



# YR MEDIA Making WAVES: A STEM- Powered Youth News Network for the Nation

Rockman et al  
External Evaluation  
Summative Report  
2019

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# EXECUTIVE SUMMARY

YR Media (formerly Youth Radio) engages young people in digital media production that combines journalism, design, data, and coding. With support from the National Science Foundation (NSF), YR Media collaborated with the Massachusetts Institute of Technology's App Inventor to launch WAVES – A STEM-Powered Youth News Network for the Nation. This three-year initiative expanded YR Media's model of informal STEM education through the launch of a national platform that utilizes STEM-powered tools to create and distribute news stories, mobile apps, and digital interactives.

Rockman et al, an independent research and evaluation organization, conducted the external evaluation of the WAVES project. The evaluation offered formative and summative feedback using a case study approach. This report presents a summative assessment of the project's outcomes.

With an emphasis on making media that investigates issues and tells stories from youth perspectives, WAVES harnessed digital technology to develop young people's creative license and civic agency. The initiative broadened youth participation in STEM by creating systematic learning opportunities for diverse young people to collaborate with media professionals in producing story-driven, fact-based multimedia that reframes national dialogue on important issues related to science and technology.

WAVES' pedagogical stance directly addresses the need for meaningful relationships, relevant content, and rigor in STEM learning. YR Media's approach centers on the exploration of real world issues and problems through media production. Young people are expected to raise questions and observations about actual local, regional, and national issues and to consider the ways that these matters affect their lives and communities. Media projects emanate from questions and investigations that are relevant to youth. Although the expectations or publishing guidelines for media products often originate with educators and audiences, young people exercise free choice in selecting topics and devising plans that resonate personally and respond to events and social issues they care about.

Two key organizational developments of WAVES were: 1) the establishment of a National Network for youth news creating pathways for young people from across the country to contribute to YR Media's journalism from outside of its Oakland headquarters and 2) the expansion of YR Media's partnership with MIT App Inventor

to produce Youth Mobile Power, a series of do-it-yourself App Inventor tutorials that integrate youth journalism and computer programming.

The National Network's STEM Desk publishes news reports and commentaries exploring young people's perspectives on STEM-related stories. Over forty STEM stories were produced by contributors from around the US. Collectively, youth reporters working at YR Media and beyond are shaping national conversations about science, technology, health, and environmental issues that have significance for broad audiences.

The Youth Mobile Power app building guides drew on youth-produced stories as a way to frame App Inventor's visual block coding program. Each tutorial incorporates a YR Media story that explores how youth are using technology. Users move through a step-by-step process to build and customize their own related mobile app. The tutorials contextualize computer science concepts in youth journalism to maximize student engagement and provide substantive content to anchor computational practices.

WAVES demonstrated that youth engagement in STEM reporting, computational thinking and coding is deepened through critical computational literacy, that is, by participating in digital media projects that respond to real social issues affecting their lives and communities. The public nature of the youth media products establishes authentic audiences and offers tangible examples to pique young people's curiosity in STEM. YR Media's "collegial pedagogy," which positions young people as full collaborators working and learning alongside media professionals and peers in all phases of media production, creates dynamic learning conditions to convert that student curiosity into active investigation and production.

Through the WAVES initiative, young people have realized opportunities to become producers of journalistic media and interactive technology that have impacted the knowledge and attitudes of youth and adult audiences. By adopting and adapting STEM-powered resources developed by YR Media and MIT App Inventor, WAVES' growing network of youth, educators, journalists, and STEM professionals are participating in a loose coalition focused on mobilizing technology in ways that attend with care and responsibility to not just the market viability of products, but rather, their catalytic validity to provoke social change.

# INTRODUCTION: YR MEDIA MAKING WAVES WITH/IN STEM



YR Media (formerly Youth Radio) is a non-profit media production company based in Oakland, CA that works with youth from culturally and economically diverse backgrounds to provide educational opportunities and career pathways into journalism, digital media, arts, and youth development. Most of YR Media's youth participants come from historically underrepresented groups in STEM. More than 80% are low-income or youth of color, approximately 50% are girls, and 30% are involved in foster care or the juvenile justice system.

Following a 6-month core training in journalism and media production, young people aged 14 to 24 years can apply for a range of quarterly paid internships to develop their knowledge and skills in media and technology creation. Through collaborative production and mentoring by peers and professionals, youth participants receive hands-on training as journalists and media producers. The result is a culturally- and generationally-diverse learning community that brings under-represented youth perspectives to bear on pressing matters of broad public concern.

YR Media's approach to informal science, technology, engineering and math (STEM) education intentionally draws on young people's interests in media and technology to scaffold learning. Youth participants and professional staff are positioned as collaborators in shared projects that develop decision-making skills, computational thinking and creative confidence. This model for youth-adult collaboration, or "collegial pedagogy," (Soep & Chavez, 2005, 2010) creates new forms of interactive media and learning resources that incorporate diverse voices and stories. STEM learning takes place in an environment that embraces cultural differences, encourages perspective-taking, and applies rigorous journalism standards in producing media and technology for real audiences.

With support from the National Science Foundation (NSF), YR Media teamed up with the Massachusetts Institute of Technology's App Inventor to launch WAVES – A STEM-Powered Youth News Network for the Nation, a three-year initiative to expand YR Media's model of STEM education through journalistic media and app development.

In announcing the NSF project, former Congresswoman Barbara Lee said, "Youth Radio is a gem in our community and a global leader in innovative science journalism." She added, "STEM education is the key to our economic future. We must equip our young people with the necessary skills and creativity to succeed in the 21st century global economy."

Conceptually, WAVES built on pedagogical knowledge gained in part from prior informal science initiatives, including DO IT! (NSF AISL Grant #1011085), NEXT: The Youth Radio Innovation Lab (NSF AISL Grant #1323791), and From Data to Awesome (NSF ITEST Grant #1513282). These projects helped develop YR Media's institutional capacity to engage under-represented youth in informal STEM learning through interest-driven inquiry that combines journalism, design, data, and code.

WAVES leveraged the national presence of YR Media, MIT App Inventor, and partner media outlets, such as NPR, The New York Times, KQED, and KCBS, in the establishment of a national platform to promote and distribute student-produced media. YR Media's National Network consists of emerging journalists and media makers around the Bay Area and across the country, collaborating with professional journalists and STEM educators to develop multimedia for real audiences. The National Network's STEM Desk primarily focuses its lens on issues and innovations in technology and the relationship between science and society, situating STEM in social, cultural, and ethical contexts.

This final evaluation report examines the underlying philosophy, implementation strategies, and outcomes of the WAVES project. The remainder of the report is broken into five sections:

- Brief overview of the evaluation methods,
- Theory of change underlying WAVES,
- Samples of published youth media products,
- Discussion of findings, organized by research question, and
- Concluding remarks.



Photo by Pixabay from Pexels

## EVALUATION OVERVIEW

Rockman et al (Rockman), an independent research and evaluation organization, served as the external evaluator on the WAVES project. Rockman has conducted independent evaluations of YR Media's prior NSF-funded initiatives.

Rockman's evaluation of WAVES assessed the project's implementation and outcomes, offering recommendations to support the project's research goal of understanding the pedagogical conditions that educate and empower young people through equitable, hands-on STEM engagement. The overall research questions guiding the project, as well as external evaluation, were:

**RQ1.** *What key scaffolds pique young people's curiosity about STEM and enable youth to convert that curiosity into active investigation and production?*

**RQ2.** *What conditions make STEM learning not just educative but equitable and empowering, in the sense that underserved young people achieve authorship, leadership, and agency in their communities and in public spheres?*

**RQ3.** *What is the key evidence educators should look for to determine that young people are in fact learning STEM through hands-on multimedia production and app development, in ways that are visible in their projects as well as in their interests and identities?*

**RQ4.** *What difference does it make when critical computational literacy drives the making of STEM stories, apps, and educational resources for mass distribution?*

The external evaluation offers an independent view of the project's results to formulate and share new knowledge on theory and practice related to informal STEM learning. Rockman provided both formative and summative feedback to help the research team critically examine: (a) the extent to which the WAVES project was meeting its intended goals and objectives, (b) new questions and potential unintended consequences, positive or negative, arising from this work, and (c) the intellectual merits and broader impacts of the project.

The evaluation employed a case study approach, which enabled inquiry into changes over time in program implementation, collective knowledge, and participant outcomes resulting from use of interactive apps, news stories, and digital resources.

The evaluation drew on and extended existing instruments and methods developed in prior NSF research projects, which have proven to be useful in studying informal STEM pedagogy at YR Media. Evaluation protocols were adapted using processes negotiated in previous projects. Evaluators continued to ideate, refine, and expand on shared research tools, based on evidence for content and process validity collected through expert review (Gehlbach & Brinkworth, 2011) and cognitive interviews with youth and educators (Bass, Dritz-Esser & Stark, 2016).

Data collection activities undertaken to inform the evaluation included:

- *Staff interviews* to review project activities, discuss implementation, and explore YR Media educators' perceptions and experiences related to youth engagement and learning.
- *Youth focus groups and interviews* to explore youth participants' perceptions and experiences working at YR Media or in the National Network.
- *Observations* of WAVES-related classes at YR Media to examine instruction and learning interactions when STEM educators and youth collaborate to produce STEM media.
- *Stakeholder interviews* with STEM professionals who partnered on project activities to identify lessons learned, the most significant changes they have experienced, and the factors that may have contributed to this process.
- Literature searches and review of project team research, conceptual frameworks, and evaluation tools related to youth media production and assessment of informal STEM learning.
- Analysis of youth media products to identify evidence of STEM learning.
- Audience focus groups, interviews, and surveys with educators and youth that have used the mobile apps, news stories, and other media produced through WAVES, in order to explore the potential impact of these products with target users.

Collected data were read and coded iteratively using the constant comparative method (Charmaz, 2008). Research memos were employed to raise questions, clarify researcher logic, and develop analytic codes. Members of the YR Media and Rockman teams met periodically to share and analyze data, discuss emergent findings, discuss challenges and promising strategies, and explore the implications and potential applications of this informal STEM pedagogy in a range of settings.

# THEORY OF CHANGE AND ACTION

In approaching this collaborative project to develop YR Media's STEM learning strategy on a national level, the WAVES team began by fleshing out the shared goals, operating theories, and imagined impacts of the initiative. The articulation of the program logic helped to create a conceptual road map to study the linkages holding together the initiative's core components, underlying assumptions, and ultimate outcomes.

WAVES built on and expanded YR Media's long-standing collaboration with MIT App Inventor, as well as public and corporate media organizations, to broaden participation in STEM by "unlocking robust learning pathways for thousands of young people and partnering with them to reframe national conversations on key social issues related to science and technology in our lives" (Soep et al, 2019, p.1).

The WAVES initiative was grounded in a theory of change that assumed IF YR Media and its cross-sector partners:

1. engage culturally-diverse, often under-represented young people in using and producing STEM-powered media that responds to real issues and stories affecting their communities and the environment,
2. employ "collegial pedagogy" that positions young people as full collaborators alongside STEM-powered media professionals in all phases of media production for real audiences, and
3. teach young people to create STEM-powered media through an iterative design-based approach that reflects journalistic principles and critical computational literacy practices;

THEN, young people will:

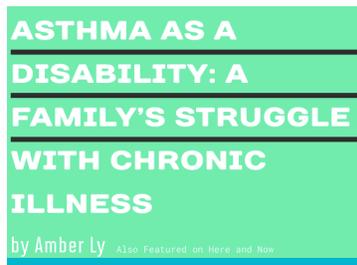
4. become leaders in producing cutting-edge media and technology that have the potential to impact the knowledge and perceptions of youth and adult audiences, and
5. play key roles in the development of a STEM-powered learning network of youth, educators, journalists, and STEM professionals that shares, replicates, and adapts YR Media's model of informal STEM learning in diverse settings.

# FROM THE NATIONAL NETWORK'S STEM DESK: SAMPLE STORIES

YR Media's STEM Desk presents young people's perspectives on science-, tech-, and health-related issues. In addition to STEM stories created by youth working at YR Media, WAVES established new pathways for youth from across the country to contribute to YR Media's journalism. The National Network published stories from 123 youth reporters from outside their Oakland headquarters. In total, over 40 STEM stories were produced from around the US.



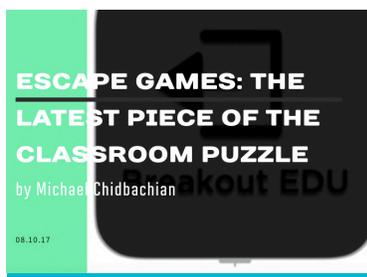
[Hidden No More: STEM Spotlight Shines on 'Hidden Figures.'](#) Interview with MIT student about her work to counter the hidden biases in computer code that can lead to systemic discrimination.



[Asthma As A Disability.](#) Personal commentary discussing the social and economic consequences of living with asthma. Featured on NPR's Here and Now.



[A 17-Year-old Made a Computer Program that Raps. But Is It Art?](#) Interview about the process and the implications of building a neural network that generates lyrics.



[Escape Games: The Latest Piece of the Classroom Puzzle.](#) News story highlighting the educational uses of escape games, which require students to collaboratively solve a puzzle or challenge.



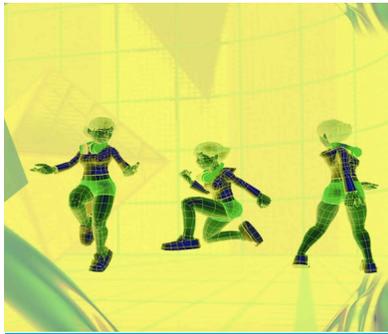
[Gen Z Won't Let #NetNeutrality Go Without A Fight.](#) Op ed examining teens' views about controversial changes to FCC rules repealing net neutrality that required Internet service providers to charge all Internet communications equally.



[Girl Who Rose to Gaming Stardom Was Actually One Guy's 'Social Experiment'.](#) News story reporting on the harassment and cultural barriers women face in the e-sports gaming industry.

# YOUTH RADIO INTERACTIVE (YRI): SAMPLE DIGITAL INTERACTIVES

In YR Media's Interactive department, youth interns combine programming, design, and journalism to develop new technology tools and tell stories in interactive ways about social issues facing the environment and their communities. Throughout the WAVES project, 16 digital interactives were produced and distributed.



## Can You Teach AI To Dance?

News story and interactive website that shines a spotlight on the subjectivity of Spotify's "danceability" algorithm, used to rate songs based on predetermined criteria and automate song recommendations for users.



## What if You Ruled the School Dress Code?

Personal commentary and interactive website that explores the basis for school dress codes, the implicit social messages behind the official policies, and how policies are interpreted in practice.



## Remix the Movies

Interactive website that examines the representation of race and gender in Hollywood movies. Users select categories to search for movies with lead roles played by actors from under-represented groups.

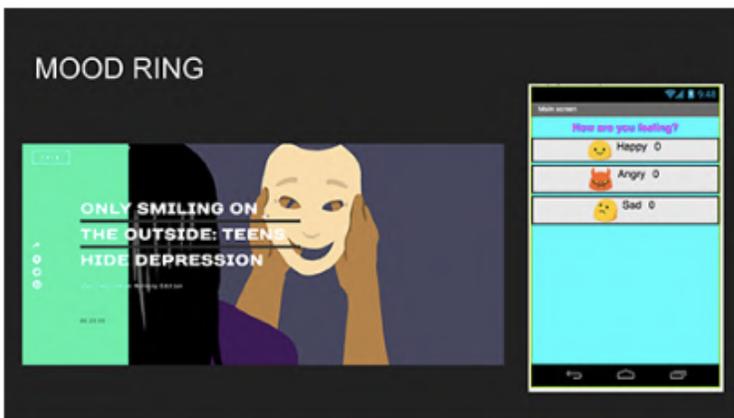


## Ready to Vote?

Interactive website, created with a National Network contributor, featuring a quiz to test one's knowledge about the electoral process and encourage youth participation in voting.

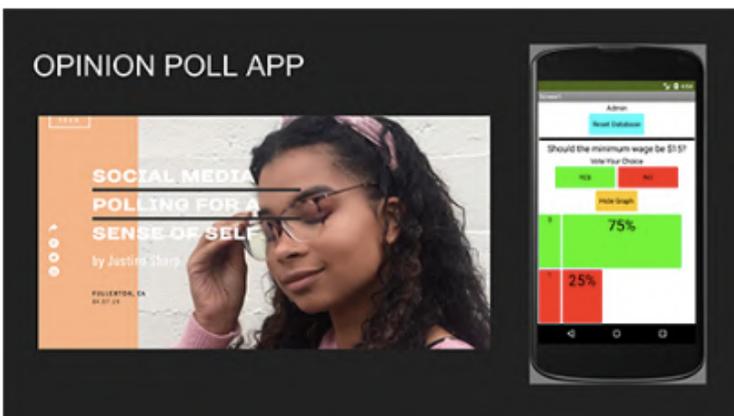
# YOUTH MOBILE POWER SERIES: SAMPLE APP INVENTOR TUTORIALS

The [Youth Mobile Power](#) series integrates youth journalism with computer science learning. These app building guides feature youth stories and learning tools that highlight youth media-making and help others to replicate and extend YR Media's technology projects using MIT App Inventor. WAVES produced nine (9) app building guides have been downloaded by over 100,000 users in and outside of the United States, including South Korea, Spain, Taiwan, and Russia.



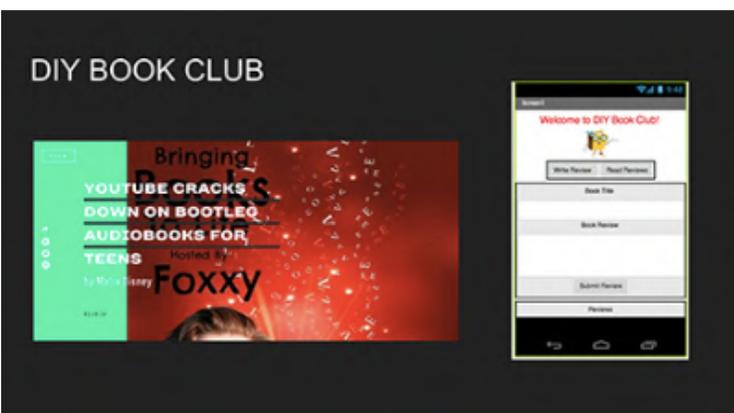
## Mood Ring

This beginner-level tutorial shows users how to create an app to track one's emotions using emojis. Connections to stories about YR Media's Mood Ring app development and social-emotional well-being: [Only Smiling on the Outside: Teens Hide Depression](#) and [Could Your Next Therapist Be Your Phone?](#)



## Opinion Poll

This intermediate-level tutorial connects to YR Media reporting on the use of [polling on social media](#) and an interactive quiz about [the polling and voting process](#). The guide helps users create a polling app to gather opinions and display the results.



## DIY Book Club

In this intermediate-level tutorial, students learn how to create an app that enables users to write and share reviews of favorite books or music. Inspired by [YR Media's story](#) about the rise of bootleg audiobooks on Youtube and efforts to halt copyright infringement.

# ACTIVATING CURIOSITY ABOUT STEM TO INVESTIGATE AND TELL STORIES

**RQ1. What key scaffolds pique student curiosity about STEM and enable youth to convert that curiosity into active investigation and production?**

At YR Media, STEM learning does not always explicitly address STEM topics. Youth and educators often create media that directly tackle STEM-related content. However, other projects are deemed STEM media because they incorporate or create technology, integrate multi-modal data, or apply scientific and engineering practices in the media production process.

The WAVES initiative leverages digital media production to engage young people in researching social issues affecting their own and others' lives. WAVES draws on STEM-powered media tools to create and broadly distribute news stories, mobile apps, and digital interactives. Working as paid YR Media interns, youth participants are tasked with designing and developing news stories, mobile apps, or digital interactives that illuminate a problem or story of importance. YR Media educators invest time and energy in creating and maintaining a personalized learning environment that reflects and respects the evolving questions, interests, and strengths of participating youth.

YR Media's published body of youth-made media demonstrates that "by sustaining a community and space that facilitates youth-driven, problem-solving explorations on topics they are passionate and knowledgeable about, youth can create dynamic, complex digital products that speak to the complexities of culture, in subtle and nuanced ways" (Lee, forthcoming, p. 2).

The initial draw for many youth participants at YR Media is the allure of learning to create digital multi-media and the promise of getting paid to do it. The ability to fairly pay young people's work is not only a motivating factor but, in some cases, the enabling factor. Students often have competing responsibilities, such as sibling child care or part-time work, necessary to help support their families. One youth intern said, "I've been interested in technology and coding for a while, so this is great for me. But if it wasn't paid, I wouldn't be able to do it."

The public nature of the YR Media artifacts provides tangible examples to spark young people's curiosity and channel their interests in journalism, creative arts, or

computer science. In WAVES's first year, YR Media worked both internally and externally with partners to negotiate and establish protocols for communicating and collaborating on its efforts to nationally scale a model for professional learning with young people and educators. In addition to maintaining long-standing partnerships with NPR and Bay Area media organizations, YR Media successfully cultivated new alliances with Teen Vogue and the New York Times, which significantly broadened the audience reach into national and international markets.

A key development of WAVES resided in the expansion and refinement of YR Media's partnership with MIT App Inventor. Through the Youth Mobile Power series, the team incorporated high-impact journalism with computer science learning. Using youth journalism as a creative framework to introduce App Inventor's visual block coding program, the Youth Mobile Power App Building Guides offer a means to contextualize young people's exploration of computer science concepts and computational thinking skills. The self-paced tutorials, which range from beginner to advanced, were formatively tested with a range of teachers and students and then released to App Inventor's worldwide practitioner community. Each Youth Mobile Power tutorial starts with a YR Media story examining how young people use mobile technology in powerful or surprising ways. The guide then takes users through a step-by-step, scaffolded process to build and customize their own related mobile app.

One high school student learning to code, who was introduced to YR Media and the App Inventor tutorials by a computer science teacher, explained:

"[YR Media] has some cool stuff. I checked out some of their articles... It made me more interested to see what they were making... It gave me ideas about what I could do with my own app."

The WAVES team launched the Youth Mobile Power app building guides to offer a new type of tutorial on App Inventor that could enable users to "better understand how to use App Inventor and think about new ways to engage coding for what purposes," explained one MIT staff. The tutorials meant to inspire young people learning to code by helping them understand mobile technology development in the context of current issues and social problems impacting youth communities.

Through MIT's own formative testing with high school teachers and students, the team observed that, "When you introduce specific YR Media products [when teaching App Inventor], user engagement goes up," said one MIT designer. In the absence of the story, the app building tutorials can seem abstract and technically difficult, in

particular for App Inventor beginners. “The moment you put a face to it, students can visualize the task,” said the MIT designer, “We are story-driven creatures. Most people need something to relate to.” As a result, the App Inventor team situated each tutorial around a specific story and digital media produced by YR Media.

High school teachers who tested the Youth Mobile Power guides reported that the tutorials were highly engaging, functionally intuitive, and differentiated to work with multiple skill levels. Most teachers felt that the inclusion of youth stories served to elevate students’ interest in discussing the underlying issue addressed by the app. One computer science teacher and member of the App Inventor community said:

“I think my students related to the tutorial more because of the youth story. They respond well to the youth voices. The language is more current... The stories are presented in a way that’s authentic and relatable. I think it made them [students] want to go a little deeper into the topic.”

Another high school teacher was excited about the integration of storytelling with app building:

“My students care that they are doing something meaningful... Youth storytelling and journalism is such a powerful way to get students involved in thinking about their communities, to get them civically involved. The [Youth Mobile Power] tutorials put the power of storytelling into the app making process.”

Other computer science teachers appreciated the meaningful social context surrounding the tutorials:

“When I saw the YR Media connections, it made sense right away. I got pulled in to the human interest part... I think it really helps to draw in kids not immediately interested in coding or CS... For the kids really interested in the social issue, they can do deeper.”

“I like the inclusion of the stories. I don’t really have time to explore the social issues in depth within the class. We usually make the connection to a social purpose for their apps pretty quickly. For most students, it tends to be fairly easy to identify the issue. With this, they see how other teens made the app and what issue they were trying to solve.”

One teacher questioned whether organizing the app building tutorials around a single social issue and a specific story could inadvertently stifle student creativity by

limiting their frame of reference to just one of many possible approaches to a particular problem. The teacher typically prefers to leave the subject of classroom projects open-ended, allowing students to identify an issue that matters to them. However, this teacher and others acknowledged that for students who struggle to engage with computer science or have difficulties choosing a focal topic, Youth Mobile Power provides relevant, well-researched youth perspectives that tie conceptually to the App Inventor guides.

Young people who tested the tutorials offered largely positive feedback as well. In one high school CS class that utilizes App Inventor, students were given the option to

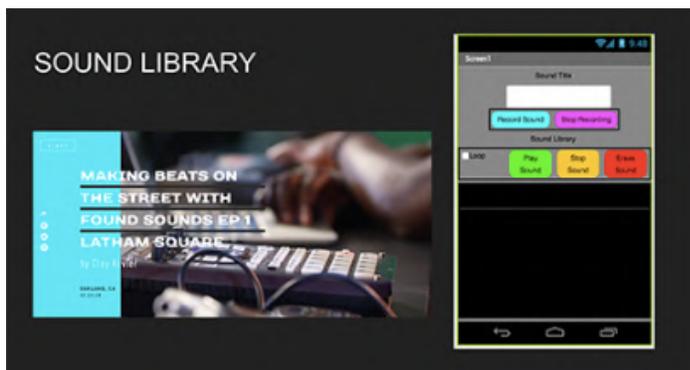


Figure: Youth Mobile Power, Sound Library

select one of the App Inventor guides, follow the tutorial, and create their own extension on the app. Two students shared their thinking for selecting Sound Library, an intermediate-level tutorial that challenges users to make an app that records, stores and plays sounds.

After watching the linked YR Media video story [Making Beats on the Street with Found Sounds](#), the students were motivated to make their own app.

“It was cool they were making beats from street sounds. I play around with producing music so that struck me... I’ve thought about recording street sounds like that to put into a beat.”

“I like how it showed where the idea for the app came from... The guys in the video were pretty funny... It kind of made me more interested in the assignment... I’ve already got an app to make beats. It’s not simple like this one, but it was cool to make one myself.”

Feedback from educators, students, and project stakeholders demonstrates that young people’s curiosity about coding and other STEM practices is piqued when they are able to practice computational thinking in the context of relevant, real-world media production. In particular, student engagement is heightened when media projects explore social issues they care about, achieve purposes they identify as important, and aim to reach real audiences.

# CREATING CONDITIONS FOR EQUITABLE AND EMPOWERING STEM LEARNING

RQ2. What conditions make STEM learning not just educative but equitable and empowering, in the sense that underserved young people achieve authorship, leadership, and agency in their communities and in public spheres?

YR Media operationalizes STEM learning within an environment of youth-adult collaborations in digital media production. WAVES was intentionally grounded in three key practices that combine to establish educational conditions that are effective, equitable, and empowering for youth.

## 1 Peer Education

YR Media relies heavily on peer assisted learning and development. From the outset, youth participants are trained and coached by other young people working as peer leaders alongside journalism and media professionals. While peer teachers usually have more media experience than other youth interns, the peer education dynamic is one of equals and shared decision-making.

## 2 Collegial Pedagogy

“Collegial pedagogy” (Soep & Chavez, 2005, 2010) refers to the process of partnering young people with media and journalism professionals to co-design and co-create media products for real audiences. Through a shifting of roles, the final products that reflect the experiences, perspectives, and creativity of youth and adult contributors.

## 3 Critical Computational Literacy

“Critical computational literacy” (Lee and Soep, 2018) is a pedagogical and conceptual framework that combines computational thinking and critical pedagogy to design media and technology that tackle social issues and expand young people’s understanding of the social, cultural, and political forces that shape our world.

YR Media's longstanding philosophy of collegial pedagogy centers on the maintenance of a collaborative learning community in which young people partner with media professionals to co-create multimedia products intended for public consumption. Throughout each stage of production, young people and adults must work together to design and develop news stories and interactive media. While they bring different skills and perspectives to the table, neither the youth interns nor their adult mentors could do the work or achieve the same impact without the others' creative participation (Lee & Soep, 2016, 2018; Soep & Chávez, 2005).

The iterative media production process necessitates educators with genuine interest in exploring issues that young people care about, helping to identify educational and newsworthy angles, and deepening youth perspectives on those issues through research and open dialogue. YR Media staff intentionally develop inclusive work environments that encourage youth of all cultural and linguistic backgrounds, , gender identities, and sexual orientations to freely express their identities, ideas, and points of view.

With each new cohort of youth participants entering Core training and starting paid internships, considerable time is devoted to build relationships among peers and between staff and youth. By carefully attending to the development of these relationships, educators remain cognizant of the interests, aspirations, uncertainties, and fears that inherently shape young people's engagement and learning.

These peer-to-peer and youth-adult collaborations start with an issue or problem that youth are interested in or passionate about investigating. Developing youth media around complex social issues requires adult collaborators who have knowledge about societal dynamics, expertise in journalism or social science methods, as well as insight into student's own lives and lived communities (Lee, forthcoming). YR Media educators consciously work to establish and maintain "a learning ecology that values and leverages the prior knowledge, experiences, and backgrounds of our youth, while fostering the rigorous skills necessary to produce high quality media that reaches audiences in the tens of millions." (Lee & Soep, 2018).

This three-pronged approach positions young people as critical consumers and producers of digital media and technology. Putting trust in youth to become valuable, creative contributors of publishable media is an abiding belief that shapes YR Media's in-house mentoring of youth interns, the formation of its' National Network of young

journalists, as well as the development of Youth Mobile Power's App Inventor DIY tutorials.

### *Youth National Network*

In launching the National Network, organizational leaders understood that these three core practices would need to be adapted to fit the shifted context. Two key constraints they faced were time and distance. Within YR Media, all youth participants engage in intensive classes that introduce them to media production, opinion writing, and journalistic inquiry to examine social issues impacting their communities and the environment. After they enter internships, youth work after school several days a week to develop their media projects. "One challenge with having youth drive decision-making is the amount of time it takes to achieve results," said a YR Media staff member, "I'm not exaggerating when I say we spent hours discussing and researching the topic and figuring out how they wanted to approach the story...before actually making anything."

The National Network consists of emerging journalists scattered across the country. This created an obvious barrier to intensive in-person training, brainstorming, and idea development. "It simply wasn't possible to invest the amount of time we do [at YR Media]," explained a staff member mentoring youth in the National Network. "I wish we had the capacity to develop a small cadre of writers without much experience, but the focus is more on growing the number of youth writers nationally."

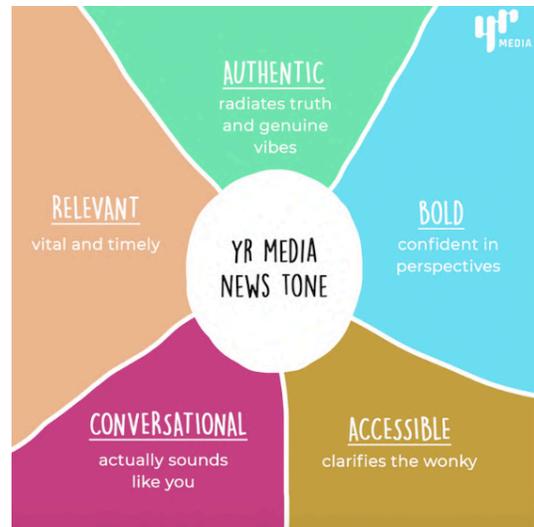
As a result, alongside emerging writers with minimal experience, there was a need to identify and recruit youth who already possess relatively advanced analytic and writing skills but are not already professionally employed. YR Media staff tapped into their social network of youth-serving organizations and small media outlets to find young people capable of working semi-autonomously and collaborating with an editor remotely. The editorial teams also worked to develop new "signature product" formats, such as listicles and photo/caption posts, with relatively low barriers to entry so even contributors with relatively little experience could produce for the network.

One young person who participated in the STEM Desk described the editorial process and the importance of having a background in journalism.

"I got a lot of editorial guidance from [YR Media staff]... They helped out with framing the story, deciding on the interview questions, and editing the flow. They were the first set of eyes on the piece and gave me specific feedback...They took

care to welcome me and support me, but there was a lot of work I had to do on my own. I've got a lot of writing experience. I don't think it would've worked as well if I didn't already have experience shaping pitches."

To further address the barriers to participation for youth with limited journalism experiences, the editorial team created a series of [DIY resources](#) and [annotated YR Media stories](#) to assist young people interested in contributing to the National Network. Covering a range of topics, including crafting a pitch, live reporting on social media, ensuring accuracy through fact checking, understanding ethics in journalism, and adopting a news tone, the guides provide tips, style guides and recommendations to help write stories that YR Media is most likely to publish.



Infographic from [DIY: YR Media News Tone](#)

As contributors develop competencies in specific areas, they exercise increasing independence in the editorial process. A STEM Desk writer who had two years experience working on a high school newspaper before joining YR Media's network observed a gradual release of responsibility by the editor:

"The first story I did, [YR Media editor] was more directly involved. There was a lot of back and forth. For the second one, I think they saw I could be more on my own."

The young people received feedback at key stages in the writing, in particular when pitching and editing a story. A youth contributor said, "Before I made the pitch, [YR Media] sent me some background material. They gave me the overall topic, and I had to research it and to figure out the angle."

A YR Media staff stressed the importance of setting clear expectations and then giving youth the opportunity to lead:

"We send them a research frame to help narrow down a topic. I see this as a jumping off point. I prefer the writer to put together the assembled materials and look closely at their background research, interview, and notes and then find the story. What's the soul of the piece?"

The intensity of the editing process is regulated based on the individual's needs as a writer and the complexity of the subject matter. A YR Media staff member explained why the STEM Desk usually entails in-depth editing:

"Sometimes the material doesn't warrant such intensive editing. But STEM stories have great complexity that need nuance. They warrant an intensive process. Because the concepts are multi-faceted, we need to ensure that we get it right. We're not scientists or techies. We're primarily journalists. You have to do your homework to make sure you ask the right type of questions to get below the surface."

As journalists reporting on STEM stories, extra attention is paid to how the issues are framed and language choices. A youth contributor argued that it's not necessary to have content expertise in science or technology, but one must have an interest and willingness to delve deeply into the content.

"I'm not a quote-unquote STEM person. I don't have a background in science so I had to do a lot of reading to familiarize myself and ask the right questions... I relied on [youth scientist interviewed] and asked him to explain things in lay terms."

Sometimes, the editorial team decides that there is a need to significantly revise a story. "When the message is, 'You need to redo this,' we have to be mindful how that's communicated and what type of support we give to prevent demoralizing them," said one staff member.

YR Media educators must strike a balance between the learning- or youth development-driven goals of a youth-serving organization and the product- or deadline-driven goals of a public media organization. This is an enduring tension that youth and adults at YR Media must navigate. Teens who intern in-house at YR Media may spend a year or more learning how to pitch newsworthy stories and commentaries, identify the youth angle in the story, conduct background research, interview experts, script, and edit, prior to releasing their work for public consumption. However, given the National Network's geographically dispersed group of youth journalists and tighter timelines, it became trickier to work with youth who needed significant coaching attention. In scaling the newsroom nationally, YR Media made the human resource decision to cultivate a diverse contributor pool that included young people who possessed the requisite skills to tailor writing for specific purposes and audiences, to work independently, and remain largely self-motivated.

This freed up editors to do concentrated work with emerging voices who required more dedicated support to produce content for publication.

### *Youth Mobile Power*

MIT App Inventor is a visual block language program and online community designed to support beginners and non-programmers to create their own mobile apps. Since its inception, the makers of App Inventor have sought to reduce or remove the barriers to computer science education. At YR Media, App Inventor is used to introduce new interns in the Interactive department to computer science concepts and to create mobile apps, such as [Mood Ring](#). The program provides youth an on-ramp to coding and app development. One YR Media intern said:

“App Inventor was great because I understood pretty fast how coding works. I got the concepts and could start building in the program right away. I know I’m not an expert but I could still jump right in. It’s cool to see your ideas on the screen.”

For years, the App Inventor team has partnered with YR Media to pilot test its product updates and tutorials with the young people learning to integrate journalism and coding. Before rolling out service upgrades or new tutorials, educators and interns in YR Media’s Interactive Department implement and provide feedback on functionality and usability. As part of WAVES, App Inventor grew its field testing sites to include high school computer science classrooms. By collaborating with formal educators teaching computer science, the WAVES project expanded its capacity to understand about the scalability of the educational resources.

Based on feedback from YR Media and collaborating teachers, the MIT App Inventor team designed a new type of tutorial aimed at enhancing user engagement, expanding built-in supports, and improving usability. The Youth Mobile Power series responded to a key learning obstacle present in previous App Inventor tutorials that required users to open multiple windows on their computer in order to read the instructions and navigate the App Inventor coding. The new series allows users to toggle all necessary tutorial components on one screen, including how-to instructions, gifs animating each step along the way, and their coding workspace. As a result, students no longer need to switch back and forth between screens, letting them read the tutorial and see what to do at the same time they are building the app.

The Youth Mobile Power series integrated targeted learning scaffolds in App Inventor that riff off of youth-produced stories. As discussed in the previous section, the incorporation of YR Media stories into the tutorials serves as a key mechanism to spur young people's interest and ideas to build their own mobile apps. One high school teacher maintained:

"The powerful thing about App Inventor is that it's not just teaching students how to code. It's getting them to think creatively and solve problems. It helps them to use computational thinking to build apps. And they don't need to have a background in CS to do it."

Moreover, with the development of the App Inventor tutorials, teachers can learn how to code and lead app building projects in the classroom, an MIT project member explained.

Teachers and students who tested the Youth Mobile Power tutorials found the resources to be highly engaging, in large part as a result of the embedded YR Media stories as well as students' broad based interests in learning to make mobile apps. In general, teachers implementing App Inventor projects in the classroom did not face difficulties getting students excited about designing their own apps. "There's so much value in making something that students care about," said a high school teacher.

Participants said that the tutorials offered ample amounts of scaffolding that included detailed instructions and procedural information. Two teachers said:

"[The tutorials] aren't easy. A lot of my students wanted to make the Opinion Polls app. It was tough and pretty involved. You have to stay focused, but the guide gets you where you need to be if you follow along."

"I feel like nothing is missing in terms of step-by-step process. There's so much attention to detail. It's easy to look at the code and get help from tutorial itself."

In particular, the teachers were impressed with the differentiated supports built into the app building guides. Each tutorial offers step-by-step instructions. For students who are struggling, there are two forms of just-in-time feedback to get help. There are embedded links to "show a hint" for how to complete each step or to "see a solution." One teacher highlighted the importance of these built-in supports:

“It’s almost like having an App Inventor teacher to help out as students work through the tutorial... It’s great because I can offer more options for my students. They’re all at different levels of comfort and knowledge.”

With an expert collaborator to assist when they experience difficulties, students are able to extend their work further and accomplish more than if they were left entirely on their own. At the same time, students can complete the tutorials individually. In many school-day classrooms, teachers shy away from group projects in order to more easily assess individual student learning. Most of the teachers we consulted preferred giving students projects to complete individually, allowing them to ask peers questions and share ideas but not to write code for one another.

The Youth Mobile Power series advanced YR Media and App Inventor’s goal of democratizing tech production. The tutorials broaden access to computational thinking and computer science principles. With these guides, the purpose of app building is contextualized in real-world, youth-led investigation and storytelling. The process of app building is supported through features that enable students, regardless of ability level, to focus on learning the underlying concepts of coding without having to first learn a programming language.

# DETERMINING EVIDENCE OF STEM LEARNING IN MEDIA PRODUCTION

**3. What is the key evidence educators should look for to determine that young people are in fact learning STEM through hands-on multimedia production and app development, in ways that are visible in their projects as well as in their interests and identities?**

The WAVES project aimed to expand YR Media's model for engaging youth in STEM media production and help others to replicate and adapt this model in their own educational settings. As this network of youth producers and STEM educators grows, it is crucial to assess STEM learning in ways that are transparent to youth and adults. By articulating what is meant by STEM learning and providing examples of key evidence to determine that young people are in fact learning STEM through media and technology production, this project can deepen educators' understanding of what young people learn as they produce digital media.

YR Media's approach to STEM draws on educational research and theories that young people need ongoing opportunities to engage in inquiry practices that build on and expand their existing understanding of the world. STEM media production provides entryways for youth to think critically and act in ways that mirror how STEM professionals conduct their work. This type of experiential know-how entails reasoning from evidence, asking critical questions, testing assumptions, and developing models to develop and explain ideas in systematic ways.

In an effort to better assess and support STEM learning with program evaluation, YR Media staff have engaged in a long-term process of reviewing the organization's system for tracking and monitoring youth outcomes over time. YR Media is spearheading the development of evaluation tools that seek to build assessment measures more seamlessly into program design, taking up the charge: How can we create mechanisms that leverage evaluation as an opportunity for learning with youth participants and educators? How can evaluation instruments encourage deeper learning?

Individual departments (e.g. Newsroom, Interactive, Music, Video) have devised performance rubrics that articulate the standards that young people need to master in order to successfully produce specific media content. Descriptions of outcomes

provide practical examples of the requisite skills that are approaching, meeting, or exceeding the learning objective.

The rubrics are currently being piloted and used to guide 1-on-1 discussions between youth and supervisors and to assess youth learning in the context of specific tasks and work products. At the start of an internship session, youth set a small number of personal goals for the session. Mid-session, youth have a check-in meeting with their supervisor to discuss progress, identify what is working well, and areas for improvement. At the end of the session, the intern and supervisor meet again to reflect on what specific skills improved during the internship and signs of growth in skills. "These conversations are intentionally grounded in a growth mindset," said one staff member, "We want the students to see assessment as a way to direct their own growth and development." By developing a framework to embed performance-based assessment into the internships, this work can that link informal STEM practices to real-world media production.

Elsewhere, the Rockman team has relied on the Next Generation Science Standards (NGSS) framework to develop evaluation protocols that help to illuminate STEM learning through (1) the review of student work products or artifacts, (2) observation of informal STEM instruction and learning interactions towards the production of STEM media, and (3) reflective interviews with youth producers on the processes and products of STEM media projects. The NGSS describe professional practices commonly used by scientists and engineers, serving as learning outcomes and general statements of what it takes to engage in science and engineering, such as, asking questions and defining problems, planning and carrying out investigations, and analyzing data. As young people engage in these practices, they may come to understand the means by which STEM professionals develop theories or explanations for phenomena and construct solutions for problems.

Through program observations and youth interviews, evaluators have witnessed ways that young people at YR Media engage in iterative processes that often reflect scientific and engineering practices. In producing media and technology, youth participants employ multiple inquiry strategies to make sense of social and natural phenomena and develop responsive products. Youth interns in the Newsroom collaborate with peers and adults to develop researchable questions, conduct research, and incorporate multiple kinds of data in writing news stories and critical commentaries, often though not always about STEM topics. In the Interactive department, interns identify problems to be solved, perform rapid ideation, conduct

research to review existing technology products and better understand user needs, and test prototypes and products through various stages of design.

YR Media educators have also utilized formative assessment to better understand what type of support youth need or level of autonomy they can handle. This sort of personalized attention necessitates an understanding of young people's existing funds of knowledge, learning styles, and emerging skills in the context of specific media production tasks. YR Media educators engage in regular check-ins to assess project progress, identify areas of struggle, and openly discuss potential strategies and next steps. For instance, during a check-in with Newsroom trainees, a staff discovers that one young journalist has struggled to conduct an interview with a key subject who cancelled and then failed to respond to email requests. Accompanying the youth producer to make the request in person, the matter is resolved quickly. Another youth experiencing difficulty crafting appropriate interview questions is first paired with a peer to brainstorm questions before sitting down to strategize and revise with an instructor.

In the Interactive department, project check-ins are routinely coupled with sharing screenshots of interactives in progress. In addition, interns take occasional mini-quizzes to assess their ability to identify and explain key concepts of coding or design. One youth intern said, "It's not like a school test to get a grade. It's more just about where we're at with html and CSS." The instructor explained that this type of formative assessment is "an assessment of them as much as an assessment of me. It helps me know better where they are in their learning. It lets us know that lots of folks actually struggle to explain coding concepts." When needed, the group engages in refresher workshops to cover basic concepts and functions in relation to their current projects.

YR Media staff understand that education is highly contextualized. Learning never occurs in a vacuum, but instead, is situated in social, economic, and cultural dynamics. Multiple contextual factors need to be addressed when assessing youth learning as something that transpires over time in specific settings. Understanding when, how, and why learning takes places requires sensitivity to these complex processes. There is no basis to claim that a pedagogical innovation or intervention "works," outside of the specific teaching context, participants, and learning conditions.

For these reason, the WAVES project operated from an assumption that student learning takes place through social interactions within groups and communities that

are situated in a particular social and historical moment. In addition to presenting criteria that can be applied to appraise individual STEM learning, the project considered how individual displays of learning connect to social realities surrounding young people's lives. In other words, in what ways do young people's STEM media projects refract social and cultural dynamics? How do young people's emerging STEM literacies inform and shape the social and material conditions of their local communities or broader social structures?

# MIXING CRITICAL PEDAGOGY AND COMPUTATIONAL THINKING

## 4. What difference does it make when critical computational literacy drives the making of STEM stories, apps, and educational resources for mass distribution?

In conceptualizing the role of STEM learning in collaborative media production, WAVES advanced the notion of *critical computational literacy* (Lee & Soep, 2016, 2018). This view “provides a way to create and theorize conditions for the potent learning that can take place at the intersection of engineering and computational thinking on the one hand, and narrative production and critical pedagogy on the other” (Lee & Soep, 2016, p. 481). Moving beyond merely teaching young people to code or create technology products, critical computational literacy “centers marginalized points of view and creates conditions for young people to break silences, reveal obscured truths, and challenge unjust systems and conditions” (Tissenbaum, Sheldon, Soep, Lee & Lau, 2018, p.1708).

The dual focus on critical computational literacy and collegial pedagogy means that the integration of STEM practices occurs in an environment that engages young people as collaborators working alongside media professionals with the goal of developing personally relevant news stories and interactive media aimed at achieving social or educational impact in the world. By providing opportunities for youth to become “critically conscious producers and developers that seek to use their critical and cultural knowledge and technical skills to produce digital tools, one can support the social transformation of the world through the artifacts they create” (Lee, forthcoming, p. 5).

Journalism offers a dynamic framework to teach young people how to create media that investigates significant questions, encourages skepticism and critical thinking, and communicates information accurately in ways that resonate with real audiences. As one YR Media intern put it:

“One of the things that makes our work here special is the combination of journalism with media making. When we make a website or an app, we are holding up standards of news making. You can’t write a biased news story. We don’t create a biased interactive. You have to think about these issues throughout the whole process. You have to create something that’s factual, that’s

based on trustworthy evidence, and let people form their own opinions and judgements. It's what makes (YR Interactive) products fun. You let the user form their own interpretation rather than being told what to think or how to feel."

In the National Network, the emphasis on critical computational literacy explicitly situates STEM journalism in the social sphere. One project staff member maintained that "STEM journalism is important because we are helping youth to critically examine what's happening in their own communities." Given the pace of technological changes taking place, "We want to build up young people's knowledge and skills to create technology...[but] the goal is to develop their tools for transformative change."

National Network contributors see themselves as helping to shape dialogue on issues impacting broad audiences. By tackling STEM stories, these contributors offer unique youth perspectives on scientific and technological phenomena. For example, a contributor writing about the Flint water crisis acknowledged that this crisis is "rightfully a socio-political issue." Most news coverage she read approached the political and economic causes or ramifications of lead contamination in the water supply. At the same time, she added, "There are also complex scientific angles to explore. This is also a scientific problem with possible scientific solutions." By highlighting a young scientist's experimental response to the crisis, she hoped to show how science can play a role in developing new techniques to address the problem and improve people's lives.

Another STEM Desk contributor reporting on the application of escape rooms in the classroom sought to expand students' and teachers' imaginations beyond traditional educational methods. "I wanted to show teens that there are different teaching approaches... Maybe I can reach teachers and show them there are other ways to teach their content."

The goal of effecting change through media production is a core aspect of YR Media's work. Youth and adult staff see this as a logical conclusion of empowering youth through journalistic media. "I think it's a natural by-product of our work. When you're empowering young people to tell stories about their communities, we're going to have a mentality that there are things we want to change," said one youth participant.

YR Media's emphasis on critical computational literacy results the creation of digital products whose producers have thought deeply about what to create, how it may benefit society, and why it matters, in addition to the technical questions and procedures of how to make it.

In working with a diverse population of young people, including youth from historically underrepresented groups in STEM, YR Media is directly tackling educational inequities. By developing young people’s critical consciousness of social issues and unequal power dynamics, the WAVES initiative broadens youth participation in the tech sector. However, as one project member stressed, “We are focused on teaching technical skills and computational thinking, but not just for their own sake. We are focused on coding for what purpose.”

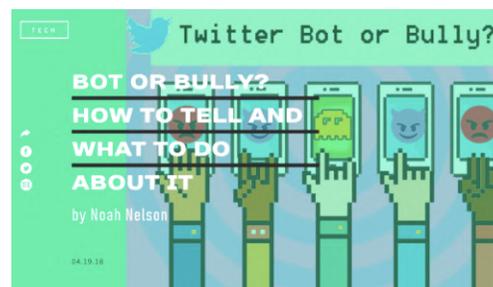
As Lee (in press) writes, when critical computational literacy drives the making of STEM-powered media, “it supports the development of computational thinking practices that move beyond bringing more Black, Latinx, and women into the tech field for profit-generation and entertainment, but focuses on whom these products will benefit.” (p. 2).

The combination of active production and social consciousness translated into classroom applications outside of YR Media as well. All teachers and students using the Youth Mobile Power tutorials could articulate the social issue and intended benefits of their mobile app creations. One high school teacher who has implemented app building projects in the classroom credits the new App Inventor resources with advancing digital media production for good:

“App Inventor sets an expectation that your app will serve a purpose. Be useful. In my class, students don’t have to come up with something lofty, but they need to be able to say what it’s going to do and who’s going to benefit from it.”

Youth Mobile Power was intended to support “computational action, a new framing for computing education, [which] proposes that while learning about computing, young people should also have opportunities to create with computing that have direct impact on their lives and their communities” (Tissenbaum, Sheldon, & Abelson, 2019, p.34). As one App Inventor designer explained, the tutorials were designed “to teach students tools in App Inventor and then turn them loose with a focus on open-ended learning.”

As part of a classroom assignment, two high school students built an app loosely based on the YR Media story, [Twitter Bot or Bully](#), which discusses how to distinguish between a social media bot and an actual person who is bullying. The students wrote, “We created an app that will



YR Media story offered inspiration for anti-bullying app

get victims of bullying the help they need. The app will determine whether it is a real life person or an online robot that is bullying.” The pair knew about bullying from their own and friends’ personal experiences, but understood they needed to do a lot of background research. The YR Media article gave them some initial ideas and helped frame their research. “We started reading about online bullying and the differences between bullying that’s done by a person online and harassing or trolling done by bots.” Based on a series of questions about the type of bullying the user is experiencing, the app provides guidance about how to deal with the particular situation. If the problem is taking place at school, the app would suggest to talk with a trusted teacher or administrator. If it is happening online, the recommendations would include resources to report the activity to the social media platform and strategically using the block or mute functions to silence the comments.

Youth Mobile Power gives teachers and young people highly accessible resources to gather inspiration and receive just-in-time guidance to create mobile technology that can be used to make a positive difference. By combining social and civic engagement with digital media making, educators can encourage emerging writers and developers to learn and apply new technical skills and socio-cultural knowledge to produce digital media that can become part of the change they wish to see in the world.

# CONCLUSION

Dominant narratives about young people and technology tend to either romanticize youth “digital natives” who intuitively develop competencies to interpret, use, and create digital content, or position youth as passive subjects of the world of digital technology. These narratives fail to account for youth agency to make their own choices about when and how they use technology, as well as the reality that many young people do not have access to opportunities at home or school to master the skills necessary to harness digital technology for learning.

The WAVES initiative was guided by a vision of young people exercising power to apply technology as a tool to contribute to and transform their own social and academic pathways and their communities. Through the development of the National Network for youth news and the Youth Mobile Power app building series, the project has promoted the acquisition of STEM media practices for social good. The focus on the analysis and production of cutting-edge media means that young people engage content and literacy practices through a medium that they find appealing.

By using STEM-powered tools to create and broadly distribute relevant news stories, mobile apps, and digital interactives, WAVES centered its youth-adult collaborations on story-first media. The project helped to advance understanding about why and how to situate informal STEM learning within larger socio-cultural, political and economic contexts. Developing strategies that ground media production within young people's lived experiences, observations, and questions about the world, YR Media's encourages youth to construct working theories that explain aspects of their communities and personal lives.

Operating within a community of practice focused on upholding high standards of journalism helps to ensure that the purpose and meaning of youth products are critically reviewed and iteratively improved to reflect fact-based, youth-driven interpretation of the world. When youth producers are asked to investigate and tell stories with specific purposes, to research issues and problems that matter to youth communities, and to create content for actual audiences, engagement in learning is catalyzed. These conditions contrast to many youth participants' learning activities in school that often entail completing assignments for consumption and assessment by teachers.

YR Media's approach entails shifts in prevailing educator/student relationships. Situating STEM learning in the context of youth-adult collaboration reconsiders traditional roles of teacher and learner. YR Media's projects all involve ongoing forms of collaboration between educators and youth. When teachers are not the sole "experts," and choose to play the role of observers or guides in developing media, they learn new skills and knowledge from their students. By positioning both teacher and students as learners, classrooms can center on shared experiences, challenges and problem-solving approaches in an open forum. With the heavily scaffolded app building guides, classroom teachers can play a critical observer role and put students more in control. By exploring relevant social issues through media making, young people can experience feelings of empowerment. Positioning youth as producers, rather than just consumers of media content, establishes meaningful educational stakes.

K-12 computer science education has traditionally been focused on students learning the "fundamentals" of computational practices and programming. "Leaving real-world applications for 'later' runs the risk of making learners feel that computing is not important for them to learn." (Tissenbaum, Sheldon, & Abelson, 2019, p.34). MIT App Inventor and YR Media show the value of giving young people the tools and appropriately scaffolded supports to create meaningful computing projects while they are still learning the fundamentals of programming.

Digital media and technology are intimately intertwined with our lives. The WAVES initiative demonstrated how they can serve as powerful tools to engage youth in critical thinking and action to understand and influence the complex dynamics that shape our everyday realities. Teaching youth visual- or text-based programming languages or investigative reporting techniques are not seen as the end goals in and of themselves or arbitrary standards to achieve. Rather, these practices are a productive means to help youth better connect, create, and organize around issues they care about. The key result of this work is expanding opportunities for youth to create multi-media journalism and mobile apps that allow them to participate and contribute substantively in civic dialogue and action.

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