The Promise of Digital Resources for
Effective CTE STEM Career Exploration:
Summary of Key Findings from the
CTE STEM Digital Resource Study Project

Table of Contents

**The Promise of Digital Resources for
Effective CTE STEM Career Exploration:
Summary of Key Findings from the
CTE STEM Digital Resource Study Project**
Executive Summary to WGBH
Education Development Center

EXECUTIVE SUMMARY

The goals of the project were to build an understanding about the perception of career and technical education (CTE) as an option for middle school students in pursuing skill-based STEM-related careers, and to use that information to develop an innovative suite of digital tools designed to improve mentors' and school counselors' communication with middle school–aged students. The team included

- WGBH, a leader in public media design and creation,
- Education Development Center (EDC), an education research and evaluation organization, and
- Global Strategy Group (GSG), specialists in the in-depth researching and testing of communication strategies.

During the project, four phases of work were completed. In the first phase, Global Strategy Group (GSG) conducted qualitative research with CTE STEM professionals and surveyed middle grades students to learn about participants' perceptions of STEM and CTE. In the second phase, EDC's research team conducted interviews with a sample of volunteer mentors from industry about their concerns and the supports they reported that they required in order to mentor middle-grades students. In the third phase, WGBH's development team utilized the findings from Phases 1 and 2 to create an innovative suite of digital tools intended to improve communication with middle grades students about careers and pathways that relate to CTE fields with a STEM focus. EDC's research team used those digital tools to conduct formative research at three points during the development process, testing the tools with a small sample of mentors and a larger sample of school counselors. During the fourth phase, EDC researchers conducted a pilot study with school counselors to assess the impact of the digital tools.

PROJECT SUMMARY

This section of the executive summary includes a description of the project's phases and overarching findings.

Phase 1: Research on CTE Perceptions and Messaging

During the first phase of the project, Global Strategies Group (GSG) conducted both qualitative research to explore the language and effective messaging that is used to discuss STEM-related CTE by professionals in those skill-based careers and existing perceptions of STEM-related CTE, and quantitative research with students to identify

the misconceptions, stigma issues, and other barriers that exist for them in considering CTE. GSG's research was used to inform the development of the digital tools for the study.

GSG conducted 30 interviews with professionals in STEM careers (those who received career and technical education, and those who work as communicators or advocates in these fields). GSG also conducted an online survey of over 1,000 12–14-year-olds to gauge their perception of STEM and CTE. The findings suggest that:

- CTE day-to-day activities are highly interesting to middle school students, but CTE careers have an image problem.
- Gender is a stronger factor than ethnicity in determining interest in tested careers;
- Messaging about reasons to pursue CTE can increase student interest in participating in those programs.
- Among the strongest reasons to pursue CTE are (1) working at a job you love, (2) gaining college credit, lowering educational costs, and graduating faster, and (3) preparing you for careers in fields that lead to high-paying jobs.

Recommendations from this research informed the development of a messaging strategy, which was used to guide the creation of digital tools. These recommendations included the following:
- To appeal to middle grades students, start by meeting them where they are, matching activities they are most interested in with the opportunities that CTE can provide.
- Since helping people and making a difference in the lives of others are important goals for many middle school students, they need more information about how CTE in STEM-related fields can help do that.
- Middle school students are seeking a sense of discovery, wonder, and awe.

The messaging strategy provides guidelines for effective ways to communicate the benefits of CTE in STEM-related fields to middle-grades students.
- Middle school students, first and foremost, want to enjoy what they are doing. CTE STEM allows students to pursue exciting passions and interests.
- Students want to be prepared for higher-paying jobs that employers are actively looking to fill.
- Middle school students want to succeed in college and graduate faster. Most students who pursue CTE do go to college at some point, often right after high school.
- CTE has an image problem. Middle school students have misconceptions about the types of students who pursue CTE, and the long-term prospects of students in CTE careers.
- CTE is a pathway that increases students' choices, exposing them to options that they did not know they had, to do work that they enjoy while being paid for it.
- One of the best ways children learn is through hands-on experience, and that is also something that employers value and look for.

- CTE's appeal should be broadened with content that includes diverse groups and tasks. Middle school students need to see themselves reflected in communication materials and promotional activities.
- Girls and minorities need to be presented in non-stereotypical professional settings (e.g., avoid presenting girls only in caring professions) to broaden the appeal of different programs to interested students.
- CTE and related activities are particularly appealing to African American boys, suggesting that, with the right communication strategies, their participation in CTE and STEM-related fields can be improved.
- Middle school students need to see what they can do through CTE and STEM fields, not just be told.
- Middle school students need to see how much fun it is to work on issues one loves. Stereotypes that STEM fields are too hard should not be promoted.
- Middle school students are looking for challenging questions and issues they can solve in areas they are passionate about. They need to experience how CTE STEM increases their self-efficacy. Guidance on how to turn problems into questions they can answer can help them do that.
- Messengers are key: The most effective communicators are likely to be young people doing cool things, who have themselves been through similar programs and work in STEM fields.

Phase 2: Research on the Needs of Mentors

During this phase, the EDC team conducted formative research with middle-grades mentors to guide the development of the digital tools. Researchers conducted interviews with a sample of volunteer mentors from industry about their needs and the challenges they faced in mentoring middle-grades students. They also solicited their feedback on the features of the proposed tools that would be designed to help them communicate with middle-grades students about CTE STEM career pathways.

Key findings from this phase of work suggest that:
- Mentors' years of experience, backgrounds, and motivations to engage in mentoring vary widely.
- Mentoring organizations vary widely in the way they are structured and run, which influences how mentors interact with mentees.
- Mentors believe that mentoring holds the potential for improvements in the representation of diverse populations in CTE STEM fields, and that it serves as a way to recruit potentially talented individuals to those fields.
- Students often find it difficult to envision the intricacies of a specific job.
- To successfully mentor students, mentors must contend with the additional time commitment, find ways to engage with mentees, and do so even when mentoring organization do not provide adequate support.

Phase 3: Development of the Tools Guided by Formative Research

The development of the digital tools was informed by the findings in Phases 1 and 2, and then guided by ongoing formative research conducted throughout the development at three different points. Phase 3 resulted in prototypes of the following three digital tools:

- *Career Stories*. This tool was designed to create and share the trajectory of the CTE STEM professional's career path in a fun and engaging way. Professionals were encouraged to upload photos, videos, anecdotes, and other details to a template to create a "history" of their career path and what led them to a STEM-related career. The *Career Stories* tool also aimed to help students see how personal interests, family life, and influences can lead to choosing a field of study and, in turn, how that education can be applied to numerous jobs in the real world. To test the tool prior to recruiting real professionals to add their personal histories, the development team created a set of prototype profiles in order to ensure that students in the pilot study were still able to review profiles of typical career paths that represent a range of industries.

- *CTE Exploration*. This multimedia tool combined video and engaging content galleries, all aimed at providing students with exciting information about CTE and STEM. The content ranged from success stories, to connecting hobbies with careers, to describing how CTE STEM jobs are making the world a better place. Animated video, GIFs, and interviews with CTE students were designed to help counteract any negative preconceptions previously associated with CTE STEM.

- *Communication Coach*. This interactive video simulation tool, for use by professionals working with students, demonstrated effective ways to communicate with middle school-aged students. The video simulation between a school counselor and two different students allowed the user to choose between conversation topics and to watch various scenarios play out on screen. In addition to troubleshooting communication pitfalls that commonly occur between adults and middle-grades students, this tool served as a dynamic way for individuals with less experience working with middle school students to learn communication tips and hone their interpersonal skills.

Phase 4: Pilot Study with School Counselors

Once the digital tools were developed, the EDC research team conducted a pilot study over a six-week period with school counselors who implemented the tools (aided by an instructional guide) with middle-grades students in whole-class or small-group settings. The instructional guide wove four 60-minute sessions into a larger, broader discussion of CTE STEM. It provided sample questions to help frame student discussions in terms of their interests, and to identify together what CTE pathways might appeal to them—for instance, asking them to reflect on what their "success" story might look like if they chose a CTE career pathway. The guide also provided prompts that helped counselors gauge how students' perceptions of CTE may have changed over the course of the pilot (e.g., "A few weeks ago, you thought CTE was [X]. What new information have you

learned? Have your opinions or ideas changed? If so, how?"). The guide included additional ideas for using the tools, prompts to gather further information about local CTE programs to arm students with as much information as possible, and a log for counselors to record reflections about their work with the students.

The study included 10 school counselors and 401 of their students, and was an initial investigation of how the tools worked and how they affected the participants. The goals were to understand the initial promise of the tools to improve communication and discussions about career options and pathways, to ensure middle school students' perception of career and technical education is accurate, and to cultivate young people's self-efficacy and awareness that these career paths are possible for them by changing how school counselors frame and communicate them.

Phase 4: Pilot Study Findings

School counselors recognized the importance of encouraging students to pursue CTE/STEM careers

Prior to the pilot study, school counselors in our survey affirmed the importance of encouraging students to pursue CTE/STEM careers and most felt that the school supported career exploration to some degree. School counselors' initial support of the intervention's goals may have reflected the fact that they opted into the study, so we do not know how school counselors who did not choose to participate in the study think about these issues; however, the level of supportiveness that the American School Counselor Association provided during recruitment for the study, along with this information, suggests there is likely general agreement among school counselors regarding the importance of this.

The tools were feasible to implement by school counselors with middle grade students

Pre-surveys found that school counselors have minimal time to work with each student individually, suggesting this intervention's whole class or small group approach fits the needs of school counselors as they work with their students. When implementing the program, school counselors typically spent a full class period on each tool within a whole group setting, although some used each tool over multiple class periods. School counselors typically showed the CTE Exploration tool to students prior to the Career Stories tool, as the instructional guide suggested.

When school counselors are able to meet with students individually, they typically discuss students' personal lives, schoolwork, career goals, and academic interests. Thus, the career exploration that the intervention encourages may help them to have additional individual discussions with students after the conclusion of the study.

The tools improved knowledge and interest in CTE STEM careers and pathways
Overall, school counselors liked both tools (slightly preferring the *CTE Exploration Tool*), felt they had sufficient time to use the tools, reported that students were engaged with

these tools, and that the use of the tools improved both students' knowledge (*CTE Exploration* helped achieve this goal slightly more) and interest in CTE STEM careers and pathways. Specifically, teachers felt these tools were a good complement to the tools they currently use and that the tools led to engaging discussions with students. School counselors reported positive impacts on students' knowledge of and interest in CTE STEM careers and pathways. Although the survey did not find significant changes on students' overall scores, there were findings from individual questions that provide clues about middle school students' thinking. Middle school students' own interests and abilities and their belief that spending time gathering information about careers would help them make good career choices increased significantly. In addition, middle school students were more committed to learning about their own abilities and interests and getting the education required for their career choice. However, students significantly decreased their intention to spend more time learning about careers and intent to talk with lots of people about careers. This may indicate that students in the study felt that they had sufficiently explored careers and pathways at that given point in time or that they may return to the career exploration activities mentioned above at a later point in the future.

The tools Improved communication and discussions about career options and pathways

Of the two student-facing tools, *CTE Exploration* was favored by both counselors and students. The features participants enjoyed included the videos, the wide array of featured CTE STEM careers, and the introduction of careers that a student might not typically encounter. School counselors reported that the tool was an appropriate starting point for discussions with and among students because it also incorporated hands-on learning, career directions, and success stories. *Career Stories* tool was also rated well and appreciated by participants. School Counselors liked the diversity of the career profiles and were positive about the tool. To improve both tools in the future, school counselors wanted students to have direct access, more videos and profiles, links to external sources of information. They also wanted updates to the instructional guide (more content and updated time estimates). With the counselor-facing tool, the *Communication Coach*, counselors felt that it has potential for new school counselors or others who do not have extensive training with middle school students.

KEY RECOMMENDATIONS

Overall, this project generated new knowledge about the messages and images that can shift opinions about the value, relevance, and status of STEM CTE education pathways and CTE careers. This messaging can be useful to mentoring programs, school teachers and administrators, career and guidance counselors, parents, industry leaders, and other "influencers" of career pathways.

Meet middle school students where they are, matching activities they are most interested in with the opportunities that CTE can provide.

Resources for adults working with students should provide explicit advice and tips on how to elicit information from students about their interests both inside and outside of school, as well as how to then directly connect those interests to potential CTE STEM careers. Similarly, resources for students should provide specific examples directly tying common interests and hobbies to potential careers (e.g., how an interest in cars and computers can lead to rewarding careers in the automotive tech industry). And they should promote a broad range of career pathways, with greater emphasis on the field (agriculture) than the job (farmer).

Helping people, making a difference in the lives of others, and learning how things work are important to middle school students. Middle school students need help "connecting the dots" so they are able to see how CTE in STEM-related fields can help them achieve these goals (e.g., how an engineer investigates design principles that help poor communities turn waste into energy).

Middle school students, first and foremost, want to enjoy what they are doing. With the goal of providing a means to *explore* rather than choose a possible career interest, resources for middle school students ideally should be fun, engaging, and should elicit a sense of discovery, wonder, and awe. They should allow students to consider alternative approaches, since there will likely be several possible pathways in pursuing a CTE STEM career.

Promote the concrete benefits of CTE in STEM-related fields.
Middle school students are concerned with succeeding in college and graduating faster; therefore, it is important to feature examples that allow students to explore a range of possible means of affordable and effective ways to advance their education goals. Students will be encouraged to know that most students who pursue CTE go to college at some point, and often right after high school. However, it is also essential to make it clear that, although a 4-year college is an option, it is not the only option for achieving a rewarding and successful career (e.g., 2-year college, industry credential).

Resources should feature CTE professionals engaged in CTE pathways, illustrating the many ways they are enjoying their work and have become a vital force in the 21st century work world. They should also highlight students currently enrolled in CTE programs, who can speak about the benefits of being part of their programs, including the integration of academic work and hands-on experiences in their high school years, and how hands-on experience can result in a competitive edge. Resources should feature more than one student to reinforce the fact that students have distinct needs and desires.

It also is important to promote messages about hands-on learning being a crucial supplement to academic learning for CTE, and this learning is something that employers value and look for. Since students want to be prepared for higher-paying jobs that employers are actively looking to fill, resources also should highlight needs for employment within communities, particularly those connected to CTE STEM careers.

Address the misconceptions about the types of students who pursue CTE and the long-term prospects of students in related careers to combat CTE's image problem.

Resources should feature messages and messengers that show that CTE *increases* students' choices by exposing students to options that they did not know they had, and by helping them see that they can do work connected to their interests that they will enjoy and be paid for. Resources should offer specific examples of the opportunities that became available to those who choose a CTE STEM pathway, and how those pathways challenge students and enhance their academic learning. They also should provide relevant, up-to-date information that addresses common misconceptions about CTE STEM to offer a more accurate picture of these educational opportunities and pathways.

Broaden CTE's appeal with content that includes diverse groups and tasks.

Middle school students need to see themselves in communication materials and promotional activities. Resources should feature girls and minorities in non-stereotypical settings (e.g., avoiding presenting girls only in caring professions) in order to broaden the appeal of different programs to interested students, such as a young female welder and a young female bike mechanic. Messengers are key: The most effective communicators are young people doing cool things, who have themselves been through similar CTE programs and work in STEM fields.

Show, do not just tell, students what they can do through CTE and STEM fields.

The top three career goals that motivate middle school students are (1) helping people, (2) discovering how things work, and (3) drawing, designing, and planning things. Messaging should illustrate the ways CTE STEM careers address these career goals, including showing how certain careers improve people's quality of life (e.g., robotics), how certain careers involve discovering how things work (e.g., auto mechanics), and how some careers involve drawing and design (e.g., engineering).

Resources should show a wide array of possible CTE STEM careers, highlighting careers that are not typical and always identifying how each of these careers incorporates hands-on learning and academic rigor, and how they address human needs.

Finally, resources that are media-rich engage students best. Resources should contain videos that show professionals "in action" in their careers, and should be offered in a variety of formats with which students are familiar (e.g., GIFs, short clips, etc.).

Cultivate young people's self-efficacy and awareness that CTE STEM career paths are possible for them by changing how they are framed and communicated.

Middle school students are looking for challenging questions that they can solve in areas they are passionate about. Messaging should frame and communicate careers to students in ways that emphasize how they are achievable. Resources should emphasize how CTE STEM increases their self-efficacy by providing guidance on how to turn problems into questions they can answer.

Resources should include professionals and students representing racial, ethnic and geographic diversity to enable the broadest possible range of students to see themselves in the materials.

Provide flexible resources that students can use to work at their own pace, individually or in small groups, in school or at home.
Adults working with students (such as school counselors and mentors) have very limited time. Resources thus should be designed to not depend solely on one-to-many presentation, but also to provide students with direct access so they can work individually at their own pace, or in small groups in school or at home. Students should be able to access CTE content in various ways (e.g. sequentially, sorted by profession) and be able to explore the content through a variety of lenses (e.g., education, interest, jobs, challenges).

CONCLUSION

In this project, we have generated new knowledge about middle school students' perceptions of CTE STEM careers and pathways, and have developed digital tools that capitalize on the affordances of technology to spark career exploration among middle school students and to deepen their knowledge and interest in CTE STEM.

School counselors need tools that help facilitate career exploration with their students, with whom they have limited time to work. For this reason, interventions that are low-cost, support school counselors' work, and can be implemented feasibly and flexibly are greatly needed. Evidence suggests a variety of ways that this intervention provides school counselors with an avenue to engage middle-grades students in career exploration at a key time in their educational pathway, before students make critical decisions about their high school courses and directions. This pilot study shows that the digital tools can help address the needs of both school counselors and their students.

The Promise of Digital Resources for
Effective CTE STEM Career Exploration:
Summary of Key Findings from the
CTE STEM Digital Resource Study Project
Final report to WGBH
Education Development Center

Introduction

WGBH, a leader in public media design and creation, and the Education Development Center (EDC), an education research and evaluation organization, partnered to develop and conduct initial testing of a set of tools to inform middle schools students about career and technical education (CTE) jobs with a STEM (science, technology, engineering, mathematics) focus.[1] Specifically, the team developed an innovative suite of digital tools that improve communication with middle school students about careers and pathways.

During the project, four phases of work were completed. In the first phase, Global Strategy Group (GSG) conducted qualitative research with STEM CTE professionals and surveyed middle school students to learn about participants' perceptions of STEM and CTE. In the second phase, EDC's research team conducted interviews with a sample of volunteer mentors from industry about the concerns and supports they reported needing in order to mentor middle grades students. In the third phase, WGBH's development team utilized the findings from phases 1 and 2 to create the digital tools. EDC's research team used those digital tools to conduct formative research at three points during the development process, testing the tools with a sample of mentors, but primarily with school counselors. During the fourth phase, EDC researchers conducted a pilot study with school counselors to assess the impact of the digital tools.

Originally, the project proposed only testing the tools with mentors, but due to recruitment challenges, we expanded the project to include school counselors for the final phase of the project: a pilot study. Working with the American School Counselor Association (ASCA) to recruit a diverse sample of middle-grades school counselors and students from across the country, this pilot study investigated the potential promise of using the tools to improve middle school students' knowledge and interest in STEM CTE careers and pathways.

This report summarizes the needs of school counselors, describes the development and formative testing of the tools, and reports on the findings from our pilot study.

The Importance of Career and Technical Education (CTE)

Career and Technical Education (CTE) is uniquely important because "it engages students in an enormous variety of subjects, incorporating academic, creative and technical skills, with the specific goal, nowhere else represented in education, of preparing students for all of life that comes after high school" (NASDCTEC, 2013). However, compelling the argument, and despite the fact that CTE has been transformed over the last two or three decades, old and negative perceptions of CTE persist (Symonds, Schwartz, & Ferguson, 2011). CTE is rarely presented to students as a viable pathway, and is still often seen as a lesser, more appropriate option for those who are not seen as "college material." In fact, CTE is often a springboard to success for students, allowing them to contribute to a critical pipeline need for a technically trained workforce, especially in STEM (Science, Technology, Engineering, Mathematics) fields, in which many high-paying jobs do not require as much formal education. Changing the perception of CTE for students through the creation of new, more accurate messages about STEM-related CTE programs could go a long way toward solving this problem, especially for students in their middle school years, a critical defining point for career preparedness (ACT, 2008) since it is when students' work habits, sense of self-efficacy, and thoughts of career exploration generally begin (Bleeker & Jacobs, 2004).

As gatekeepers to the world of 21st century career and work opportunities, school counselors are ideally and uniquely positioned to deliver positive messages about CTE to middle grade students (Gibbons & Borders, 2010; NOSCA, 2010). Research suggests, however, that middle school counselors lack awareness of current career pathways and trends, do not fully understand "the significance of their role in establishing one of the earliest anticipatory expectations with regard to how a student views his or her ability in specific academic areas" (Schmidt, Hardinge, & Rokutani, 2012), and that they need additional supports and information about CTE pathways and careers. It is during the "make or break" middle-school period when students develop the skills that will impact their STEM-related course selections in high school and their engagement in STEM-focused programs of study (Turner & Lapan, 2005). There is therefore a critical need for resources that help school counselors ensure young people's perceptions of STEM-related CTE programs is accurate and cultivate middle school students' self-efficacy and awareness that these career paths are possible for them.

Intervention Development and Iteration

Phase 1: Research on CTE Perceptions and Messaging

During the first phase of the project, Global Strategies Group (GSG) conducted both qualitative research to explore the language and effective messaging that is used to discuss STEM-related CTE by professionals in those skill-based careers, and existing perceptions of STEM-related CTE and quantitative research with students to identify the misconceptions, stigma issues, and other barriers that exist for them consider CTE

career pathways. GSG's research was used to inform the development of the digital tools for the study.

Global Strategy Group (GSG) conducted 30 in-depth interviews with professionals in STEM careers, including those who received career and technical education (CTE), and those who work as communicators or advocates in these fields. Professionals were recruited from a wide variety of specialties including nursing, marketing, management, auto repair, HVAC (heating, ventilation and air conditioning), construction, design, and engineering, among others.

Following the in-depth interviews with professionals in STEM careers, GSG conducted quantitative research in the form of an online survey. The survey, conducted between December 9–23, 2015, included 1,006 12-to-14 year-olds nationwide and was focused on better understanding their perceptions of STEM and CTE (the geographic and demographic divisions of the sample were properly represented based on U.S. Census information.) The findings suggest that

- CTE day-to-day activities are highly interesting to middle-school students, but CTE careers have an image problem;
- gender is a stronger factor than ethnicity in determining interest in tested careers;
- messaging about reasons to pursue CTE can increase student interest in participating in those programs; and
- among the strongest reasons to pursue CTE are (1) working at a job you love, (2) gaining college credit, lowering educational costs, and graduating faster, and (3) preparing you for careers in fields that lead to high-paying jobs.

Recommendations from this research informed the development of a roadmap, which was used to guide the creation of digital tools. These recommendations included the following:
- To appeal to middle grades students, start by meeting them where they are, matching activities they are most interested in with the opportunities that CTE can provide.
- Since helping people and making a difference in the lives of others are important goals for many middle-school students, they need more information about how CTE in STEM-related fields can help do that.
- Middle-school students are seeking a sense of discovery, wonder, and awe.

Recommendations from this research informed the development of a roadmap, which was used to guide the creation of digital tools in phase 3 (see description below). They include:

1. ***To appeal to middle school students, start by meeting them where they are: matching activities they are most interested in with the opportunities that CTE can provide.***

Helping people and making a difference in the lives of others are important goals for many middle-school students, but they do not receive enough messages about how CTE in STEM-related fields helps do that. A sense of discovery, wonder, and awe are what middle-school students are after.

This finding prompted us to create opportunities within the tools where these connections can be easily made and promoted. A coaching tool for adults working with students provides explicit advice and tips on how to both extract information from students about their hobbies and interests and directly connect that information to potential CTE STEM careers. It also offers users a chance for users to explore simulated conversations which portray this kind of interaction, and tips on how to discuss CTE STEM in an appealing way.

For students, a CTE exploratory tool allows them to click through several slides of information that provide specific examples directly tying common student interests and hobbies with potential careers (e.g., how an interest in cars and computers can lead to rewarding careers in automotive tech industry).

2. ***The messaging strategy should also include concrete benefits of CTE in STEM-related fields.***

Middle-school students, first and foremost, want to enjoy what they are doing. Students want to be prepared for higher-paying jobs that employers are actively looking to hire for. Middle-school students are concerned with succeeding in college and graduating faster. Students are encouraged to know that most students who pursue CTE eventually, and often right after high school, go to college.

To address this recommendation, we included across the tools video testimonials of CTE professionals and students engaged in CTE pathways that illustrate the many ways these people are enjoying their work and have become a vital force in the 21st century work world.

We taped interviews with students currently enrolled in CTE programs, who speak about the benefits of being part of their programs, including the thrill of balancing academic work and hands-on experiences in their high school years, and how they are getting a "higher leap" than other kids, especially if continuing onto college. Woven throughout the tools are messages about hands-on learning being something employers value and look for, and a crucial supplement to academic learning.

3. ***Address the misconceptions about the types of students who pursue CTE and the long-term prospects of students in related careers to combat CTE's image problem.***

To this end, we presented messages and messengers throughout the tool that show CTE as a pathway that *increases* students' choices, exposing them to options that they did not know they had, doing work that they enjoy while being paid for it. We offered several examples of the choices available to those who have chosen a CTE pathway and how those pathways have challenged students and enhanced their academic learning.

We also provided relevant, up-to-date information that addresses common misconceptions about CTE STEM to offer a more accurate picture of STEM CTE careers and the CTE pathway. Information is directed towards adult users and students. Student-directed information is given in a visually animated way, and adult-directed information is given in a way that shows how it can be used within the context of various activities with students.

4. ***Broaden CTE's appeal with content that includes diverse groups and tasks. Middle-school students need to see themselves in communication materials and promotional activities.***

To address this finding, we show girls and minorities in non-stereotypical settings (e.g., avoiding presenting girls only in caring professions) to broaden the appeal of different programs to interested students. Sample profiles include a young female welder and a young female bike mechanic. We also made sure to "skew young" in the profiles, since GSG's findings emphasized that messengers are key: the most effective communicators stand to be young people doing cool things who have themselves been through similar programs and work in STEM fields.

To further help students ground themselves in the materials, also we included a digital feature that allows students to navigate informational content choosing an "avatar"; further fostering identity as they explored the content and themes.

5. ***Show, don't just tell, students what they can do through CTE and STEM fields.***

One key finding showed that the top three career goals teens are motivated by are: "helping people"; "discovering how things work"; and "drawing, designing, and planning things." To address this, we created an entire chapter of information titled "Building a Better World" devoted to profiles and messaging that illustrate ways CTE STEM careers contribute to helping people. One example showed a young male engineer and how his job helps people in need gain access to cheap energy. This one profile "connects the dots" for students, showing how a career in engineering can allow one to discover how things work, design, draw, and plan things, and help people at the same time.

GSG's research found that middle-school students are looking for challenging questions they can solve in areas they are passionate about. Information in the

tools emphasizes how CTE increases their self-efficacy by providing guidance on how to turn problems into questions they can answer.

Finally, as a way to orient the first-time users, and a way to help them further ground students in a more accurate picture of CTE STEM and see themselves in these pathways, we also created a sample plan that includes introductory information about the tools and a sample 4-week lesson plan to use the tools.

The lesson plan weaves four, 60-minute sessions into a larger, broader discussion of CTE STEM. The lesson plan provides sample questions in each lesson that help frame student discussions in terms of their interests and identifying together what CTE pathways might appeal to them. For example, the lesson plans start with an introduction of what CTE is, and, having students using the tools as a guide, questions ask them to reflect on the career stories profiled as a way of thinking about what their "success" story might look like if they chose a CTE career pathway (e.g., "What success stories might be yours someday?"). The plans also provide prompts that help users gauge how students' perceptions of CTE may have changed over the course of using the tools (e.g., "A few weeks ago, you thought CTE was [X]. What new information have you learned? Have your opinions or ideas changed? If so, how?"].

The lesson plan includes additional ideas for using the tools, prompts to gather further information about local CTE programs to arm students with as much information as possible, and a log for users to record reflections and their work with students.

Phase 2: Research on the Needs of Mentors

The goal of this study, conducted prior to transitioning to a primary focus on school counselors, was to gather and analyze data to inform the design of the proposed suite of digital tools and gain a deeper understanding of the experiences of mentors from industry. Since previous research suggests that mentoring programs do not always meet the goal of preparing students for the workforce, this round of interviews sought to illuminate the supports needed by mentors to succeed in this endeavor. In addition, the interviews aimed to uncover the different needs and prior beliefs of mentors from different backgrounds and professions.

Key findings from this phase of work suggest that:
- ***Mentor Experiences***. Mentors' experiences vary widely from their years of mentoring experience to their career backgrounds to their motivations to begin and continue mentoring.
- ***Mentor Organizations***: The structure and dynamics of mentoring organizations vary dramatically and influence how mentors interact with mentees and the areas of support that are most needed by mentors.
- ***Mentoring to Provide Opportunities***. Mentoring could lead to long-term empowerment for underrepresented populations, drawing more "top talent" into

their industry, and/or providing "honest" guidance to individuals who might not receive it otherwise.
- **Challenges for Mentees**. It is frequently difficult for students to imagine the intricacies of a specific job, especially if it is in a specialization that they are not initially interested in.
- **Challenges to Successful Mentoring**. Challenges of successful mentoring include the time commitment, lack of or difficulty connecting with and engaging mentees, and insufficient support from the mentoring organization.

Phase 3: Development of the Tools Guided by Formative Research

The research described above served as a roadmap to inform the creation of digital tools, with the goal that these tools would help mentors improve their overall messages about STEM-related CTE and advance knowledge about positive and effective messages that can be used to change public attitudes toward STEM-related, skill-based education and careers.

Tool development

The WGBH development team developed prototypes of four tool prototypes, which underwent formative research and were revised into a final set of three digital tools and a set of lesson plans to guide school counselors' implementation.
- Career Stories: This tool is designed to let school counselors, career mentors, and others working with young people document, organize, and share the trajectory of their own career path in a fun and engaging way. The tool also contains a database of additional profiles of other CTE STEM professionals. Users upload personal anecdotes, photos, videos, and other details to a template to highlight the steps they took to attain a STEM-related, skill-based career and to ultimately create a "history" of their career path. The template is then stored in a database connected to the tool.
- CTE Exploration: This multimedia tool begins with an overview of CTE and then allows students the opportunity to engage with a wide range of content and media approaches (i.e. animation, videos, gifs and photos) within themed galleries, all aimed at providing students with accurate information about CTE and STEM and at helping counteract any preconceptions previously associated with CTE. Topics range from success stories, to connecting hobbies with careers, to describing how CTE STEM jobs make the world a better place.
- Communication Coach: This interactive video tool was adapted for use by school counselors, allowing the user to choose between conversation topics and watch different scenarios play out on screen between a counselor and a student. In addition to troubleshooting communication pitfalls that commonly occur between counselors and middle schoolers, this tool was designed to be a dynamic way for new school counselors to learn communication tips, for experienced counselors to hone their interpersonal skills, and for career mentors to understand how to work with this age group. This is a tool for school counselors to use in preparation for interaction with students, but the tool is not directly used by students.

- Lesson Plan: To help counselors utilize the digital tools, they were provided with a 4-week lesson plan to use with middle-school students participating in the study. The lesson plan was based on four, 45- to 60-minute sessions, which could be easily condensed or extended, depending on the time available and material school counselors wanted to cover. The lesson plan included tips on how to use the tools and suggested activities. The lesson plan also integrated the tools into a larger discussion of CTE STEM. Counselors were told that they were free to adapt the lessons to meet their needs and those of their students.

Formative Research on the Digital Tools
The EDC research team conducted formative research during three points in the development of the tools. The goal in conducting these cognitive interviews was to probe mentors' comprehension of the purpose, functionality, and utility of each digital tool, and to provide feedback about their perceptions of the relevance, utility, and appeal of each tool. The first round of formative feedback consisted of cognitive interviews with five mentors who were shown descriptive pictures that illustrated the way the proposed tools would function. In the second round of formative feedback, twelve mentors from one mentor organization were interviewed and viewed revisions to the illustrations in the first round of design. In the third round of formative feedback, twenty-four mentors provide feedback on prototype versions of two of the tools (Career Stories and CTE Exploration). After each round of formative feedback, the development team used the findings and recommendations to refine the tools.

Transition from Mentor-Focused to School Counselor Focused Intervention
None of the partnering organizations or our project advisors [2]anticipated the challenges associated with asking mentors from industry – all of whom volunteer – to participate in this research project. Their limited interest and availability resulted in major recruitment issues. It now appears, that when developing our project, our partner organizations and advisors believed that more organizations were actively supporting programs that matched STEM-related CTE industry mentors with middle school age kids than was actually the case. Even well-informed government agencies were under the impression that more of these middle school mentoring programs existed. The lack of actual programs that match industry representatives with middle school age kids around STEM-related CTE, coupled with the challenges of working with an all-volunteer corps, made efforts to identify participants in the research study difficult. As such, the team revised the intervention from an out-of-school intervention for use by mentors to an in-school intervention for use by school counselors.

---

[2] Parner Organizations include: Boy Scouts of America, Learning for Life & Exploring, American School Counselor Association, and Ace Mentoring. Project Advisors include: Bernadette Sanchez (Professor, Community Psychology, Director, Community Program, DePaul University), Jane G. Stout (Senior Project Director, YouGov), Alan Gomez (Chief Academic Officer, STEM Academy), Kimberly Green (Executive Director of the National Association of Career and Technical Education), Dru Tomlin (Director of Middle Level Services, Association of Middle Level Education), and Jean Rhodes (Professor of Psychology UMASS-Boston).

Phase 4: Pilot Study with School Counselors

This section of the report provides full information on the pilot study, including the study goals and research questions, elements of the intervention, the specific tools used by school counselors during the intervention, the data collection, and findings.

Pilot Study Goals and Research Questions

The broad goal of this intervention was for school counselors to use the suite of digital tools and supporting assets to improve communication and discussions about career options and pathways, ensure middle school students' perception of career and technical education is accurate, and cultivate young people's self-efficacy and awareness that these career paths are possible for them, by changing how school counselors frame and communicate about these career paths. We conducted an exploratory pilot study as a first step in investigating how the intervention worked and potential of this intervention. The research team worked with the American School Counselor Association (ASCA) to recruit a diverse sample of middle-grades school counselors from across the country, including ten school counselors and 401 of their students.

The pilot study was implemented in Spring 2017. School counselors were asked to integrate the following three digital tools into their practice during the 6-week pilot-study: CTE Exploration and Career Stories with their students, and Communication Coach independently by themselves. Counselors were free to implement the tools in the manner they found most appropriate, including (1) whole classroom and small group settings, (2) during one classroom period or over the span of multiple days and weeks, (3) with their own accompanying lessons, or (4) using with lesson plans designed by WGBH.

Figure 2. Timeline for Pilot Study
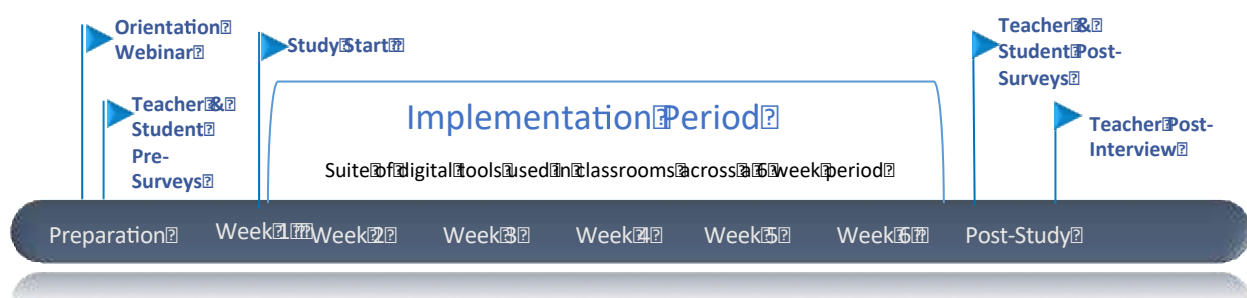
The study aimed to address the following research questions:
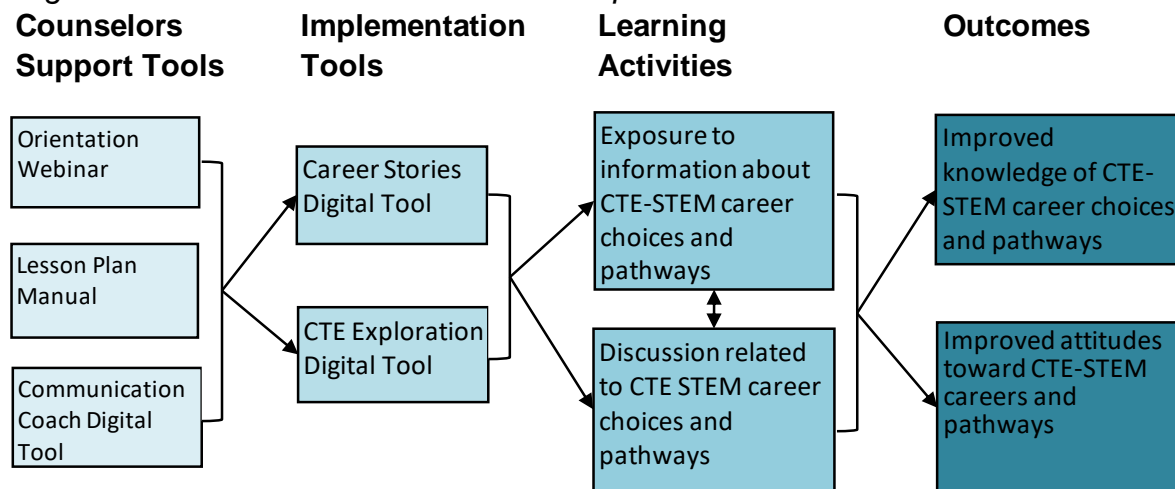1. What are school counselors' pre-existing attributes related to CTE/STEM (i.e., initial perceptions of, knowledge of, preparation to discuss, attitudes toward CTE/STEM or STEM)?
2. How did school counselors implement the intervention (i.e., how often and when were tools used, what were student groupings, what coordination was there with other staff)? What is their feedback on each tool?

3. How do participants respond to the intervention as a whole, and to its individual elements? (What are the strengths and weaknesses, in what ways did the tools support them in their counseling and in what ways could they be improved?)
4. What is the intervention's impact on school counselors?
5. What is the intervention's impact on students?

Elements of the Intervention for the Pilot Study

Figure 1 (see below) shows intervention elements and anticipated outcomes, including: supportive tools for counselors (orientation webinar, lesson plan manual, and Communication Coach Digital Tool); tools that are implemented in the classroom with students (Career Stories and CTE Exploration Digital Tools); learning activities that students engage in (exposure to and discussion of CTE STEM career choices and pathways); and anticipated outcomes (improved knowledge of and attitudes toward CTE STEM career pathways).

Figure 1. Intervention Elements and Anticipated Outcomes

Counselors Support Tools	Implementation Tools	Learning Activities	Outcomes
Orientation Webinar	Career Stories Digital Tool	Exposure to information about CTE-STEM career choices and pathways	Improved knowledge of CTE-STEM career choices and pathways
Lesson Plan Manual	CTE Exploration Digital Tool	Discussion related to CTE STEM career choices and pathways	Improved attitudes toward CTE-STEM careers and pathways
Communication Coach Digital Tool			

Study Implementation

Prior to implementing the intervention, school counselors were provided with the three tools[3] to increase their familiarity with the intervention and support their implementation, participated in a training webinar, reviewed a lesson plan manual, and engaged with the Communication Coach interactive video tool, described below. During the six-week study implementation, school counselors engaged middle school students in career exploration activities over approximately four class periods utilizing two digital tools designed for use by counselors with students (Career Stories and CTE Exploration) to spark discussion and evoke questions about CTE STEM careers and pathways.

Participant Demographics

School Counselors: Participants in the pilot-study included 10 school counselors from 6 states (Georgia, Alaska, Mississippi, Utah, Maryland, and Indiana). Years of practice as a school counselor varied from 3 to 20 years with the majority (70%) serving five or

---

[3] Of the four tools developed, three were used in the pilot-study as the fourth tool was designed specifically to meet the needs of mentors.

more years, and the remaining sample (30%) three to five years. The school counselors ranged in age, but all were between 30 and 59 years of age. Their ethnicity was 70% white and 30% black/African American, all were female, and all had received a master's degree. In addition, the counselors varied in terms of their prior knowledge and comfort level in communicating about CTE/STEM career pathways.

Middle School Students: A total of 401 students participated in the study with 277 providing data for both surveys. The cohort of students were diverse in terms of their initial interest level in CTE/STEM fields, prior exposure to CTE/STEM educational and career pathways, and frequency in communicating about these topics with their school counselors. The students who completed the survey at both time points, were equivalent in gender[4], ranged in age from 11-14 years,[5] and included grades sixth through eighth[6]. Approximately half of the sample was Caucasian, a fourth Hispanic/Latino, and one fifth selected "other"[7].

Study Data Collection Activities
The following data were collected from school counselors and students:

School Counselor Surveys: Counselors completed both a pre- and post- survey and were asked various questions relating to their attitudes, knowledge, and level of preparedness about CTE/STEM, details about their current role, demographic information, attitudes toward early career development, and perceptions of CTE courses, as well as general career awareness. The post-survey also probed the school counselor's perceptions of the effectiveness of the digital tools, and their judgments of the utility and relevance of the tools.

School Counselor Interview: School counselors were asked to participate in a 45-minute phone interview, conducted by EDC researchers at the completion of the pilot study. The purpose of the interview was to gather additional information about the implementation, including: feedback on each of the three digital tools, structure of the pilot-study, their students' general reactions to the tools, professional history, current role, professional needs, and prior experience using digital tools.

---

[4] 53% were male and 47% female.

[5] Students ages included 11 year old (3%), 12 year olds (20%), 13 year olds (53%), and 14 year olds (22%).

[6] The majority of students were in 7th grade (62%), followed by 8th grade (32%, and a small number of 6th graders (7%).

[7] Ethnicity included Caucasian (49%), Hispanic/Latino (25%), Black/African American (6%), Asian/Pacific Islander (6%), Native American (3%), and Other (18%). It should be noted that students were permitted to select more than one category on the survey, leading these percentages to add up to more than 100.

Table 1. Data Collected from School Counselors by Instrument

	Pre-Survey	Post-Survey	Post-Interview
School Counselor Demographics	x		
School Counselor Current Role	x		x
Attitudes toward Early Career Development	x		x
Perceptions of CTE Courses	x		x
Attitudes toward CTE STEM	x	x	
Knowledge about CTE STEM	x	x	x
Preparedness to teach CTE STEM	x	x	
Perceived Effectiveness of Intervention		x	x

Student Surveys: Participating middle school students were asked to complete both a pre- and post- intervention survey. The survey questions pertained to basic demographic information, interest in learning about various career and educational pathways, and knowledge about CTE/STEM education and career pathways, as well as additional questions intended to elicit feedback specifically on the two digital tools used, CTE Exploration and Career Stories.

Table 2. Data Collected from Students by Instrument

	Pre-Survey	Post-Survey
Student Demographics	x	x
Interest in Career Pathways	x	x
Interest in Educational Pathways	x	x
Knowledge about CTE STEM Education	x	x
Knowledge about CTE STEM Career Pathways	x	x
Feedback on Career Stories		x
Feedback on CTE Exploration		x

Analysis

The pilot study utilized a mixed methods analysis. Quantitative analysis of survey data began with descriptive statistics and culminated in paired samples t-tests to test for

statistical significance from the beginning to end of the study. Qualitative analyses of open-ended survey responses and interview questions was conducted by identifying key themes and summarizing and organizing those themes by research question.

Pilot Study Research Questions and Findings

Findings from the pre- and post-survey research questions are summarized below:

Overarching Findings

The features that resonated positively with counselors and students included the videos, showing a wide array of possible CTE STEM careers, highlighting careers that were not typical, incorporated hands-on learning, career directions, and success stories.

1. **Importance of Students' Career Exploration and Tools to Encourage that Exploration**
   Prior to the pilot study, school counselors in our survey affirmed the importance of encouraging students to pursue CTE/STEM careers and most felt that their school supported career exploration to some degree. This initial support of the interventions goals may have reflected the fact that school counselors opted into the study, so we do not know how school counselors who did not choose to participate in the study think about these issues; however, the level of supportiveness that the American School Counselor Association provided during recruitment along with this information suggests there is likely general agreement among school counselors.

2. **Tools were Feasible to Implement by School Counselors with Middle Grades Students**
   Pre-surveys also found that school counselors have minimal time to work with each student individually, suggesting this intervention's whole class or small group approach fits the needs of school counselors as they work with their students. When school counselors are able to meet with students individually, they typically discuss students' personal lives, schoolwork, career goals, and academic interests. Thus, the career exploration that the intervention encourages may help them to have additional individual discussions with students after the conclusion of the study.

   When implementing the program, school counselors typically spent a full class period on each tool within a whole group setting, although some used each tool over multiple class periods. School counselors typically showed the CTE Exploration tool to students prior to the Career Stories tool, as the lesson plan suggested.

3. **Improved Knowledge and Interest in CTE STEM Careers and Pathways.**
   Overall, School Counselors reported improvements in their own knowledge about CTE STEM topics and felt the tools helped them conduct counseling with students and led to engaging discussions with students. Counselors reported that

students were engaged with these tools and that the use of the tools improved their knowledge and interest in CTE STEM careers and pathways.

In addition, school counselors liked both tools (slightly preferred the CTE Exploration Tool), felt they had sufficient time to use the tool, reported that students were engaged with these tools and that the use of the tools improved students' knowledge (CTE Exploration helped this goal slightly more), and interest in CTE STEM careers and pathways. Specifically, teachers felt these tools were a good complement to the tools they currently use and that the tools led to engaging discussions with students.

School counselors reported positive impacts on students' knowledge of and interest in CTE STEM careers and pathways. Although the survey did not find significant changes on students' overall scores, there were findings from individual questions that provide clues about middle school students thinking. Middle school student's own interests and abilities and their belief that spending time gathering information about careers would help them make good career choices increased significantly. In addition, they were more committed to learning about their own abilities and interests and getting the education required for their career choice. However, students significantly decreased their intention to spend more time learning about careers and intent to talk with lots of people about careers. This may indicate that students in the study felt that they had sufficiently explored careers and pathways at that given point in time or that they may return to the career exploration activities mentioned above at a later point in the future.

4. **Tools Improved Communication and Discussions about Career Options and Pathways**
   Of the two student-facing tools, CTE Exploration was favored by both counselors and students. The features participants enjoyed included the videos, the wide array of featured CTE STEM careers, and the introduction of careers that a student might not typically encounter. School counselors reported that the tool was an appropriate starting point for discussions with and among students because it included a wide range of career topics and incorporated hands-on learning, career directions, and success stories. Career Stories tool was also rated well and appreciated by participants. School Counselors liked the diversity of the career profiles and were positive about the tool. To improve both tools in the future, participants wanted students to have direct access, more videos and profiles, links to external sources of information, and updates to the lesson plan manual (more content and updated time estimates). With the counselor-facing tool, the Communication Coach, counselors felt that it has potential for new school counselors or others who do not have extensive training with middle school students.

Research Question 1: What are school counselors' pre-existing attributes related to CTE/STEM (i.e., initial perceptions of, knowledge of, preparation to discuss, attitudes toward CTE/STEM or STEM)?

CTE/STEM Career Development Attitudes:
All school counselors indicated in the pre-survey that it was important to encourage students to pursue CTE/STEM careers (50% extremely important, and 50% somewhat important). School counselors reported that they used a variety of career interventions or strategies to work with students, including: interest, personality, and values assessments (100%); informational interviewing (30%); computer-assisted career guidance systems (100%); job shadowing/occupational exploration (30%); and decision-making models (30%). All school counselors in the pilot study used an existing career interest inventory[8] with their middle-grade students, and felt that the tools in this intervention were a good complement to their counseling work and existing tools and resources.

Interacting with Students: When school counselors were asked who decides how time is spent with students, the majority reported that the counselor decides, and that sometimes the student or principal is involved in that decision as well. School counselors reported that they typically have an hour (20%) or less (70%) to meet with their students. The number of meetings ranged from 2–14 per year. When asked to rank the focus of time spent with students, discussing students' personal lives and student schoolwork was highest, followed by discussing career goals and academic interests, engaging in social activities, and using technology together.

Support of Student Career Exploration: School counselors mostly felt (80%) that their school supported students' career exploration to some degree, but some did not feel there was support. When directly asked to agree or disagree that their school supports students' pursuit of CTE/STEM careers, most agreed (50%) or slightly agreed (30%), with a small number of counselors saying they had no opinion (10%) or that they slightly disagreed (10%) with that statement.

Research Question 2: How did school counselors implement the intervention (i.e., how often and when were tools used, what were student groupings, what coordination was there with other staff)?

Implementation of Intervention: When implementing the two student-facing digital tools, CTE Exploration and Career Stories, almost all school counselors devoted two classroom periods, one per tool, to introduce each seprately to the class as a whole. In fewer cases, counselors chose to use the tools across multiple classroom periods, or in a small-group setting. Even though classroom periods ranged significantly, from 25 to 50 minutes, all school counselors felt they had sufficient time to introduce and use the tools with their students. The number of students in each session also varied greatly, ranging from 1 to 50 or more students at a time. The frequency of use also varied, with

---

[8] Inventories mentioned include: Career Cruising, Alaska Career Information System (Alaska only), Mississippi Choices (Mississippi only), Mynextmove.org, and Indiana Career Explorer.

"weekly" being the most frequent response for both tools. School counselors also reported that they often used the tools without the students in order to prepare for the lessons. None of the school counselors reported during the post-interview that they use the tools in collaboration with other staff members.

School counselors reported that students were engaged with both tools, but there was higher engagement with CTE Exploration than with Career Stories.[9]

Figure 3. School Counselor Rating of the Digital Tools
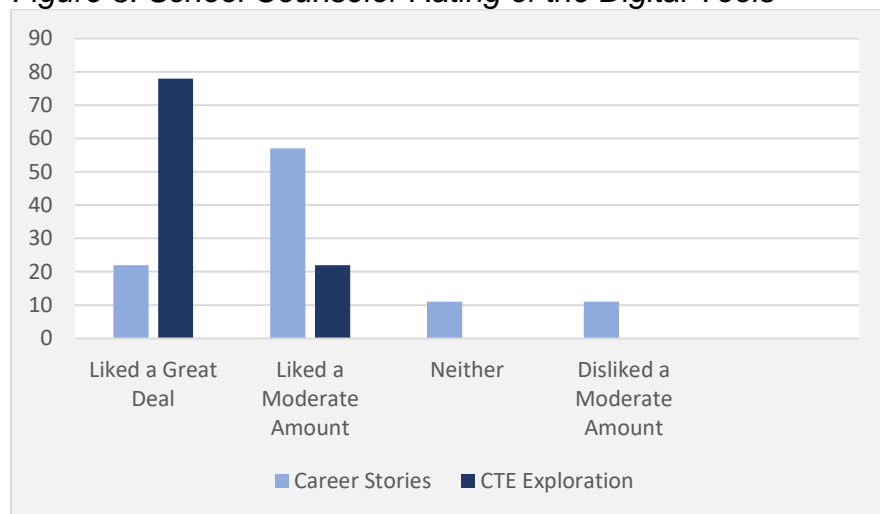
Student Engagement with Tools: School counselors provided feedback on the intervention's impact on students' engagement, knowledge, and interest in CTE STEM careers and reported that most students knew more about CTE STEM careers after using both tools.

Research Question 3: How do participants respond to the intervention as a whole, and to its individual elements? (What are the strengths and weaknesses of the intervention, in what ways did the tools support school counselors in their work and in what ways could the tools be improved?)

Feedback on the digital tools was collected from counselor and student post-surveys as well as counselor post-interviews. EDC researchers coded the data sources with the following themes in mind for each tool: strengths, weaknesses, suggestions for improvement, student outcomes, and implementation method. Below is feedback on each of these areas, by tool.

---

[9] Post-Surveys questions asking School Counselors to report on the level student engagement with the tools revealed that Career Stories was "Very engaging" (33%) or "Somewhat engaging" (67%) and CTE Exploration was "Very engaging" (89%) or "Somewhat engaging" (11%).

Overall Feedback on the Tools: All school counselors in the pilot study reported that the tools in this intervention were a good complement to the current set of tools they use in their work and that implementing the digital tools led to engaging discussions in the classroom. Overall, counselors noted a high level of student engagement when using both student-facing tools. In addition, students were asked to provide their feedback on the two digital tools (post-student survey). Across responses for both tools, a few common themes emerged such as: an appreciation for the variety of careers and diversity of individuals represented in the tools and guidance for visualizing possible educational and career pathways, as well as positive reactions to the format of the tools in general. A full description of each tool's strengths, weaknesses, and suggestions for improvement is in Appendix A.

CTE Exploration: Across all post- interviews, counselors had mostly positive reactions to the tool, with minor suggestions for improvement (see suggestions section below). It was the favored tool, as both counselors and students enjoyed the videos within the tool. Counselors appreciated that many of the careers shown in the tool were not typical pathways that most students were already aware of, as this tool showed a wide array of possible CTE STEM careers.

Most school counselors chose to introduce the pilot study to their class with the CTE Exploration tool. Counselors reported that the tool was an appropriate starting point for their discussions, as the it covers a broad range of CTE STEM-related topics, including hands-on learning, career directions, and success stories. In interviews, school counselors liked this tool's video-based and visually appealing career information display, and felt it was an effective technique for engaging middle-grades students in discussion about and exploration of careers. One counselor, whose students did not have a high level of familiarity with CTE STEM career pathways, chose to introduce this tool to her students first because it and provided a "great overview of CTE STEM."

Career Stories: The Career Stories tool provided examples of CTE STEM career trajectories using a variety of sequential storyboarded media assets to introduce the unique career pathway of individual professionals across a range of industry clusters. This technique was rated as being effective. Counselors appreciated the pre-populated examples as well as the diversity in the profiles; however, in general they did not upload their own information onto Career Stories due to a lack of time[10].

In the post-interviews, school counselors described their experience using Career Stories in a variety of ways. Most counselors began using the tool by asking students which career profiles they would like to explore. One particular counselor, who chose to select the profiles ahead of time, stated, "I previewed the tool first, watched all of the videos, tried to decide which ones were most meaningful or unique, most of which were the girls!" Whether the counselor chose the profiles ahead of time, or with input from

---

[10] Only one counselor uploaded her own information to the tool, with all others citing lack of time as the reason they did not do so.

students, all counselors stated that they were able to explore most, if not all, of the career stories. With the exception of one counselor who is already using a similar tool[11] in her state-mandated career exploration program, all counselors said they would use this tool again.

Student Outcomes: School counselors reported positive student outcomes related to both tools, including student engagement, increase in student knowledge and interest about CTE STEM careers and pathways (see "Student Engagement with Tools" section above and Research Question 5 section below).

Research Question 4: What is the intervention's effect on school counselors?

This study assessed the effect of the tools on school counselors' knowledge and preparedness with STEM and CTE and pedagogical teaching efficacy, as well as their attitudes toward early career development, perceptions of CTE courses, and general career awareness.

Knowledge of CTE/STEM Topics: With regard to school counselors' knowledge, in interview responses after using the tools, most counselors felt "somewhat knowledgeable" and able to discuss CTE/STEM topics with their students. All counselors reported that they felt there is still more knowledge to be gained in this realm. (As context, it should be noted that none of the participating school counselors were new to the field of school counseling).

Teaching Efficacy: With respect to pedagogical teaching efficacy, school counselors reported they felt that the digital tools helped them conduct counseling with students, and that each tool supported this endeavor in different ways.
- Career Stories helped counselors to engage students by providing real-life stories, and the appealing visuals and graphics helped actively engage students in discussion as opposed to a creating a passive learning experience (i.e. lecture). When asked to provide insight on the experience of using Career Stories in the classroom, one counselor said: "It was a very positive experience, I had maybe 60 kids at a time in the classroom, and it would have been easy for them to get distracted, but they asked great questions…they really liked the videos."
- CTE Exploration was a tool that supported counselors in doing the work they need to do with students, specifically helping them set goals and clarify their career interests. One counselor stated, "It allowed me to talk about high school scholarships and classes they have the option of taking in the future. I was able to talk about classes they might take to support their interests."
- Communication Coach provided school counselors with ideas for how to best engage students. In the post-interview, one counselor stated, "The interactions made it look real. Watching the interaction between another professional is always helpful."

---

[11] Career Crusing (https://www.careercruising.com/).

Attitudes and Perceptions about Careers: School Counselors' attitudes toward early career development[12], perceptions of CTE courses[13], and general career awareness[14] did not change significantly from the beginning to end of the intervention. And although these variables were measured, it was not anticipated that the intervention in its current form and length would lead to changes on these variables and, as such, these analyses were exploratory in nature.

Research Question 5: What is the intervention's impact on students?

Findings from Student Surveys: Student surveys included an adapted version of the Middle School Career Self-Efficacy Scale (MSCSES), a measure of how middle-school students rate possible future career activities and behaviors that are related to engagement in career exploration and decision making. Of the full sample of 401 students, 277 students had full data from both time points having completed both the pre- and post-survey, and were included in this analysis. A paired-samples t-test was conducted to compare the pre- and post-survey questions. The overall composite score for the MSCSES was not statistically significant (p=.302); however, individual questions in the scale did indicate significant changes from pre- to post- survey.

There was a significant positive impact from pre- testing to post- testing on: (1) students' acknowledgement that knowing their interests and abilities will help them choose a career[15]; (2) students' acknowledgement that spending time gathering information about careers will help them select a career[16]; (3) students' commitment to learning more about their own abilities and interests[17]; and (4) students' intent to complete the education required for their chosen career[18]. However, students' commitment to learn

---

[12] A paired-samples t-test was conducted to comparing the pre- and post- survey composites scores for the Attitudes Towards Early Career Development. There was not a significant difference in the scores for pre- (M=15.20, SD=1.62) and post-survey (M=15.80, SD=1.62) composite scores; $t(9)$=-1.62, p = .140.

[13] A paired-samples t-test was conducted to comparing the pre- and post- survey composites scores for the Perceptions of CTE Courses (Herian 2010; Adapted). There was not a significant difference in the scores for pre- (M=38.5, SD=3.10) and post-survey (M=40.30, SD=3.40) composite scores; $t(9)$=-1.38, p = .202.

[14] A paired-samples t-test was conducted to comparing the pre- and post- survey composites scores for the General Career Awareness (Herain, 2010). There was not a significant difference in the scores for pre- (M=31.80, SD=4.08) and post-survey (M=32.00, SD=4.85) composite scores; $t(9)$=-.183, p = .859.

[15] There was a significant difference in responses to the statement "If I know my interests and abilities, then I will be able to choose a good career for me" for pre- (M=1.53, SD=.568) and post-survey (M=1.65, SD=.720) composite scores; $t(277)$=2.628, p = .009.

[16] There was a significant difference in responses to the statement "If I spend enough time gathering information about careers, I can learn what I need to know to make a decision." for pre- (M=1.75, SD=.675) and post-survey (M=1.96, SD=.888) composite scores; $t(276)$=3.846, p = .000.

[17] There was a significant difference in responses to the statement "I am committed to learning more about my abilities and interests." for pre- (M=1.82, SD=.756) and post-survey (M=1.99, SD=.851) composite scores; $t(276)$=3.251, p = .001.

[18] There was a significant difference in responses to the statement "I intend to get all the education I need for my career choice." for pre- (M=1.54, SD=.678) and post-survey (M=1.72, SD=.876) composite scores; $t(276)$=3.516, p = .001.

more about careers decreased from pre- to post-test.[19] This may indicate that students in the study felt that they had sufficiently explored careers and pathways at that given point in time or that they may return to the career exploration activities mentioned above at a later point in the future.

Findings from School Counselor Surveys: According to all the school counselors, the CTE Exploration tool led to improvements in student knowledge about CTE STEM. Career Stories tool was rated positively as a means to improve student knowledge about CTE STEM, but less so than the CTE Exploration Tool.[20] In addition, school counselors reported that all students were more interested in CTE after using both tools. CTE Exploration was related to higher reports of student interest in CTE than Career Stories, but both were still rated as leading to higher interest in CTE.[21]

Conclusion

This report presents the new knowledge gained from the project about the messages and images that can shift opinions about the value, relevance, and status of CTE education pathways and CTE careers. The intervention is intended to provide an image of STEM-related, career and technical education that invites all students to consider CTE career paths, by engaging them with school counselors who are prepared to communicate about CTE in new, accessible, and age-appropriate ways. Although CTE is often viewed as a lesser option for those who could not make it to college; it can actually be a springboard to success for the right student. The overarching goal of changing this stereotype for students was met through the creation of new, more accurate messages about CTE programs for middle grades that allow them to learn about these options and plan high school course work in accordance with those goals.

The project's specific goal is to (1) develop a better understanding of how to communicate with middle grades students about career and technical education (CTE), particularly those career paths that focus on STEM career trajectories (phase 1), (2) develop an intervention that invites all students to consider CTE career pathways in an accessible, visual, and age appropriate manner (phase 2 and 3), and (3) conducted initial research to determine the potential of this approach (phase 4). Throughout the four phases of the research and design process, we have discovered the features of digital tools, resources, and content are most helpful for school counselors when it comes to communicating about CTE STEM career pathways to middle grades students.

---

[19] There was a significant difference in responses to the statement "I intend to spend more time learning about careers than I have been." for pre- (M=2.44, SD=.864) and post-survey (M=2.27, SD=.961) composite scores; $t(276)=2.676$, $p = .008$.

[20] Post-Surveys questions asking School Counselors to report on the level student knowledge interest in CTE STEM career pathways with the tools revealed that CTE Exploration was rated higher (78% definitely had higher interest; 22% somewhat higher interest), while Career Stories varied more (33% definitely had higher knowledge; 56% somewhat higher knowledge; 22% not higher student knowledge of CTE STEM career pathways).

[21] Post-Surveys questions asking School Counselors to report on the level student interest in CTE STEM career pathways with the tools revealed that CTE Exploration was rated higher (78% definitely had higher interest; 22% somewhat higher interest), while Career Stories was more evenly split but still positive (44% definitely had higher interest; 56% somewhat higher interest).

In phase 1, the project generated new knowledge about the messages and images that can shift middle grades students' opinions about the value, relevance, and status of CTE education pathways and CTE careers. This messaging is useful across informal and formal educational settings and may help school- based staff (i.e. teachers and administrators), career and guidance counselors, parents, industry leaders, and other "influencers" of career pathways. This research led to the following set of recommendations that, in conjunction with phase 2 findings, guided the development process.

- *To appeal to middle school students, start by meeting them where they are: matching activities they are most interested in with the opportunities that CTE can provide.*
- *The messaging strategy should also include concrete benefits of CTE in STEM-related fields.*
- *Address the misconceptions about the types of students who pursue CTE and the long-term prospects of students in related careers to combat CTE's image problem.*
- *Broaden CTE's appeal with content that includes diverse groups and tasks. Middle-school students need to see themselves in communication materials and promotional activities.*
- *Show, don't just tell, students what they can do through CTE and STEM fields.*

In phase 2, direct input from CTE professionals guided the iterative design process, resulting in prototypes of digital tools that illustrated promise. These findings suggest that how adults (i.e. mentors, school counselors) communication with middle students depends in part on organizational structures and the knowledge, availability of adults to educate and support middle grade students' career exploration, and the beliefs that adults bring to the situation. For example, interviewed mentors expressed their belief that mentoring is a way they hope leads to more diversity in these fields and serves as a way to recruit potentially talented individuals to their fields. Yet, students often find it difficult to envision the intricacies of a specific job and need both written and visual information in order to truly explore career pathways.

Phase 3 leveraged findings in phase 1 and 2 to produce three digital tools (Career Stories, CTE Exploration, and Communication Coach) and a set of complementary classroom activities (lesson plan manual) to test during the last phase of the project. The use of this intervention culminated in the Phase 4 pilot study, which provided insight into the intervention's feasibility and use, as well as preliminary impacts on participating school counselors and middle grades students. Key findings from the pilot study suggest that:

- School counselors agree with the importance of encouraging students to pursue CTE STEM careers and most felt that the school supported career exploration to some degree.
- Due to the limited time school counselors have to work with each student individually, this intervention's whole class or small group approach in

combination with the tools was a good complement to the tools school counselors currently use. that the tools led to engaging discussions with students.

- When implementing the program, school counselors typically spent a full class period on each tool within a whole group setting, although some used each tool over multiple class periods.
- Overall, school counselors liked both tools (slightly preferring the CTE Exploration Tool), and had sufficient time to use the tools with students.
- School counselors reported that students were engaged with these tools and that they sparked discussions with students about career options.
- School counselors reported positive impacts on students' knowledge of and interest in CTE STEM careers and pathways.
- School Counselors reported improvements in their own knowledge about CTE STEM topics and felt the tools helped them conduct counseling with students.

Findings from this project suggest that this approach holds promise and justifies additional development of the intervention and more research.

Future Research

While these studies contribute to our knowledge, there are many areas for future research that we were not able to address in this exploratory project. The first area for investigation is to further develop the intervention to provide more information about the specific knowledge student gain with a full intervention and investigate how that new knowledge impacts career interests and exploration long term. As part of a future study, the inclusion of a comparison group is needed to determine how the intervention works in comparison to other interventions or a business-as-usual comparison. Finally, further work is needed to investigate how students themselves think about career exploration, preparation, and selection.

Appendix A: Specific Feedback on Intervention Elements

This appendix provides detailed feedback on each intervention element, including the strengths, weaknesses and suggestions for improvement.

Career Stories Tool Themes and Recommendations for Future Revision

Diversity of individuals and Careers: Counselors spoke highly of the diversity of individuals and careers across the industries represented in the tool (for example, "The Diversity in it was good. In all of it."). Counselors also noted that a strength of the tool was that it introduced students to careers that "were not typical" (for ecample, "I had students who were very appreciative of the welder. Alternative lifestyles. I was grateful about the positive spirit that she had."). Student feedback (post-surey) noted that the tool was inclusive of both genders, and helped inspire students to think that CTE/STEM careers are possible for anyone (or example, "We got to see each gender shown in any career").

Illustrating Career Trajectories: Counselors also appreciated that the tool showed the path and steps to obtaining a career in the CTE/STEM fields, not just the final destination (for example, "I liked how it told the story of how they got started. A lot of kids think 'Wow, they have this really cool job, and they make all this money!' but they really don't understand the work it took to get there.").

Student Engagement: A common piece of feedback we heard from counselors was how engaged students were when using this tool, particularly when videos were included in the career profile (for example, "It was a very positive experience. I had maybe 60 kids at a time in the classroom. It would have been easy for them to get distracted, but they asked great questions. They really liked the videos.").

Exposure to New and Interesting Careers: When students reported what they liked best about Career Stories, the most common answers included praise for how the tool exposed them to new and interesting careers they were previously unaware of.
- "I liked how you could see a bunch of specific different career choices."
- "It told me about how the people got to where they were and all they needed to do to get there."
- "It helped me get motivated so that I can know that the only limits are what I put myself to."
- "I liked the videos and how it showed the career and things you can do in the certain careers."
- "I like that you're able to learn what education the people have to go through."
- "It gave good insight on different jobs in the world."

Turning Students Interests into Careers: Students also appreciated how the tool exhibited the process of turning one's interests and hobbies into a career.
- "It is a good way to find interests for you, and to just widen my ideas in general."
- "I liked that it talked about more than just their job. I liked that it also talked about their interests."

- "It showed how people chose a job that related to some of their hobbies or interests."

Need for Individual Student Access: With this tool in particular, counselors noted with their whole-class instruction model, some students were unable to explore the profile that most interested them. They suggested allowing students to access the tool individually, on computers or tablets, so they could select the career that most interests them and not miss any relevant information. One counselor noticed that some profiles were more robust than others. "Some of the profiles had more information than others, having more content so they look the same across the board [would be better]."

Need for More Content: When asked about the weakness of the Career Stories tool, the most common piece of feedback received from students was that they would like to see more video content (for example, "I would like it if there were more videos.", "I wish there was more videos and more careers.", "How some of them didn't have a cool video."). Students also wished to see more career profiles, as there were not always enough options to satisfy a student's interest (for example "Something I disliked was that it didn't give a lot more career options in one field, it only gave three or less that I saw."). Students also noted that some of the profiles did not have as much information as they would have liked (for example, "I disliked that there wasn't enough information in some of the categories.", "I wanted more information about the person's thoughts"); adding additional video content could solve that issue.

Career Stories Improvement Ideas

When we asked counselors how the Career Stories tool could be improved, we heard the following suggestions.

1. *Student Access*: First, as mentioned above, many counselors felt that giving students the ability to access the tools individually would lead to greater engagement (for example, "It was a little challenging to discuss as a whole, may have been better if we did breakout groups because students had different interests and wanted to see different profiles. It would be better if students went on themselves and I gave them an activity to do along with it.", "I had to read the stories, which made it difficult to keep their attention at all times.").
2. *More Videos and Profiles*: Counselors also suggested adding video to each profile, rather than to a select few, as video content is what drew the most attention from their students. When asked what sort of video content school counselors and their students would like to see more of, school counselors said things like "videos that show the careers and what it's like day-to-day," "pros and cons of the job," and "glimpses of the person on the job." They also suggested adding more profiles.
3. *Add External Links*: Lastly, providing links to items in the tool, such as university websites, geographical information, or even vocabulary words that may be unfamiliar would allow students to dive deeper in their exploration.

Table 3: Summary of Feedback for Career Stories

	Strengths	Weaknesses	Suggestions for Improvement
Career Stories	High level of student engagement and interest while using the tool Exposed students to careers and pathways they didn't know existed Diversity and variety within career profiles	Facilitation of the tool was challenging due to amount of reading required to browse profiles Counselors wished for more "day in the life of" style videos and interviews of those profiled in the tool Students' profiles of interest were not always explored, due to time constraints and lack of individual student logins	Provide each student with a way to individually access the tool. Use real individuals in the tool[22] Make sure each profile is consistent in terms of the amount of content. Include links so students can explore deeper, e.g., links to colleges, programs, etc. Include more video content across all profiles

CTE Exploration Tool Themes and Recommendations for Future Revision

Overall Feedback: School counselors generally had a great amount of positive feedback when asked about CTE Exploration tool (for example, "This was by far the best tool. We picked our character and we went through each of the tabs. We watched almost all of the videos."). According to their survey responses, students generally responded positively to the CTE Exploration tool.

Student Engagement: All counselors noted that students were very engaged while using the tool, and counselors emphasized the fact that students were especially interested while viewing the video content (for example, "The videos really caught them … our conversations were very rich.", "The students like watching the videos; those were more enjoyable than the slides that you have to read.").

Turning Students Interests into Careers: Some students reported that the tool did a nice job of engaging students' in their interest and exposing to CTE STEM careers related to those interests. For example,
- "I liked how CTE Exploration helps kids find careers with their interests."

---

[22] Due to the exploratory nature of the project, these profiles were piloted to determine if the approach was successful prior to investing resources in creating many authentic profiles.

- "It showed how people who like more hands-on activities used CTE to find a job they like."
- "It was a good showing and/or preview of going into a career."
- "The way the program asked us questions to get us interested."
- "I like how it explained what the jobs were."

Tool Features To Encouraged Engagment: Many students noted that they enjoyed being able to choose a character (for example, "I liked that you could choose a person to start with.", "The character was just like me."), and liked the animated style of the tool (for example, "I like that there was a little animation that went along with it."). The content, specifically video content, excited most students and led to engaging discussions in the classroom.

Focus on Real-World Application: Counselors also appreciated how the tools depicted the real-world application of CTE/STEM careers (for example, "It [CTE Exploration] was practical. My favorite thing was about SkillsUSA, because we have that in our district, too."). Counselors and students alike noted the visuals within CTE Exploration, including the animated characters, GIFs, and photos (for example, "They had a map of 'What is CTE?' that was a really good visual.").

Need for Individual Student Access: The tool was originally designed for use one-on-one or with very small groups of students. So, not surprisingly, when counselors were asked to think about any difficulties they encountered while using the tool, most said that the format of the tool was not always conducive for use in a large-group setting. A specific reason cited was the amount of text-heavy slides that required a lot of reading and since most counselors were using the tool during a single classroom period, reading the slides therefore took up more time than was preferred. Additionally, the tool was designed to be facilitated by an adult, and some counselors expressed the desire for students to be able to explore on their own.

Need for More Content and Interactivity: When asked what they disliked about CTE Exploration Tool, consistent with feedback from school counselors, a common sentiment for students was that students wished that there was more video content throughout the tool (for example, "I would like more videos."). Students also noted that the tool was not very interactive (for example, "That it wasn't very interactive."), that there was too much reading involved while using CTE Exploration (for example, "So much reading." "Some parts were really small and hard to read."), that there were not many character choices (for example, "I did not like that there were only two characters to choose from.) and some expressed an interest in having more information (for example "It was kind of vague, it didn't go into detail that often.").

<u>*Career Stories Improvement Ideas:*</u> When asked for suggestions on how to improve the tool, a recurring sentiment, as with the Career Stories tool, was that it would be more beneficial if students could use CTE Exploration on their own (for example, "It was harder to do it as a whole group. As a group, reading all that is not as effective."). Other suggestions included an audio text-to-read feature, creating different story lines for each

of the two "Alex" characters (i.e. "When we clicked on male Alex, and then the girl Alex, it was the same story, it would be cool if it was different stories.").

Table 4: Summary of Feedback for CTE Exploration

	Strengths	Weaknesses	Suggestions for Improvement
CTE Exploration	Students enjoyed choosing their own character Many counselors cited this tool as their favorite Most counselors spent the longest amount of time using this tool Easy to use and navigate Interesting visuals, e.g. "What is CTE" map Appropriate length of videos ideal for keeping students' attention Examples of practical application of CTE/STEM, e.g., Skills USA.	Format of the tool not conducive for using as a whole group Reading the content within the tool added to the length of time it took to facilitate Amount of content not consistent across slides and chapters Tool bar difficult to find due to hovering Not all slides within the tool go full screen, which is important when displaying to a whole class	Create additional video content—specifically, including video on all slides Provide individual student access to use the tool Add text-to-read feature, making the tool audible Create different stories for each character

Lesson Plan Manual Themes and Recommendations for Future Revision

Counselors also suggested improving the WGBH lesson plans. Specifically, school counselors mentioned adding more content (this could come from the adaptations that school counselors commonly made), as the time allotted for each lesson was an overestimate of how long the lesson took to implement in the classroom.

Communication Coach Themes and Recommendations for Future Revision

Overall Feedback: As with the other tools, the Communication Coach was designed originally for out-of-school mentors from industry to help them communicate effectively and appropriately with a middle school-aged students and was then adapted for use by school counselors (see description in development section above). Unlike the other two tools, it was not student-facing, but was intended to be used only by the school counselors. The tool models interactions between a counselor and student as they discuss various topics related to CTE STEM. When asked to rate this tool, school

counselors ranged in their responses (33% liked it a moderate amount, 50% neither liked or disliked it, and 17% disliked it a great deal).

Tool Use: When asked how they used this tool, all but one school counselor viewed and used it one time. Counselors did not use the accompanying WGBH lesson plans while using the tool, nor did they take notes, pause, or return to specific scenarios within the tool. Typically, counselors walked through the tool in order, from start to finish. Counselors also did not find it necessary to return to specific chapters to review, as they noted finding the tool "straightforward" and "user-friendly."

Communication Coach Strengths: When asked about the strengths of the Communication Coach tool, one participant noted that the self-paced aspect of the tool is conducive to the schedule of a school counselor. "I liked the fact that it's self-paced; we're in a field that we're interrupted so much, so that's nice." Generally, counselors believe that watching and learning from others is an effective tool for improving one's own practice: "Watching the interaction between another professional and a student is always helpful." Another liked the fact that she could easily watch the videos while multi-tasking, and that it was less laborious than reading a textbook chapter: "It was a video, so it wasn't like I had to read, I could just watch."

Communication Coach Weaknesses: This tool was originally designed for out-of-school mentors who do not have teaching experience, so many of the weaknesses mentioned by school counselors are a reflection of the fact that the tool's intended audience changed and it did not fit the needs of school counselors well. More than half of the participating counselors had more than 10 years of experience. It is likely because of this that many stated that the Communication Coach was a better fit for newer school counselors, rather than those who have years of experience working with students. One school counselor stated, "It's great for somebody that's just starting out in counseling to give them some ideas about how to communicate with children about careers. For me, I didn't feel like it was all that helpful." Another had a similar sentiment when she explained, "As a teaching tool for adults, I found it to be simplistic. As a school counselor, I have been trained to do what was presented already." If the tool could meet the needs of newer school counselors, as well as provide new and interesting material for veteran counselors, more engagement and use of the tool may occur.

Communication Coach Suggestions for Improvement: In addition to providing information for more experienced counselors, there were not many other suggestions for improvement. Some counselors suggested making the scenarios and dialogue more realistic. Others noted it would be great to have a real interaction between a school counselor and student to increase the authenticity of the conversations: "I'm not sure I thought it was really necessary for a counselor. It didn't seem very natural." Another counselor explained that if the purpose of the tool was to improve communication between counselor and student, talking about careers immediately may not be an effective way to break the ice. "I'm not sure if, when I'm trying to get to know kids, I would talk about careers." One additional suggestion we heard was that using this tool could be helpful with another demographic: school counselors in training.