital divides affect teens' technology use and their interest in STEM/STEAM careers and the research process.

Participatory Research with Teenagers

Participatory research with teenagers provides opportunities to incorporate their perspectives and understandings into the design and interpretation of research studies about them. This changes both the questions asked and the analyses of data, and it treats the perspectives of youths as relevant and valid in constructing understandings of their world. It "challenges the normative production of knowledge by including excluded perspectives and engaging those most affected by the research process" (Cahill, 2007b, p. 326). This allows scholars to effectively challenge old assumptions, push scholarship in new directions, and develop theory from within the process rather than being based on the existing literature, thereby challenging the status quo. This research, rather than relying upon prescribed methods and ideas, "unfolds in an iterative, cyclical manner [and] is . . . particularly well-suited for engaging adolescents" (Powers & Tiffany, 2006, p. 86). Hazel (1995, p. 2) points out that "research on the lives of children and adolescents has traditionally neglected the views and voices of the young people themselves. . . . There has been a tendency to treat young people as passive subjects whose opinions are peripheral to the understanding of the issues which fundamentally affect them." In designing the Young Researchers project, a primary concern was involving the teens in the study design from the start so that they were in charge of generating research questions, thus allowing their understandings to drive our investigation.

Contrary to the traditional belief that young people are unable to contribute meaningfully to research that seeks to understand their lives, they are now recognized as having the capacity to "assimilate and report their views, highlighting cognitive capabilities from a very young age" (Hazel, 1995, p. 2). To take advantage of this capacity, participatory research moves the research itself from the position of being imposed by the researchers on the population studied to that of being a project owned by that population, thus promoting marginalized voices and making them central to understanding the issues relevant to their lives: "The epistemological framework of a PAR [participatory action research] project privileges a bottom-up analysis, placing emphasis upon the critical insights of the community collaborators" (Cahill, 2007b, p. 327). This type of approach "recognizes young people's agency and competency and very directly privileges their voices and develops their capacities, and is potentially open enough to allow young people to challenge accepted points of view" (Cahill, 2007a, p. 308). Research is more likely to be successful when adults intervene only as needed and students can reflect on their own learning processes. In addition, the research benefits from considering how the youths themselves define and understand success in their information-seeking (Dresang, 1999). Particularly in understanding informal information behaviors using technology and social media, young people are widely considered to be more informed and current on recent developments than adults. Having grown up with the use of technology as a part of their lives, teens are nonetheless often asked to demonstrate mastery within contexts where their interests and needs are irrelevant, such as many school-based tasks. Dresang (1999) suggests that this arises from the creation of these tasks by adults to assess youths' information-seeking behavior rather than observing them in situations where they are using technology and information naturally and voluntarily. During the Young Researchers project, teens work independently to find and discuss information about the project, decide on research questions and methods, and conduct the research and analyze the results.

Participatory research has the additional benefits of developing participants' scientific literacy and, potentially, increasing their interest in pursuing careers in STEM/STEAM fields. This last is one goal of the research and will be assessed using open-ended interviews conducted both prior to and after camp participation. Whether it affects participants' interest in STEM/STEAM fields or not, it will enable the young people to interrogate and think critically about their everyday lives and those of their peers within the context of the research project (Cahill, 2007a). Stereotypes related to young people and social-media use are wide-ranging and often derogatory, with the use of social media viewed as a distraction and veritable minefield of perils. In academic circles, however, it is increasingly leveraged as a learning tool. By facilitating young people's inquiry into the

impact of social media on their lives, we hope to develop an understanding that is more useful, accurate, and productive of action that impacts their lives.

In addition, participatory research changes the way that participants view their own use of social media, and engagement with information through such media (Cahill, 2007b). Powers and Tiffany (2006) note that effective research is a result of opportunities to learn and practice, and that "participatory research, which often unfolds in an iterative, cyclical manner, is ideal for this kind of learning and particularly well suited to engaging adolescents" (p. 86). Calls for the improvement and advancement of STEM education have also pointed to the efficacy of a participatory research approach, emphasizing its power to transform participants' understanding of what STEM is and to encourage future participation in the field (Dierking & Falk, 2016). Finally, this approach presents the opportunity for youths to develop and participate in learning networks that support and expand their understandings, such as working with youths from different areas on a project and exposing them to university settings (Powers & Tiffany, 2006). In the case of the Young Researchers project, the groups of teens involved have and will maintain contact throughout the process of analyzing and presenting findings, so relationships continue after the camps finish. We aim to build a network of scholars both in libraries and university settings to further expand the informal resources available to participants, and to ensure that each group has the opportunity to present findings in a formal setting.

One of the challenges for researchers working with youths doing participatory research is that it requires changing the power dynamic between researcher and participant. With youths this is particularly significant, because of the strong social and institutional supports for the difference in status between teenagers and professional researchers. Thus Hazel (1995, p. 2) emphasizes the need for the researcher to "cross the cultural and communicative divide which has characterized the paternal adult–child relationship." Lolacono Merves, Rodgers, Silver, Sclafane, and Bauman (2015) found that a youth-development perspective was most productive in engaging youths and facilitating efficient and effective work. To do this, researchers need to apply best practices from educational and informal settings that have been shown to effectively facilitate the discussion and exchange of ideas. Dresang (1999, p. 1) suggests that researchers should "seek out-of-school situations where youth have generated their own queries, to which they have come voluntarily as a 'first resort,' and with which they feel both comfortable and competent." The key then is creating a research environment in which youth can explore, discuss, and develop their ideas on their own, with minimal intervention from the researchers, who work to empower them to own and direct the research process. In the methods section below we discuss in more detail our strategies for empow-

ering youth participants in this project. However, the teaching methods used during the camps were designed specifically to disrupt the traditional power dynamic, which we discuss in the next section.

Constructivist Pedagogy

The pedagogical approach to participatory research must then incorporate strategies to promote effective collaboration that overcomes this inequality and allows the researchers and youths to share ideas and disagree with one another comfortably and collegially. A constructivist pedagogical approach is, we believe, best suited to facilitating this kind of atmosphere, because it is designed to place the youths at the center of the learning process, and to empower them to investigate and reach their own conclusions. The term *constructivism*, originating with Piaget's psychological theory, has been used to describe a number of different psychological and educational approaches, so some consideration of the sense in which the term is used here may be useful. Jones and Brader-Araje (2002) state that

> the meaning of constructivism varies according to one's perspective and position. Within educational contexts there are philosophical meanings of constructivism, as well as personal constructivism as described by Piaget (1967), social constructivism outlined by Vygtosky (1978), radical constructivism advocated by von Glasersfeld (1995), constructivist epistemologies, and educational constructivism (Mathews, 1998). (p. 2)

Constructivism, as discussed here, "construes learning as an interpretive, recursive, non-linear building process by active learners interacting with their surround—the physical and social world" (Fosnot & Perry, 1996, p. 23). Constructivism in education has given rise to numerous specific approaches, including though not limited to the constructionism developed by Papert (Guzdial, 1997). Other approaches include project-based learning, inquiry-based learning, problem-based learning, gamification, and a host of other specific activities and approaches (Larmer, 2014).

Equally importantly, constructivism, like participatory research, facilitates a collaborative relationship with the teacher, instead of the traditional dynamic where the teacher hands knowledge down to the students. It opens the door to questioning and challenging the teacher—in this situation, the researchers—on points in which students may disagree, and encourages them to reach conclusions that may differ from what is commonly held to be true. When one considers that scientific innovations and the empowerment of marginalized voices have both relied heavily upon challenging the consensus of people and institutions in power, it is easy to understand why this might be vital in the execution of effective participatory research, and in facilitating youths' development of deep understandings of research.

One essential element of a constructivist approach is that it focuses on

learning as a process of exploring a topic through the application of skills and the seeking of information to create a new understanding on the part of the student rather than on reproducing existing knowledge. Learning is "something students do, not something that is done to them" (Anderson, 2002, p. 2). This requires an approach that may be uncomfortable and unfamiliar for those accustomed to traditional teaching and learning styles where the teacher tells students and provides them with sources for the correct answers and learning is assessed by determining whether students can produce those answers on demand. However, it has also been demonstrated to be a more effective approach that allows students to develop deep understandings of topics, and to learn and implement collaboration, discussion, and information-seeking skills that facilitate their development as learners:

> Rather than behaviors or skills as the goal of instruction, cognitive development and deep understanding are the foci; rather than stages being the result of maturation, they are understood as constructions of active learner reorganization. Rather than viewing learning as a linear process, it is understood to be complex and fundamentally non-linear in nature. (Fosnot & Perry, 1996, p. 3)

One form of constructivist pedagogy uses a focus on specific projects to allow students to apply skills, tools, and information sources to solve a specific problem, and "because learning occurs in a social context, learners interact with and internalize modes of knowing and thinking represented and practiced in a community" (Blumenfeld et al., 1991, p. 371). In other words, students develop strategies for learning as well as skills, and in addition to learning facts, they synthesize new understandings of not only ideas but also their context within the learners' consciousness. In the service of this, during the pilot study camps we looked for opportunities to encourage participants to explore information on their own and draw their own conclusions rather than being told the correct answers. Instead of lecturing, they were asked to interact with texts and multimedia resources in order to learn about research ethics and methods. The students responded positively to this; in an exit interview, one teen remarked that he particularly enjoyed the mini-research projects the participants conducted in order to learn about the research process.

Constructivist learning, like participatory research, places students at the center and in control of the process, empowering them to determine what questions should be asked, and how. The role of the teacher is to support through consultation, providing resources as appropriate, and critiquing the students' process rather than delivering the information for the students to learn. The classroom is then viewed as a community of learning, where discourse is the process by which new understandings are developed and "ideas are accepted as truth only in so far as they make sense to the community and thus they rise to the level of 'taken-as-shared'"

(Fosnot & Perry, 1996, p. 22). This kind of learning is facilitated most effectively when tasks are broken down into manageable chunks, where youth can navigate each piece of the process effectively, instead of being asked to determine and implement an approach to the entire process. Instructors can also assist students by "breaking down tasks; [using] modeling, prompting and coaching to teach strategies for thinking and problem-solving; and gradually [releasing] responsibility to the learner" (Blumenfeld et al., 1991, p. 371). Participatory research could even be considered as a logical extension of this type of learning applied in a different context, while best practices for facilitating the successful design of participatory research projects may be drawn naturally from constructivist pedagogical approaches.

Instructional Design: Getting Out of the Way

The camp consists of three five-hour sessions for participating youths, focusing on successive components of the research process—specifically, research methods and ethics, study development, and analysis and presentation. Each day involves several interactive learning engagements designed to allow students to develop their understanding of the topics presented by investigating and discussing them as a group. We have used several techniques to create a collegial and collaborative atmosphere in which our authority as researchers and teachers does not deter youths from challenging our statements or sharing their own ideas. Our approach deliberately challenges the traditional adult–child power dynamic by using a constructivist or inquiry-based approach that locates the participants as the drivers of the learning process.

While the instructional portion of the camp days was designed to empower the participants' voices, we also put in place other practices that encouraged a casual, collaborative atmosphere and directly challenged the traditional adult–child relationship. Body language played a role, with the researchers sitting with the students rather than standing in front of them. We also established early on that the teens could get snacks or drinks or use the restroom without asking for permission. In addition, in order to break down social barriers, we used frequent "brain breaks" consisting of non-research-related, silly activities, such as untangling a human knot, telling stories with each person adding only one word, or choosing a side of the room based on which of two alternatives they preferred—for example, "cows or chickens" or "snakes or spiders." These activities elicited a great deal of laughter and helped everyone to relax. We took frequent breaks and allowed unstructured time for the teens to socialize with one another and with us. The intent was to encourage them to develop positive relationships and break down the social boundaries that are part of youth culture.

We set the tone from the start by asking the original eight participants

to talk about their understanding of research (one participant had to withdraw after the first camp because of scheduling changes). The learning engagements we used asked the youths to interact directly with information, and then to draw and share their own conclusions through discussion, reflection, and collaboration. We varied the groupings so that the power dynamics within them did not become entrenched, thus avoiding the situation whereby one powerful voice drowns out the others. During discussions, we asked leading questions and sometimes explained concepts or clarified information, particularly when the teens were working within their groups, but avoided any appearance of telling them the answers. In one such engagement we focused on three examples of ethically questionable research studies: the Stanford Prison Experiment (MacLeod, 2016; Zimbardo, Maslach, & Haney, 2000); the Milgram Experiment (MacLeod, 2007); and the Monster Study (Reynolds, 2003). In each case, participants were asked to consider the motivation for the study and whether it should have been conducted, as well as whether the benefit in terms of knowledge gained justified the harm to participants. They were given a sheet of chart paper and markers and asked to share their findings with the rest of the group after creating a visual aid, for which the parameters were deliberately undefined. The teens were outraged by the studies and sometimes had to be redirected in order to get them to think about what researchers hoped to gain by conducting them.

In another activity, the teens were shown charts from reports on research studies conducted by organizations, such as the Pew Research Center and the Joan Ganz Cooney Center, that focused on topics relevant to teens' engagement with social media, technology, and STEAM. They were asked to discuss the strengths and weaknesses of each chart or graph and to reflect on the accuracy of the results. We began with a chart of teens' perceptions of the social acceptability of breaking up with someone by various means, which provoked some chuckles and nonanalytic commentary that helped get the discussion started. The teens asked critical questions about the charts shown, and in doing so demonstrated an understanding of the concepts we had introduced regarding the potential flaws in the study design.

Ideas for the study that the teens designed and conducted were generated through a few rounds of brainstorming, both as a large group and in small groups. Giving them time to work in smaller groups allowed quieter voices to be heard, and when brainstorming, we emphasized that there are no bad ideas and that self-censoring was not allowed. We also politely requested that any discussion of proposed ideas be postponed until after the brainstorming session. The final list of topic ideas was refined by a voting method whereby the students placed a check mark next to their top three ideas. This removed the pressure on them to choose a favorite one, averted the potential for everyone to vote for their own suggestion,

and allowed us to easily identify the favorite focus. From there, they broke into small groups to brainstorm survey questions. We narrowed down the questions by collaboratively editing a document that was projected on a screen, using a word-processing program that allowed changes to be made quickly and text to be highlighted or underlined. We also asked leading questions and encouraged changes in phrasing to clarify questions, but generally left it to the teens to decide what should be included and how long the survey should be.

These engagements were designed to accomplish a few aims: by asking the youths to investigate and develop their own understanding, we not only encouraged them to approach the information thoughtfully and synthesize it in order to share with the class, but we also tacitly validated their abilities and understanding. Second, by assigning them to work in groups, we both provided an opportunity for them to get to know one another and created an environment in which those who lacked skills could be supported by others more capable. Finally, we placed each of the youths successively in the situation of being the teacher so that the role was shared by everyone present rather than owned exclusively by ourselves as the researchers. During the third day of camp, conducted in January 2017, we facilitated the analysis and presentation of the data collected with similar instructional techniques by empowering the teens to take the lead in analyzing, interpreting, and presenting the data, as we continued to act as advisors and assistants.

Living Up to Expectations (Instead of Down?)

In general the youth worked exceedingly well together and engaged meaningfully with the information and activities around which the camp days were structured. During the initial discussion of the nature of research, they gave mainly school-based examples, such as finding information sources and conducting polls. As they engaged with the information about research methods and ethics, they formed and clearly stated specific opinions regarding the material. For example, when discussing the Stanford Prison Experiment, the Milgram Experiment, and the Monster Study, several of the participants stated that these were unethical and should not have been conducted, regardless of the knowledge gained—certainly an opinion that reflects the consensus of researchers today. Because they could reach these conclusions on their own, it is reasonable to expect that they will also retain this information, since it has become part of their understanding. The groups were more engaged in and produced a more in-depth presentation of the information about the specific studies than about the abstract concepts of beneficence, justice, and respect for persons. This may be partially because the second learning engagement occurred after lunch and later in the day, but may also be attributable to the

material itself, because youths tend to be more receptive to information about specific persons and events (Hazel, 1995).

When observing them working in groups, we noted that participation was relatively even, although personality played a role in who spoke more. Within groups, there was some insistence that the more outgoing members share, which changed on the second day of camp when some groups chose to have everyone take turns sharing. Throughout the first day they became more comfortable and spoke more readily, so that by the time we were brainstorming at the end, they spoke up without raising their hands or waiting to be asked, and occasionally even talked over one another. One topic that was raised as being potentially of interest was the difference between generations, and the teens observed that their generation has access to a greater plurality of ideas and experiences than previous generations because of the role of technology in their lives. One participant explained this by noting that he is a football player and so one might not expect him to have an interest in soldering, but he does. Another teen stated that while one might expect him to listen only to country music, he also likes some rap music, because of the ready availability of different genres.

Engaging with Ethics

During the second day of camp it became evident, as the students developed and discussed the review questions, that they had indeed retained the information taught a month earlier, on the first day. We discussed these questions as a group. The Monster Study, which the youths used online resources to investigate on day 1, was a 1939 study conducted with orphaned children. Half of the children were labeled "normal" and the other half "stutterers." However, half of the children in the stuttering group did not actually stutter. The normal children received positive speech therapy and were told that they spoke fluently or well. The stutterers received negative therapy and were told they had speech impediments. As a result of the study, some children suffered negative psychological effects and others developed new speech problems. The researchers attempted to reverse the damage, but were unable to do so (Reynolds, 2003). Review questions generated by the teens—such as "Which is more unethical, damage to the mind or the body?" and "What changes to the Monster Study would you make?"—required thought and reflection to answer meaningfully while also demonstrating that the teens not only recalled the topics discussed but were able to meaningfully consider the ethical questions surrounding those topics. Some of the responses to the question regarding the Monster Study were as follows:

- Used wider group
- Not so much discouragement

- Kids [who] developed speech impediment—have help afterward
- Telling kids they were participating in a research study (connects to respect for persons and justice)
- Negative feedback group was unnecessary
- Could give people incentive to participate
- Publicize to wide group of people and have people volunteer to participate
- Be careful not to overincentivize—you don't want to influence the sample or group of participants

While we recorded these answers, they were generated by the teens without prompting from the researchers. The first comment speaks to the importance of sample size, as well as concerns about the orphaned children who participated as a protected population. The comments also touched on the issue of consent and assent (fourth bullet), concerning informing participants. The responses also indicate a strong feeling that a group receiving positive feedback and a control group could have elicited the same information without causing undue harm to participants. These responses demonstrate not only recall but a confident and internalized understanding of the issues at hand.

Similarly, in response to the question "What drives a person's curiosity to damage another person's health?" the following comments were generated from the participants:

- Are they doing it on purpose?
- Fear of it happening to themselves?
- Finding out information
- Researchers are able to feel objective if they're not involved
- Cost vs. Benefit—not fully comprehending potential impacts of what they were doing; being wrapped up in effort to advance knowledge
- Vulnerable populations—homeless, sick, handicapped, orphans, children, prisoners, differently abled
- Process for vulnerable populations applies if the vulnerable group is specifically targeted in the study, but not necessarily if they incidentally end up participating

Here, not only did the teens focus on the importance of weighing harm against the benefit to both general knowledge and the individuals participating in a study, but they also considered the reasons that might motivate researchers to conduct studies that cause harm to others. They also raised important questions about conducting research with vulnerable populations, and how and when that is or is not appropriate. Responses like these show more than an ability to regurgitate memorized information; they also demonstrate a thoughtful approach to understanding information

that is becoming part of the individual's understanding of the process of research.

Analyzing Research and Study Designs

When analyzing the examples of graphs and charts on the second day of the camp, participants' responses again demonstrated that they had synthesized the knowledge gained both from their prior studies and from our initial camp day's discussion of research methods. They were quick to question the number of participants in the studies; when discussing a chart from the Joan Ganz Cooney Center's report "Opportunity for All?" (Rideout & Katz, 2016) that depicted the challenges in using technology faced by families living in poverty or near-poverty, they asked about how poverty or near-poverty was defined for the purpose of the study. They also raised concerns about the effectiveness of presentation in communicating the necessary information, wondering whether participants were able to select multiple answers in some cases, and in others indicating a lack of clarity in what the *x* and *y* axes in some charts measured. They felt that one chart was too busy to be comprehensible. Taken together, these perspectives demonstrate an understanding both of how information is collected in different ways and how presentation can affect the way it is interpreted by readers.

Developing Our Collaborative Study

The teens were given the general topic of technology use as the focus of their investigation, but were asked to brainstorm topics of interest to them within that area. As a group, they decided to focus their research question on the role of social media in teens' lives, specifically asking about how their peers' perceptions on how social media inform their interpersonal and academic interactions. The process of question-generation for the survey demonstrated strong collaborative skills and a process of working toward asking questions that might generate meaningful and interesting responses. The youths started out with some vague wordings in the questions that came out of the small-group collaboration, but within the large group made some revisions that improved them. The final list of questions developed with the teens was as follows:

- Which of the following social-media platforms do you use? (multiple choice)
- How does social media most affect the types of electronic entertainment that you consume?
- How does social media affect your personality?
- Does social media help or hurt your education and why?
- Has social media affected the way you communicate with others verbally or by typing/writing? If so, explain.

- Have you heard about STEM? If so, where and what do you know about it?
- How often do you check social media?
- How often do you interact with posts and/or people on social media?
- Are there things you do or did that you learned about on social media? Explain.
- Have you picked up any slang words from social media? Name up to three and explain what they mean.
- How do you decide what information to believe on social media?
- How often do you use social media and/or entertainment when you are also interacting with people face to face?

With their permission we made minor adjustments and additions to the paper and online versions before they were available so that the teens could recruit additional participants from among their friends and acquaintances. In future camps we hope to have time to fine-tune the questions with the group, and to obtain the participants' final approval before the survey is administered. However, because of time constraints, we made final adjustments after the second day of camp and before sending the surveys to the youths. The paper and online survey questions as administered were as follows:

- What is your age?
- What is your gender?
- What types of technology do you use for entertainment?
- We are interested in social media, which includes websites, apps, and platforms where you can connect with other people and post and interact with media and information. Which of the following social-media platforms do you currently use?

❑ Instagram	❑ Twitter	❑ YouTube
❑ Snapchat	❑ Facebook	❑ Facebook Messenger
❑ Reddit	❑ After School	❑ Tumblr
❑ DeviantArt	❑ Pinterest	❑ Yahoo! Answers
❑ WhatsApp	❑ Whisper	❑ iMessenger
❑ Twitch/TwitchTV	❑ Ask.fm	❑ Wattpad
❑ Burn Note	❑ Skype	❑ Facetime
❑ Google Hangouts	❑ Google +	❑ Other:_____
❑ Other:_____	❑ Other:_____	❑ Other:_____

- How often do you check social media?
- How often do you use social media and/or entertainment when you are also interacting with people face to face?
- How often do you interact with posts and/or people on social media?
- How do you decide what information to believe on social media?
- Has social media affected the way you communicate with others verbally or by typing/writing? If so, explain.

- How does social media affect the types of electronic entertainment that you consume?
- How does social media affect your personality?
- Does social media help or hurt your education and why?
- Are there things you do or did that you learned about on social media? Explain.
- Have you picked up any slang words from social media? Name up to three and explain what they mean.
- Have you heard about STEM or STEAM? If so, where did you hear about it and what do you know about it?

Other than the addition of demographic questions and the specific options listed for social-media platforms, the final questions have been little altered from those developed collaboratively with the participants. In some cases the order has been changed to make the questions flow more logically. Again, this is something we would have preferred to do with the teen codesigners, but due to time constraints we completed that process after the conclusion of the second day of camp. The original questions, brainstormed in two small groups, are shown in figures 1 and 2.

Some of the changes that resulted from the group revision are substantial and meaningfully clarify the original question. For example, the question "Do you do things that other people have posted about on any social media?" was revised as "Are there things you do or did that you learned about on social media?" which clarifies the intent of the question and focuses it more narrowly. Similarly, "Name a couple slang terms you use on social media" became "Have you picked up any slang words from social media? Name up to three and explain what they mean." The question shifted in response to the comments of the participants who composed it on their intent, and now includes a request to specify the terms themselves. The question "How often do you use social media and/or entertainment when you are also interacting with people face to face?" began as "Do you use social media during family time" (the "and entertainment" was added during the discussion), but was broadened to indicate any in-person interaction rather than just with family and to include electronic entertainment as well as social media—for example, video games. Some questions were combined, such as the two regarding the frequency with which participants check social media and play video games, and the two STEM questions. Other questions were omitted entirely.

Overall, the final questions are largely open-ended and substantially revised from the original proposed questions, and the number of questions was narrowed down. The teens did this narrowing themselves, deciding by voting which questions to keep and which to eliminate. There was no evident rancor about the questions that were eliminated. They were also engaged throughout the process of revising them, and as with earlier

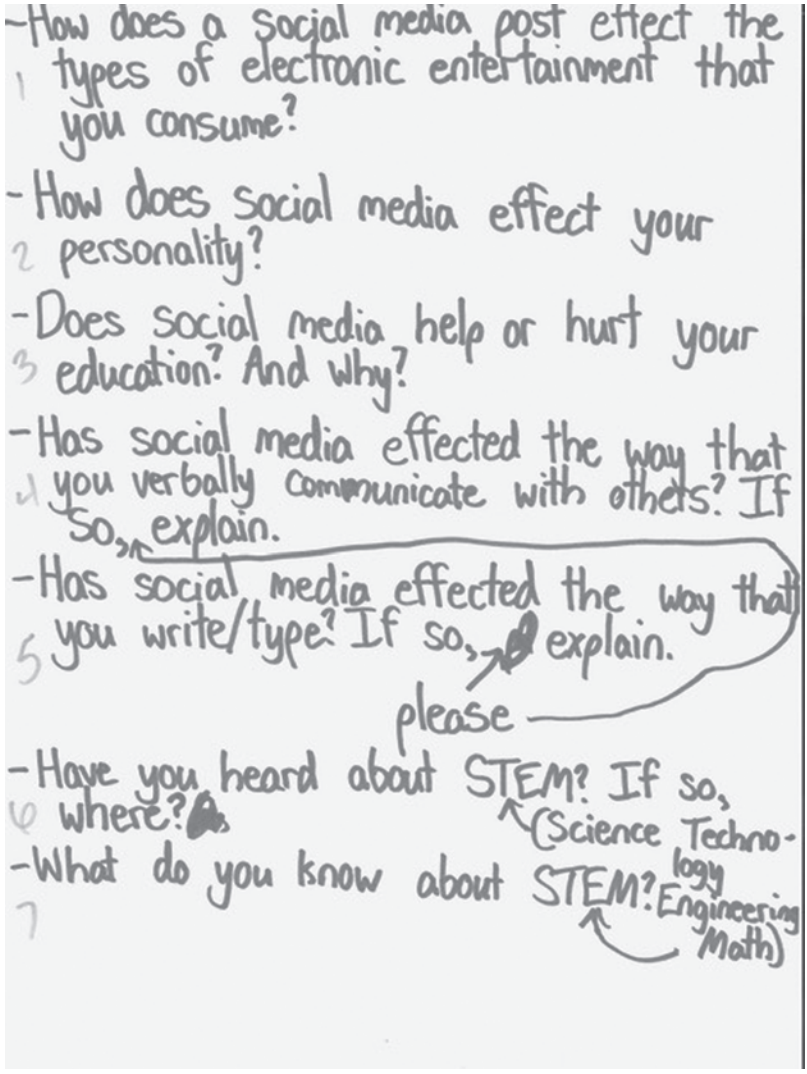

Figure 1. Questions generated by group 1.

activities, the researchers asked some leading questions, but for the most part allowed the participants to adjust without intervention.

Discussion

Our research has combined a participatory research perspective with a constructivist learning perspective. Based on our work, we consider this a fruitful combination: throughout the camp days, the teens remained

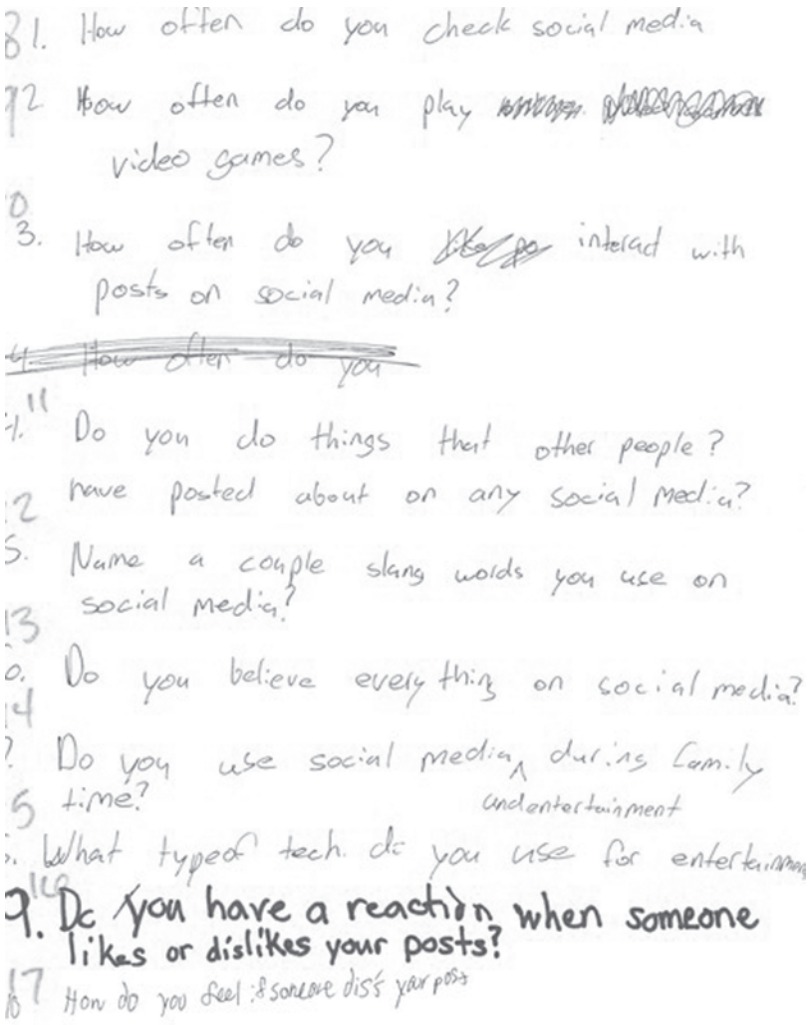

Figure 2. Questions generated by group 2.

engaged, collaborated effectively, and reflected on and discussed the material in ways that showed growing understandings. Their comfort with the researchers and with one another increased, as did their comfort with and enthusiasm for the research process. In this section we discuss the implications that our work has for coresearch with youths, as well for the application of this kind of pedagogy in these settings, and detail how we plan to conduct our future work in light of our findings.

Implications for Coresearch with Youths

Through our preliminary work, we find that although there is an enthusiasm in scholarship calling for coresearch with youths, the realities of implementing this kind of approach are complex and consume significant time and effort. While some of this is associated with the nature of pilot studies and will be less demanding in later iterations of our project, there are also considerations that will remain for any instantiation of the coresearch technique, which impact the results and processes described here. These include the great variety of contexts within which coresearch may be carried out, and the continued impact of lack of access to technology and related discourses (on topics of STEM/STEAM).

The contextual nature of this work means that coresearchers in different communities will have varying skills, perspectives, and goals. The Young Researchers in this first group are participants in the local 4-H club; in addition, they are all teens who chose to participate in a science and technology–focused camp on weekends, which may not be typical of their peers. They are from a geographically dispersed area with small population numbers, and their experiences and characteristics are not generalizable; however, it is worth noting that this type of population is perhaps underrepresented in the literature about teens and technology use. The distance we traveled to visit the teens in their residential area was considerable and presented logistical difficulties regarding providing ongoing support leading up to and during the administration of the survey they designed, although we have also been in contact via cell phone and email. These limitations have been the cost of working with a community that is distant from the university and also from large urban centers.

We focused our work on how youths interact with technology in a broad sense. We find that for coresearch study design, it is still crucial to consider the existence of disparities in access, despite current statistics revealing the strong prevalence of youths' technology access and ownership (Lenhart, 2015). Of the seven participants from our first site, only four reported having access to a personal cell phone and constant internet; one did not have a cell phone at all, one used a handheld gaming system to connect and had internet access only at his grandmother's house, and the third participant only recently began using email. Because of this, although we had initially planned to administer the codesigned survey online, we learned that some of them felt it would be necessary to use hardcopies; ultimately, we had more responses via paper than online. Despite our understanding of the variety of access and use practices among youths that belie the cultural perception of them as natural users of technology, paper being more convenient than an online option was somewhat unanticipated. There were also gaps in the Young Researchers' exposure to STEM concepts: fewer than half of the participants had heard the term *STEM* before, although it has been the subject of major nationwide initiatives for six years. These

technological considerations are likely in part related to working with a rural, dispersed community. But the diversity of access to technology and related knowledge evident in this work serves as a reminder that access should remain a consideration for any research examining youths' technology practices.

The Implications for Pedagogy

In addition to our focus on coresearch as a method, we are concerned with assessing the application of our pedagogical techniques. Here, we discuss some of the implications we are considering for our future interactions with coresearchers, including specifics about increasing available information sources, adjusting interaction styles, and accounting for more time together, as well as our plans to develop materials to support this kind of outreach by researchers and STEAM scholars who do not have professional experience working with youths.

The teens responded well to the mini-research and presentation processes they went through, but engaged less with the heavily textual material than with shorter text and multimedia. They engaged particularly readily with tasks that asked them to think critically about the experiments conducted by other researchers. In the future we plan to incorporate a wider variety of information sources to support this engagement. There are also many ways to vary the organizing of learning environments like this; for example, rather than having all the teens in a group engage with the same information, having them share information from different sources within the group can impact engagement when other groups are sharing. We found that although unstructured discussion generally went well, we sometimes needed to utilize strategies like think-pair-share, where the discussion leader asks the participants to consider a topic independently, then turn and talk for a minute or two to the person next to them before the group begins to discuss the topic. This was particularly useful when members of the group started to become distracted. Sometimes, a few stronger voices took control of the discussion, as often happens in group discussions, and ensuring that everyone had to be involved in discussions meant that the quieter teens were also able to articulate their thoughts. Placing everyone in the room in a large circle put the researchers on equal footing with the teens, and using "brain breaks" and unstructured break time to facilitate the breakdown of social barriers, successfully created the kind of collaborative environment that we had in mind, one conducive to a free and equal exchange of ideas and criticism.

While we were successful in codeveloping a research study, we also found that additional time would have been useful to allow for more exploration of potential research methods. Because we did not have much flexibility in terms of time, we selected a survey as the method for the first site, based on the relative ease with which it could be conducted.

In the future we would like the coresearchers to select their methods, which suggests that a fourth day of camp or more would be advisable in future iterations. This importance of time is further complicated by the idea that the teens who participated in this pilot study are extraordinary, in our collective experience, in that they had strong social skills and were accepting of one another and differing opinions. We did not have any concerns about or need to intervene to regulate behavior, and the group did not split into any identifiable smaller groups or alliances. Indeed, the Young Researchers themselves worked to ensure that all viewpoints were included and respectfully addressed in our discussions. We speculate that their involvement with 4-H has contributed to the social and emotional skills that have been an enormous asset in this setting. This work would be substantially different were we working with teens who were not as skilled at collaboration, and such a group of coresearchers would likely require additional time for setting shared norms about how to interact. Future iterations of the camp will allow us to examine how this might play out with other youths.

This pilot study has also been key in our identifying the importance of developing materials to support researchers and scientists in implementing these kinds of outreach activities. We have many years of experience in working with youths in learning settings, Buck as a school librarian and Magee as a public youth-services librarian. Because we realize how much we drew on our professional backgrounds to design and implement this experience, we are paying additional attention to developing a module that is practicable for academics who do not have that experience. This has prompted us to create more extensive plans for structured discussions with colleagues from a variety of STEAM fields who do not have professional backgrounds working with youths, in order to systematically identify needs and priorities for the publicly available curricular materials that we are creating.

Future Work

Our next steps with the Young Researchers will be to finalize the analysis and write about and present our shared findings. We will seek publication in professional journals, with the teen researchers included as authors—an uncommon opportunity for students at their age and level. In addition to our shared publication approach, we have plans for the Young Researchers to present their findings at the University of Illinois during Undergraduate Research Week, which is held during each spring semester. Following this, we will replicate the camps, though with the adjustments described above, based on what we have observed during this initial study. We aim to work with different populations and to have further iterations on the curriculum based on additional observations.

Once refined, the curriculum will be publically available online. Our

goal is to create a model that is easily replicable for scholars in any field around the country, and to develop a network of support for those who wish to use this model, including though not limited to teachers, librarians, after-school programs, summer camps, and university scholars. The curriculum and model we are developing through this project will be the basis for an approach that allows those working with youths, or who want to do so, to promote their engagement with STEM/STEAM fields, and to allow them to participate in scholarly level research prior to attending college.

This will also result in the exposure to STEM/STEAM and professional research for marginalized and disenfranchised groups, who would not normally have such access, and promote interest in these kinds of careers among such groups. Increasing scientific and research literacy has important implications not only for the youths who participate, but also for a democratic society in which an informed populace is the backbone of intelligent and constructive policy decisions. This will also help the youths who participate to develop critical-thinking skills, information-seeking skills, and a thoughtful approach to the science and research reporting that they encounter in their daily lives. It provides an opportunity for educators and scholars around the country to mentor youths who are interested in pursuing scholarly careers, and this preparation will potentially impact their success and likelihood to remain enrolled as undergraduates should they choose to pursue further study at the university level. Finally, it may positively influence the perceptions not only of participants but also of their peers regarding research and STEM/STEAM fields. We will examine these ideas as we continue our project.

Most importantly, our work focuses on empowering teens as scientists and researchers by helping them develop the tools and knowledge they need for this work. It recognizes that teens' voices and ideas are central to social science research about youths, and challenges traditional power structures to maximize the incorporation of those ideas into research. We understand that teens are a powerful group in our society, able to impact both economic and cultural norms; and that educating, empowering, and celebrating youths are good not only for the participants' intellectual development and the future workforce but for our democratic society as a whole. We intend for this work to provide a model that other scholars will implement, thus creating new opportunities for building relationships between teens and scholars and developing new understandings of the world that are informed by the perspectives of young people.

References

Anderson, R. D. (2002). Reforming science teaching: What research says about inquiry. *Journal of Science Teacher Education, 13*(1), 1–12.

Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist, 26*(3–4), 369–398.

Cahill, C. (2007a). Doing research with young people: Participatory research and the rituals of collective work. *Children's Geographies*, *5*(3), 297–312.
Cahill, C. (2007b). Including excluded perspectives in participatory action research. *Design Studies*, *28*(3), 325–340.
Chen, W. (2013). The implications of social capital for the digital divides in America. *Information Society*, *29*(1), 13–25.
Dierking, L. D., & Falk, J. H. (2016). 2020 vision: Envisioning a new generation of STEM learning research. *Cultural Studies of Science Education*, *11*(1), 1–10.
Dresang, E. T. (1999). More research needed: Informal information-seeking behavior of youth on the internet. *Journal of the Association for Information Science and Technology*, *50*(12), 1123–1124.
Fosnot, C. T., & Perry, R. S. (1996). Constructivism: A psychological theory of learning. In C. T. Fosnot (Ed.), *Constructivism: Theory, perspectives, and practice* (pp. 8–33). New York: Teachers College Press.
Guzdial, M. (1997, June 16). Constructivism vs. constructivism vs. constructionism. Retrieved from http://guzdial.cc.gatech.edu/Commentary/construct.html
Hazel, N. (1995, Winter). Elicitation techniques with young people. *Social Research Update, 12*. Retrieved from http://sru.soc.surrey.ac.uk/SRU12.html
Ito, M., Baumer, S., Bittanti, M., Cody, R., Herr-Stephenson, B., Horst, H. A., et al. (2010). *Hanging out, messing around, and geeking out: Kids living and learning with new media*. Cambridge, MA: MIT Press.
Jones, M. G., & Brader-Araje, L. (2002). The impact of constructivism on education: Language, discourse, and meaning. *American Communication Journal*, *5*(3), 1–10.
Larmer, J. (2014, January 6). Project-based learning vs. problem-based learning vs. X-BL [Web log post]. Retrieved from https://www.edutopia.org/blog/pbl-vs-pbl-vs-xbl-john-larmer
Lenhart, A. (2015, April). *Teens, social media & technology overview 2015*. Pew Research Center. Retrieved from http://www.pewinternet.org/files/2015/04/PI_TeensandTech_Update2015_0409151.pdf
Lolacono Merves, M., Rodgers, C. R. R., Silver, E. J., Sclafane, J. H., & Bauman, L. J. (2015). Engaging and sustaining adolescents in community-based participatory research: Structuring a youth-friendly, community-based participatory research environment. *Family & Community Health*, *38*(1), 22–32.
MacLeod, S. (2007). The Milgram Experiment. *Simply Psychology*. Retrieved from http://www.simplypsychology.org/milgram.html
MacLeod, S. (2016). Stanford Prison Experiment. *Simply Psychology*. Retrieved from http://www.simplypsychology.org/zimbardo.html
Maeda, J. (2013). STEM + Art = STEAM. *STEAM*, *1*(1), 1–3.
National Science Board. (2010, May). *Preparing the next generation of STEM innovators: Identifying and developing our nation's human capital* (NSB-10-33). Arlington, VA: National Science Foundation.
Nemer, D. (2015). From digital divide to digital inclusion and beyond. *Journal of Community Informatics*, *11*(1). Retrieved from http://ci-journal.net/index.php/ciej/article/view/1030/1131
Piro, J. (2010, March 9). Going from STEM to STEAM: The arts have a role in America's future, too. *Education Week*, *29*(4), 28–29. Retrieved from http://www.edweek.org/ew/articles/2010/03/10/24piro.h29.html
Powers, J. L., & Tiffany, J. S. (2006). Engaging youth in participatory research and evaluation. *Journal of Public Health Management and Practice*, *12*, S79–S87.
President's Council of Advisors on Science and Technology. (2010, September). *Report to the president: Prepare and inspire: K-12 education in science, technology, engineering, and math (STEM) for America's future*. Washington, D.C.: Executive Office of the President. Retrieved from https://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stem-ed-final.pdf
Reynolds, G. (2003, March 16). The stuttering doctor's "Monster Study." *New York Times Magazine*. Retrieved from http://www.nytimes.com/2003/03/16/magazine/the-stuttering-doctor-s-monster-study.html
Rideout, V. J., & Katz, V. S. (2016). *Opportunity for all? Technology and learning in lower-income families*. Report of the Families and Media Project. New York: Joan Ganz Cooney Center at Sesame Workshop.

Roth, W.-M., & Lee, S. (2002). Scientific literacy as collective praxis. *Public Understanding of Science, 11*(1), 33–56.

Subrahmanyam, K., & Šmahel, D. (2011). Connecting online behavior to adolescent development: A theoretical framework. In *Digital youth: the role of media in development* (pp. 27–39). New York: Springer-Verlag.

Williams, K. (2011). Rethinking digital divide research: Datasets and theoretical frameworks. In J. Chen, J. Shen, Q. Zhou, & W. Chen (Eds.), *Main fronts of information science and information management: Forum on information science and information management* (pp. 109–127). Beijing: Peking University Press, 2011.

Zimbardo, P. G., Maslach, C., & Haney, C. (2000). Reflections on the Stanford Prison Experiment: Genesis, transformations, consequences. In T. Blass (Ed.), *Obedience to authority: Current perspectives on the milgram paradigm* (pp. 193–237). Mahwah, NJ: Lawrence Erlbaum.

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