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Supporting A Creatively Focused Technology Fluent Mindset Among Educators: A Five-Year Inquiry Into Teachers' Confidence With Technology

DANAH HENRIKSEN
Arizona State University, USA
danah.henriksen@asu.edu

ROHIT MEHTA
California State University, Fresno, USA
mehta@csufresno.edu

JOSHUA M. ROSENBERG
University of Tennessee, Knoxville, USA
jmrosenberg@utk.edu

Teacher confidence with technology is essential during times of rapid changes in digital technologies. In this study, we draw on theoretical accounts from creativity research and the educational technology literature to characterize an approach to teaching—a creatively focused technology fluent (CFTF) mindset. Following our work with five cohorts of educational technology master's degree students in hybrid classes designed to support this mindset (n = 74), we report evidence on such an approach. Teachers reported growth in their confidence in using not only technologies they directly experienced but also significant increases in confidence with technologies overall (even with tools they did not use/learn). We discuss implications of these findings with an emphasis upon how teacher educators can support creative teaching with technology regardless of the available technologies.

INTRODUCTION

In recent decades, digital technologies have revolutionized how we live, work, and think. This fast pace of change has been a challenge in teaching (Zhao, 2012). The early days of internet infusion in schools presented dramatic change, which has only escalated as smart phones have made computing and networking ubiquitous. The ever-present nature of social media, paired with the rapid spread of digital technologies into every nook and cranny of our lives, have created a sense of 24/7 digital connectedness and overwhelming access to constant new tools, apps and information.

Exponential growth and changes in digital technology have presented a challenge for teachers and teacher educators alike. Much attention has revolved around the kinds of teacher training that support teachers' knowledge and effectiveness in classroom technology use (Mishra & Koehler, 2006). For teachers, educational technology may feel like a moving target (Salomon, 2016). For teacher educators, it is difficult to decide how to approach technology in conjunction with pedagogy, or to know which tools to cover in curricula. By the time teachers and teacher educators catch up to a technology's effects on teaching, learning, and society, it becomes obsolete and new technologies flood the market, attempting to penetrate educational institutions.

Given these challenges of rapid technological change facing teachers and teacher educators, there is a need to promote a mindset for technology fluency and openness for the new that encourages independence from changing trends (Mishra, Henriksen, & the Deep-Play Research Group, 2012). We suggest this means helping teachers develop what we term a *Creatively Focused Technology Fluent* (CFTF) mindset. Through this, teachers may become more prepared for conscious adaptation, experimentation and learning in-situ, when faced with new tools or changing contexts and cultures of learning (Collins & Halverson, 2018). Thus, there is a need for teacher education pedagogy based on creative mindsets devoted to independence, openness, and experimentation.

Even when digital technologies were still somewhat new in education, Cuban (2009) and others (Zhao, Pugh, Sheldon, & Byers, 2002) suggested that technology infusion in classrooms was limited because teachers had not bought into the potential of educational technology. Years later, scholars note that not much has changed, and technology infusion in classrooms remains constrained (Jones & Dexter, 2018). One constraining factor is teachers' confidence with new tools in the evolving technology landscape (Collins & Halverson, 2018). The idea that new generations of teachers will be more technology fluent as "digital natives" has been increasingly criti-

cized—or shown to be not supported with solid evidence (Marshall, 2018; Thompson, 2015); and technology integration in teaching remains a complex endeavor (Wang, Hsu, Campbell, Coster, & Longhurst, 2014).

Teachers are consistently operating within a challenging system that requires unique blends of pedagogical knowledge and situational expertise. The demands and pressures on teachers are greater than ever (Avidov-Ungar & Forkosh-Baruch, 2018). Even though most people are increasingly comfortable living with the convenience of new technologies (Smith, 2014), using them with critical consciousness and confidence in classrooms is difficult. This begs the question of what types of teacher learning and professional development may support teachers' feelings of technology fluency or competence in a rapidly changing classroom?

While much teacher professional development in technology focuses on tool-centered approaches, this is often insufficient to meet their needs in contemporary classrooms (Jones & Dexter, 2018). We suggest that professional development driven by what we term a creatively focused and technology fluent (CFTF) mindset, can improve teachers' beliefs about their own efficacy with technology. This improvement in teachers' efficacy extends not only to technologies that they have directly worked with, but also transfers to new and unfamiliar technologies. This is powerful for supporting teachers with the kind of mindset and approach to work consciously yet nimbly in "21st-century learning" environments that need stakeholders to be more critical of digital technologies (Henriksen & Cain, 2018; Henriksen, Cain & Mishra, 2018).

In this article, we discuss the theoretical grounding for a CFTF mindset, which has two parts, creativity and technology. We first review the *creatively focused* aspect of this idea, followed by the *technology fluent* aspect. We then describe a graduate education program that has aimed to instantiate this mindset in a series of hybrid teacher professional development courses for teachers in a Master of Arts in Educational Technology program. We share the results of a five-year inquiry into the development of teachers' technology confidence from these courses—demonstrating significant growth in teachers' technology confidence/fluency as a result of their coursework experiences. Our inquiry considers the research questions: What differences are there in teachers' technology confidence before and after their involvement in the hybrid courses designed to support educators' CFTF? What differences are there in their confidence in using tools and technology with low, medium, and high alignment? And what differences are there in their confidence in using specific tools?

We assert that the CFTF pedagogy of the courses allowed teachers opportunities to experiment with technology, creatively design artifacts with

it, and learn in ways that measurably increased their consciousness of and confidence with classroom technologies (transferring beyond technologies they directly used, even to those that they did not, showing confidence that transferred across tools).

LITERATURE REVIEW OF CREATIVITY AND TECHNOLOGY FLUENCY

To explore the conceptual basis of a creatively focused technology fluent mindset we discuss foundations and literature that support such thinking. We first examine relevant creativity literature, then pair this with the idea of technology fluency, finally considering how these intersect in a CFTF mindset.

Creativity as a Component of Mindset

The value of creativity in teaching is central to developing learning experiences that are engaging and effective (Henriksen & Mishra, 2015). While creativity is thought of as a subjective term, most research defines it as having some core components—of novelty and effectiveness. A creative idea, process, or product is *novel* when it brings something into the picture that either did not exist before, even if in a small, local setting. Cropley (2001) notes that a novel idea with no potential use cannot be "creative," because novelty does not guarantee that something will be *effective* (Amabile, 1996). So, creative things must be effective or useful, logical, understandable, or of some value to others in a context.

Asking teachers to create learning experiences that are novel and effective is challenging because the contexts of digital technologies are still new and so changeable that outcomes can be difficult to predict or fully understand. The complex spaces of teaching shift quickly and teachers deal with uncertainty and evolving tools and demands. Therefore, we suggest a focus on a teaching *mindset* that corresponds with creative thinking, rather than chasing an outcome-target of novelty and effectiveness.

Henriksen and Mishra (2015) note that creative teaching is related to the mindset and beliefs that teachers hold. If we begin by understanding creative and flexible mindsets for teaching, we are better positioned to support teachers to seek new and better ways to teach with technology.

Much creativity research has focused on traits or personality characteristics that are associated with creative individuals (Runco, 2014). For exam-

ple, *flexibility* and *fluency* are key aspects of creativity measures—which relate how creative people can flexibly adapt to different categories/contexts, and fluently come up with many ideas and alternatives (Karakelle, 2009). This necessitates openness to support adaptability and the ability to see possibilities.

Psychology research has described individual traits correlated with creativity, including flexibility, open-mindedness, tolerance for ambiguity, intellectual risk-taking, and willingness to "play" (to play with ideas or details, or tinker with plans and designs) (Baer & Oldham, 2006; Prabhu, Sutton, & Sauser, 2008; Silvia, Nussbaum, Berg, Martin & O'Connor, 2009). Karwowski (2014) suggests that mindset is key because people must believe that creativity is malleable and open to growth to instantiate it in practice. So, working to adopt and practice habits of mind, such as flexibility or openness, directly influences such habits in creative skill growth and performance.

These aspects of creative mindset, therefore, include *flexibility, open-mindedness, willingness to try new things,* and *intellectual play* or *risk-taking*. These overlap with and relate to the ability to be adaptive and identify or try new ideas and plans. Amabile (1983) emphasizes that this does not guarantee that people with these traits are "creative," nor does it provide a clear formula of traits for creativity. But it does provide a sense of the habits of mind that are helpful with situations or goals requiring creative thinking.

Given the standardization challenges across education, and unique pressures of evolving demands in school settings, creative thinking in education is necessary (Sawyer, 2015). It is relevant in teaching contexts, where the challenges teachers face, and the needs of students vary by subject matter, grade level, and unique variables across school contexts. As Cropley (2001) asserted:

> (Education) cannot limit itself to the transmission of set contents, techniques and values, since these will soon be useless to living a full life, but must also promote flexibility, openness for the new, the ability to adapt or see new ways of doing things, and courage in the face of the unexpected, in other words, creativity (p. 136).

In a study of some of the most effective teachers in the country, Henriksen and Mishra (2015) showed that a key factor that successful teachers integrate into their practice is a mindset for creativity. The award-winning teachers they studied describe creativity not as separate from other thought processes, but as an integrated openness in their thinking, a willingness to try new things, and a belief that creative thinking is accessible to everyone.

Again, the defining characteristics of creativity in a CFTF mindset are intellectual risk-taking, open-mindedness, and an openness for the new. This

topic of pedagogical mindset and creativity has value when we think about the kinds of knowledge or approaches that teachers need to successfully engage and teach with digital technologies in the classrooms.

Technology Fluency as a Component of Mindset

These habits of mind associated with creativity naturally foster a willingness to engage with the new in terms of technology, because success or confidence with technologies require a degree of adaptability and a willingness to try new things and play with ideas. Our previously mentioned notion of *technology fluency* is not about technology expertise but rather about approaching technology in ways that serve the content and context for student learning and experience. This relates to the Technological Pedagogical Content Knowledge (TPACK) framework that addresses teachers' awareness and knowledge of technology integration for teaching (Mishra & Koehler, 2006) while balancing the knowledge of subject matter, and pedagogical knowledge about teaching (Schulman, 1986). The TPACK framework weaves in technology to challenge the conventional separation of these areas in how they have been viewed in education.

The notion that skilled teachers in technology-rich contexts need to have a fluid approach as they weave between content, pedagogy, and technology is central to our CFTF mindset. Technology fluency does not require expertise in technology—that would be an unreasonable goal for many educators, whose expertise lies within pedagogy and content. Rather, it means that as teachers work in new settings with the opportunities and constraints of digital technologies, they can use a mindset that appreciates the intersection of pedagogy and content, and how technology best mediates this.

Norton and Hathaway (2015) noted that teachers are increasingly required to create new and effective approaches for "21st-century" education—using technology for learning in ways that vary from intended, often capitalistic, purposes. Kirschner (2015) describes how the range of demands in 21st-century teaching and schooling, the creative aspect of what teachers do, is distinct from the traditional view of teaching as doing or implementing. Instead, the teacher is viewed as one who, "actively constructs, invents, develops and designs the practice of schooling" (Carlgren, 1999, p. 50)—increasingly in technology-rich contexts. It is incumbent on teacher education and professional development to support educators with experiences that build up a mindset for creativity and technology fluency—leading toward confidence, adaptability, and willingness to critically and consciously en-

gage with technology in the classroom. Helping teachers succeed in technology-rich contexts involves supporting their confidence and providing opportunities to engage in creative design work, and to develop a comfort with or willingness to experiment and try new approaches to technology tools.

Research on Teacher Beliefs

Researchers have consistently noted the importance of changing teachers' beliefs about technology in ways that are connected to deeper issues of pedagogy (Taimalu & Luik, 2019). Palak and Walls (2009) examined the relationship between teachers' beliefs and their educational technology practices among technology-using teachers in technology-rich schools. In seeking to understand if and how teachers might shift in practice toward a student-centered paradigm, they found that teachers use technology most frequently for preparation, management, and administrative purposes, and their use of technology for student-centered practice is rare. Even in technology-rich schools most teachers continue to use technology in ways that support existing teacher-centered practices (Palak & Walls, 2009). Kim, Kim, Lee, and Spector (2013) note that even when technology and technical knowledge are strong, effective and thoughtful technology integration requires that teachers' recognize and believe "new ways of both seeing and doing things" (Ertmer, 2005, p. 26). This emphasis on beliefs is perhaps unsurprising, because teachers' beliefs predict, reflect, and determine their actual teaching practice (Wilkins, 2008).

Teachers' beliefs are an overarching category that encompasses many different types of beliefs—and we do not explicitly deal with the category in a broad sense. Rather we describe how teacher education or professional development curricula might consider adopting (in contextually relevant ways) a focus on mindset for creativity and technology-fluency that goes beyond tools, and how this might reflect in confidence. Certainly, many factors are in play when it comes to classroom practices and technologies. Both external (e.g. time, support) and internal factors (e.g. beliefs) can become either barriers or supports to pedagogical uses of technology (Voogt & McKenney, 2017). Yet Mama and Hennessy (2013) note that the internal factors have more of a key role in technology integration. Scholars have found that one of the most important factors appears to be teacher self-efficacy (Anderson, Groulx, & Maninger, 2011; Mei, Brown, & Teo, 2018). Liu, Lin, & Zhang (2017) haved argued that very few researchers even include pedagogical beliefs within technology-adoption models, despite knowing that those beliefs

are essential factors for successful integration of educational technology. Kim et al. (2013) state that, "although many agree that beliefs are resistant to change, they also agree that the difficulty changing teacher beliefs comes from experience that teachers bring into their beliefs. This suggests that we ought to allow experiences that can be built up to challenge teachers' current beliefs but ultimately optimize their beliefs for student learning" (p. 82). Researchers who study teacher beliefs related to technology integration consistently agree that teacher beliefs should be considered and shifted in order to improve teaching practices.

Changes in teacher beliefs are vital to facilitating change in the use of instructional technology (Ertmer & Ottenbreit-Leftwich, 2010). While some have aimed to change teacher beliefs by implementing pedagogical interventions such as problem-based learning, modeling laboratory experience, etc. (Ma, Lai, Williams, & Prejean, 2008; Park & Ertmer, 2008), these have mostly been studied in technology-focused contexts without considering or working toward fundamental belief shifts. In other words, it is important to consider more fundamental elements of beliefs and values when it comes to teaching with technology. A great deal of research has considered or attempted to shift teachers' beliefs about their TPACK, and while there have been a plethora of approaches and foci—many of them interesting and valuable—seemingly few have aimed the arrow at confidence and/or creativity. While our work here does not directly measure creativity—it does presume that mindsets can be cultivated around creativity and technology, and that this can be relevant to improvements in teachers' confidence in teaching with technology.

As follows, we describe how we have aimed to bring a CFTF mindset into teacher education and professional development experiences. We then describe a study that explores outcomes of this pedagogical approach to teacher education in terms of teachers' confidence with technology.

CONTEXT FOR THE PRESENT STUDY: EFFORTS TO SUPPORT A CFTF MINDSET IN TEACHER EDUCATION

The authors of this paper have been a part of the curricular development and teaching of a series of summer graduate courses in educational technology at a large Midwestern university. These courses are part of an intensive summer learning experience in a master's program in Educational Technology—which intentionally aims to cultivate a CFTF mindset for educational technology, rather than emphasizing a skills or tool-based approach to professional development.

The master's program vision stemmed from the idea of "deep-play" (Henig, 2008; Koehler et al., 2011; Pellegrini, 1995; Spinka, Newberry & Bekoff, 2001), oriented toward designing a program to prepare teachers to engage confidently with ever-evolving trends in technology. The program's pedagogical focus is on having teachers create (artifacts, lessons, assignments, etc.), and embracing a willingness to explore new tools and try them out in different contexts or projects. The program's teaching approach might be described as being not about simply receiving content/learning but creating content/learning (e.g., having teachers make videos, not just watch them).

The motto of this program is "*Explore, Create, Share*" as a way of emphasizing what teachers do, and how they learn and experience technology. This framing on exploring, creating, and sharing also serves as a motto of what we have recently termed a creatively flexible and technology fluent (CFTF) mindset.

Summer Program Structure

The hybrid summer program requires three courses each summer, over three years of intensive summer learning experiences. There are two weeks of face-to-face time in summer (all day, every day), followed by four weeks of online summer learning—for a six-week summer experience. The context for this study is data collected from teachers' Year Two summer learning experience (a course series that the authors have taught and co-designed). Our Year Two data (described in later sections) follows five summers of Year Two courses. The year two summer courses include one educational psychology foundations course, another course which deals with how new technologies affect student learning and teachers' pedagogy, and a course which covers foundational educational research content.

There are typically 10-20 in-service teachers (the master's degree students) enrolled for each summer hybrid session. Program faculty design the eight-hour days incorporating discussions, activities, improvisations, technology play-time, and creative design challenges where teachers produce shareable products like videos, multimodal/interactive web-based spaces, tech-tips, and others. During these days, instructors lead by example, modeling the repurposing of technologies in new ways. The learning experiences here (and in the program overall) are designed as opportunities to develop and engage in a CFTF mindset. Thus, teachers engage with learning content through opportunities to: think and *work flexibly* and *manage uncertainty* in

open-ended projects, learn by *creating* or *making new things*, continuously *try new tools* or things, and learn to *play with ideas, artifacts or tools*. While it is difficult to fully encapsulate several weeks of daily learning, we share examples of a few assignment descriptions to give a sense of it.

How the Teachers Learn: Examples and Assignments

In the ten days of face-to-face teaching, each day has one or more thematic focuses as key topics from the three courses; e.g., constructivism or behaviorism from educational psychology, navigating leadership tensions from technology and leadership, key points in research topics, or varied educational technology design tasks. Each day contains some micro-lectures and reading discussions. But much learning time is spent actively and collaboratively, in lessons, activities, and projects aiming at creating and becoming more technologically fluent. Most projects require creative design work—either at the level of *micro-design* activities (mini creative projects or quickfire assignments), or *macro-design* activities (more extended project-based assignments).

Micro-design activities. There are many daily mini-projects or assignments aimed at playful design and creativity with technology and ideas. These activities push them to try new things or see the world in new ways. Micro-design activities are done on short timescales (anywhere from about 20 minutes to 2 hours), to engage with the uncertainty of creative work and quick decisions; this also demonstrates that the uptake for new technologies need not be time consuming or complex. There is *no* direct instruction on technology tools and no mandate to use specific tools. Instead, the focus is on choosing, repurposing or playing with new technologies. A few examples of micro-design tasks include, but are not limited to: an activity where teachers create "iImages" or visual advertisements for subject matter ideas; an activity to explore how teachers navigate leadership tensions in which they photograph themselves in different roles and collage these into a representation of their leadership identity; an activity where teachers collect data from a group about media preferences and then use the Common Online Data Analysis Platform (CODAP) to create and visualize their own data models for research discussion; or an activity to teachers identify a subject matter misconception and then quickly film, edit and create a one-minute video to present and debunk that misconception.

Some micro-design activities shift slightly from year-to-year as coursework is refreshed. The overall trajectory and spirit of the assignments is consistent with the *explore, create, share* motto and CFTF mindset. Anoth-

er mini-activity everyday involves sharing "Tech Tips." Every day, several teachers take turns leading a Tech Tips segment to show a mini technology demonstration or tip of their choosing to the rest of the class to promote openness to exploring, sharing, and playing with new technologies and tools.

Macro-design projects. Macro-design activities are peppered throughout the experience. There are also many macro-design projects that teachers work on over time. We cannot describe all project content from a densely-packed summer in one article. So, we give a brief overview of just a few macro-design projects, below.

Understanding understanding. This design project is grounded in educational psychology and educational research, to help teachers consider how misconceptions interfere with understanding content knowledge. They work in small groups on a topic of their choice to create a video project investigating popular misconceptions about that topic. This requires teachers to: examine prior research of the common/alternate conceptions of their topic, develop research questions and an interview protocol; select and interview varied learners to demonstrate understanding/misunderstanding among different ages and perspectives; create and edit a video to demonstrate a variety of understandings about the topic; and design a web page to display the video, the project, and a summary of what they learned (Koehler et al., 2011).

We emphasize creativity in framing and constructing the project (from the initial idea to the editing of video, and final presentation on the website). The range of topics students explore vary (e.g., where shadows come from, what determines the color of blood, beliefs about Christopher Columbus, and misconceptions about the scale of the universe). For example, in a project about the scope and scale of the universe, the teachers interviewed adults of varying ages to investigate how people misunderstand distances in the universe. They developed a qualitative interview protocol, integrated manipulatives, included an interview with a faculty astronomer to explain common misconceptions—and wove these pieces together with multimedia to create a unique final product exploring the content as a mini-qualitative project.

STEAMlab. In the STEAMlab project, students work collaboratively in small groups to create a one-hour long interactive session for an educator audience at a local conference about STEAM (the integration of the arts into STEM disciplines). The program works with a local school district and TinkrLab to secure spots for our teachers to present. The project is assigned at the beginning of the two-week face-to-face courses, and presented before the end. Teachers must design a STEAM PD session for other teacher conference participants. They choose a topic around STEAM to suit their inter-

ests and integrate technologies into the session. As the groups design their sessions, they consider how to create an engaging, unique experience that helps educators reimagine teaching through relevant STEAM concepts, such as making, tinkering, mental modeling, and more. They do brainstorming and design thinking activities to devise creative ideas for STEAM professional development sessions that provide a balance of learning, play, and technology.

Exploring Key Topics in Technology Webinar. Students work in small groups to choose a key current topic in educational technology and organize a webinar session/discussion with experts. The teachers identify and invite experts and audience viewers, design a structure, do background research to prepare, and create a protocol to guide discussion facilitation or questions. They allocate tasks and coordinate roles in the group to execute the webinar (e.g., through YouTube Live), record it, and archive it for future sharing. A few past topics include developing information literacy skills, meeting diverse needs of students through assistive technologies, digital equity and healthy practices in technology, or intellectual property and copyright. The teachers are faced with numerous design tasks and creative responsibilities—such as situated technology learning for live production, engagement with educational technology topics, leadership around organizing the event, and professional networking with experts.

Putting it together. The individual assignments, projects, and examples here do not capture the totality of the experience, but may help illustrate the mindset. It is not rooted in a goal of perfectly creative outcomes but instead aims to cultivate habits of mind that align with creative practice and technology fluency. This is captured in practices that put teachers in situations to create or design things, to engage with the new, to try new things and be flexible, and to develop a sense of fluency around technology.

The authors of this paper observed how this CFTF approach helped teachers develop a sense of efficacy and comfort with classroom technologies. We began collecting data in pre- and post-surveys, initially to see how our students learned and viewed technology confidence before and after their summer coursework. We emphasize that our data was not designed to measure teachers' creativity over time (though we believe this is a necessary future direction). However, it does reflect changes in teachers' perceptions of their fluency with technologies. As follows, we report on our methods and results of this data collection.

During the summer experience, in-service teachers used and experienced tools and technologies. Their familiarity with these technologies varied, from tools they had used themselves, to things they were aware of, to

things they had never heard of. Using the CFTF approach, we wanted our teachers to learn to switch confidently between tools, understanding their affordances and constraints and considering pedagogy and content needs—irrespective of direct experience. This gave them more power over the technologies rather than depending on any one tool amid ever-changing trends.

During the courses, only a limited number of technologies were directly used. Thus, we wanted to understand whether our in-service teachers changed in their sense of confidence with technologies that had different degrees of alignment with the program (indicating the degree to which the students had directly used/learned the tools in question, ranging from low to high).

METHOD

We gathered data and engaged a statistical analysis on five years of pre and post-test survey data examining teachers' confidence with technologies. This data spanned five summer cohorts from the Year 2 program, which the authors of this article all taught at some point, from 2013 to 2017.

To understand the teachers' learning experience for technology confidence over the six-weeks of hybrid graduate courses designed around a CFTF-mindset, we asked three research questions:

- Research Question (RQ) #1: What differences are there in teachers' technology confidence before and after their involvement in the summer hybrid courses designed to support educators' CFTF?
- Research Question (RQ) #2: What differences are there in their confidence in using tools and technology with low, medium, and high alignment?
- Research Question (RQ) #3: What differences are there in their confidence in using specific tools?

Participants

The sample was 74 in-service teachers, with each new year associated with data from 11 to 19 new in-service teachers (depending on cohort). All the teachers were in the hybrid graduate courses described in the previous section on the context for the study.

While the program does not maintain datasets of student demographics, and our instrument did not capture teacher demographics, as longtime instructors with this student body, we can note a few general details. Situ-

ated in a predominantly white institution, the master's program tends to draw upon teachers from the upper Midwest U.S., and it captures a fairly diverse group of teachers that come from varied K12 contexts—urban, rural, and suburban, both elementary and secondary (and therefore some secondary teachers who specialize in subject matter teaching such as science, art, or social studies, and some elementary teachers with a more general education background). While the program mostly draws upon educators in varied K12 teaching settings, it also occasionally has students who are education professionals in other relevant areas such as technology coordinators or K12 administrators. The students vary quite a bit in age, just as any group of practicing teachers might—with some older veteran teachers, and some younger new teachers, but a majority of teachers having had some experience in the profession before returning to graduate school in their 30's. Thus, the technology focus of this program means that it is somewhat interdisciplinary, and the content has be to such that it can handle the breadth and depth of our teachers' contexts and needs, along with varied levels of teaching and technology experience.

Measures and Procedure

In both pre- and post-surveys, we measured the level of confidence and comfort of our in-service teachers with technology. A basic pre- and post-survey design was developed by the program instructors with the expressed goal of understanding how teachers' confidence in specific technology or program/course skills changed from the start of the six week experience to the end. Specifically, for each of 46 survey items, general or specific, the teachers were given a five-point Likert-type scale for confidence level, ranging from one being "Not Confident" to five being "Very Confident." Importantly, the survey was intentionally designed to include measures of confidence on a range of skills from the very basic to more advanced, and to include measures for tools and skills that teachers would directly use in the program (e.g. video editing) to those that they would not (e.g. creating databases). For instance, specific questions on confidence with technology read as follows: "Configuring and syncing mail accounts with applications to receive mail (computer, iPad, smartphone, etc.)," "Creating a database of information in Microsoft Access," "Using a digital camera to take pictures and transfer them to your computer," and "Getting around firewalls."

This was done to empirically investigate a conjecture (which arose over time via informally observing student learning in the program) that students

seemed to be increasing overall in their sense of confidence around technologies, and appeared more ready and willing to take risks, play, and try new and unfamiliar tools. Therefore a wide range of tools and skills (with varying alignments to the courses) was integrated into questions, with an interest in understanding how teachers' confidence both changed and potentially transferred across tools.

In order to also understand the changes in confidence across varied technologies and alignments, one of the authors coded each item as evidencing *low, medium, or high* alignment with the goals of the course. Then, a second author reviewed the codes and reached agreement on 93.5% of the items (43 out of 46), suggesting changes on the remaining three items. The authors discussed the codes for the three items to reach an agreement on the alignment for all the items. For each new cohort, we administered the pre-assessment measure (Appendix A) as an online survey in Google forms that students were sent and took before the very first day of courses. The post-test measure (with the same questions) follow-up was given to students again, sent to them via email, at the end of the six weeks of courses.

Data Analysis

To analyze the data to answer RQ #1—about differences in teachers' technology confidence in specific uses of technology before and after completing the courses—we compiled and analyzed the technology confidence responses, comparing between pre- and post-test survey data to analyze for statistical significance, especially between groups with low, medium, and high alignment, in addition to overall difference.

To analyze the data to answer RQ #2, on how these differences may be a function of how the alignment of various technologies with the goals of the courses, we coded the technologies for alignment with the program, using the ratings of the confidence levels. That is, if a technology was actually used in the program, it was considered "high alignment" as opposed to those that were not used in the past five years as "low alignment."

To analyze the data to answer RQ #3, on differences in specific technologies, we calculated pre-post differences (as well as their statistical significance and effect sizes for these differences) for each technology that teachers were asked to report their confidence about.

RESULTS

The overall analysis shows that over the course of six-weeks of teacher training utilizing a CFTF mindset approach, there was a statistically significant increase in technology confidence from pre- to post-tests. In particular, there was a statistically significant difference in the mean confidence level, which changed from 3.791 to 4.152 ($t = 4.718$, $p < .05$, $d = 0.56$).

Having examined overall differences, we then examined differences in technologies with different levels of alignment, finding that educators reported greater confidence across tools and technologies associated with all possible alignments with the program: low, medium, and high (see Figure 1)—thus, they reported significant improvements with technologies ranging from those which they did experience to those which they never used in the program.

Out of the 46 surveyed items, low alignment consisted of 26 items (α= .92), medium alignment consisted of 12 items (α= .88), and high alignment consisted of 8 items (α= .83). For technologies that had low alignment with the program, there was a statistically significant difference in the mean confidence level, which changed from 3.251 to 3.766 ($t = 11.645$, $p < .05$, $d = 0.38$). For medium alignment, there was a statistically significant difference in the mean confidence level, which changed from 4.113 to 4.458 ($t = 6.001$, $p < .05$, $d = 0.29$). For high alignment, there was a statistically significant difference in the mean confidence level, which changed from 3.943 to 4.489 ($t = 8.812$, $p < .05$, $d = 0.52$) (see Figure 1).

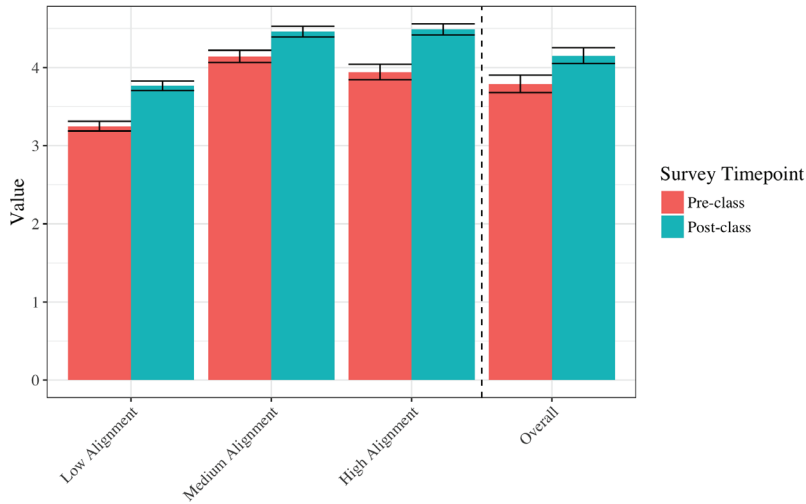

Figure 1. Pre- versus post-class teacher confidence with technology by alignment.

We then compared pre- and post-survey data for the individual technologies to understand the type and nature of technology with which our teachers felt confident (Figure 2). For individual items, we conducted a total of 47 *t*-tests for all the technology items and a general confidence in teaching and learning item. We conducted these *t*-tests (and associated effect size measures) to understand possible factors that were driving the differences observed and to provide initial insight in terms of where students report the most substantial changes. Additionally, to mitigate the risk of false positives (i.e., capitalizing on the multiple tests to find those that were statistically significant), we implemented the Hochberg procedure to adjust the *p*-values for the *t*-tests to be more conservative, as reported in Appendix B.

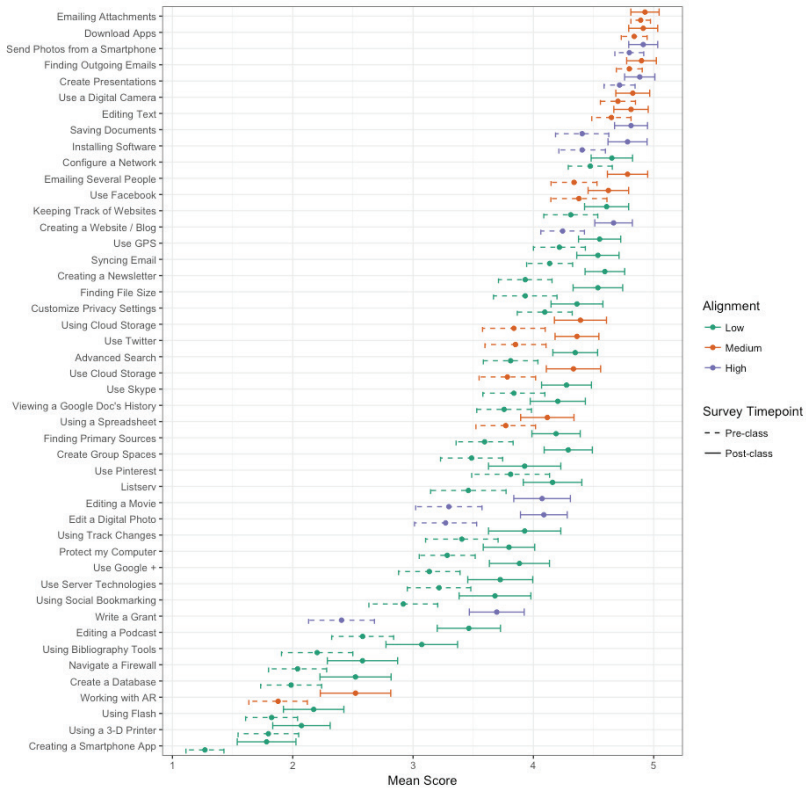

Figure 2. Pre- versus post-class teacher confidence with specific tools by alignment.

We applied Hochberg procedure to account for the multiple pre-post differences examined, which, uncorrected, may lead to overconfidence and false discoveries in the results. For instance, for "Creating Smartphone Apps," a relatively challenging skill, which we did not explore during the program (low alignment), the pre-class confidence level was low, with a mean value of 1.270. But, in the post-class survey, there was a statistically significant change ($M_{difference}$ = .512) with a medium effect size (t = 3.478, p < .001, d = 0.582). "Editing a Podcast," another skill with low to no alignment with the classroom activities also saw a statistically significant change in the mean confidence level ($M_{pre\text{-}class}$ = 2.581, $M_{post\text{-}class}$ = 3.464) with a large effect size (t = 4.735, p < .001, d = 0.792). "Writing grants," a skill covered during the program in basic detail, saw a statistically significant change in the mean confidence level ($M_{pre\text{-}class}$ = 2.405, $M_{post\text{-}class}$ = 3.696) with a high effect size (t = 7.15, p < .001, d = 1.197) (see Figure 2 and Appendix B for all individual skills/technologies).

Studying the confidence levels for specific tools helped show that a mindset towards technology could also possibly depend on personal experience or exposure to the tools and their relevance to teachers' contexts. A skill like "Creating a Database," which not only had low alignment with the program but also can be considered a difficult skill with little to no relevance to the teachers, maintained a low confidence mean with no statistically significant change (t = 2.714, p = .008, d = 0.454). Tools like "Editing a Podcast," on the other hand, that also required skills previously considered difficult, may see a jump in confidence because teachers now see them within their zone of proximal development because of their mindset shift (Vygotsky, 1980).

DISCUSSION

Limitations

This study speaks to the potential of a CFTF mindset in teacher professional development. We acknowledge that this is still merely one early/exploration study of the concept through an observational design. The nature of the design, in the use of pre-post measures from students over five years of courses, is limited in how much it can say about if or how the impact observed was due to the CFTF-supportive design and instruction, and how much was due to other features of graduate level educational technology courses. Future research should explore contexts which compare, for exam-

ple, courses which are taught with an approach designed to foster educators' CFTF with those that are not. For instance, a quasi-experimental study may contribute to a better understanding of how and why creative teaching with technology develops. A specific limitation of data analysis is also noteworthy: while we *did* collect pre-post survey measures, the specific responses were not identifiable, and so we compared overall differences from before to after the courses, rather than each educators' individual change. We suspect that the results would be similar, but nevertheless this feature is worth noting because using each educators' individual change is a more conservative (in terms of statistical significance) choice.

We must also note that the effect sizes for low and medium alignment technologies are smaller than desirable; which means a finer look is needed to understand what affects confidence with these technologies. A larger sample size per year would also provide more confident claims. Finally, it is possible that the program emphasis on technology may present an expectation for higher overall confidence, too. So, revisiting the same teachers for a longitudinal study could provide deeper insights into the CFTF mindset. There is a need to also go beyond the initial research purpose of understanding how the program's approach improved teacher technology confidence, toward additionally including a measure for investigating creativity, since this is a driving mindset in the CFTF concept. While this was not part of the measures here, we believe this is a valuable direction for future work, in helping the field to understand the potential of creativity to influence teachers' uses of educational technology.

Additionally, when designing educational technology programs that foster teacher confidence with technology and creative play, it is also important to encourage constructive skepticism and critical consciousness towards the influx of new technologies and how they affect learners and society. Changing trends in technology can often come with hidden ulterior agendas (such as collection of private data, promotion of engagement in practices that support big businesses, etc.) that may have long-term political and humanitarian issues we often ignore in educational technology research.

Findings in Context

The results demonstrate significant increases in confidence with cohorts of in-service teachers in a graduate summer program focused on CFTF mindset to teacher professional development with educational technology. Over the course of a six-week summer learning experience in creatively fo-

cused technology learning, these five years/five cohorts of teachers consistently observed confidence increases with respect to various technologies and related competencies. A professional learning experience that demonstrates statistically significant changes in teachers' confidence or efficacy could be seen as worthy of consideration. But at the same time, one might counter that it is not groundbreaking to see general technology confidence improvements, given the focus of this professional development. Yet, none of the course topic focuses were on technology per se (e.g., one course in educational psychology, one in leadership, and another in research methods), and instead technology was infused throughout the courses and teachers were required to "explore, create, and share" with and through technology. We contend that it is an interesting and unique finding that teachers' technology confidence statistically rose not only in a broad or generic sense of confidence but also in more specific and subtler dimensions—and that this relates to a pedagogical approach which was built on engaging creatively.

Significant change in low and medium alignment may be indicative of how the teachers learned to extrapolate and build confidence via the program's pedagogical approach—focused on a creatively focused technology fluent mindset that spanned the learning experiences. The creative and design-centered mindset was aimed to help teachers develop confidence in their own potential to use tools and technologies, with the characteristic willingness to create, try new things and openness to experience. But, we could not have expected to see a rise in confidence outside of what was taught.

In looking back to the data, one could note where some of the more significant increases in low alignment skills/tools arose in ways that connect to the CFTF pedagogy. As mentioned, skills such as "Editing a Podcast" or "Creating a Smartphone App," although never covered in the course content, were associated with gains in teachers' confidence. These types of skills have a more potentially creative design aspect to them, in that they require one to initiate, design and construct an artifact that did not previously exist. It may be that confidence rose in tools or skills such as this, despite a lack of direct experience, because the CFTF mindset for exploring, creating, and sharing allowed teachers to get more comfortable diving in and making new things with technology. In fact, this focus on providing teachers with learning experiences that required some creative design work via new technology may have been critical to the kinds of skills and tools that we often saw an increase in (e.g. skills/tools that emphasized being comfortable thinking and acting in creative ways with technology). This is critical as we consider the fact that much of what TPACK suggests or seeks is more deeply knowledge-

able and effective uses of technology that go beyond simple replacement uses, or integrating a technology into existing practice with no new benefits.

Mishra and Koehler (2006) explicitly use the idea of "teachers as designers" into the TPACK theory as a way to empower the kinds of knowledge that teachers have about technology as something that is unique and creative. In fact, TPACK theory explicitly draws on the idea of good uses of classroom technology as being a kind of creative design work, even describing the elements of "deep play," (Koehler et al. 2011) as being about risk, experimentation, play and design, which are key aspects of how we have characterized the CFTF mindset. While they do not frequently focus on the psychological construct of creativity in explicit terms, it is implicitly an essential component of their work (Mishra, Koehler, & Henriksen, 2011). Their emphasis on the role of the teacher as akin to that of a designer (Koehler & Mishra, 2005) is critical as we consider the value of teachers learning about technology in ways that explicitly employ a framing around creativity (i.e. framing professional development content around CFTF mindset).This link between teaching and a creative design role is not new (Dewey, 1934; Schon, 1983), though it has been increasingly observed by scholars in recent years (McKenney & Reeves, 2012). Norton and Hathaway (2015) suggest that because teachers are increasingly challenged to create novel practices that address "21st century" educational purposes and meanings, and to devise uses of technology that go beyond the intended business or leisure purposes, they are in a position to be critical, active, and creative designers of experience. They note that teaching calls for a kind of practice different from but complementary to the traditional view of teaching as a doing practice. Notions of teaching practice must acknowledge a second form of practice—the work of teachers as designers" (p. 2)

Kirschner (2015) has described how, given the tremendous range of demands in 21st century teaching and schooling, an expert teacher is both a practitioner and a designer, suggesting that this necessitates making "use of the tools, techniques, and ingredients at teachers' disposal to design and implement effective, efficient, and enjoyable experiences for the learner and effective, efficient, and enjoyable teaching experiences for the teacher" (p. 2). Thus, teaching itself is a kind of work of creating, and we might then see how creativity is important to teaching, particularly when new tools and technologies proliferate.

We connect this past research to the importance of helping teachers build skills around classroom technology that reflect and support this role as a designer, e.g. approaching teacher professional development as framed by CFTF mindset. TPACK has been a critical framework for explaining the

nature of teacher knowledge and the types of knowledge that teachers' need to be successful in implementing classroom technology. But it does not necessarily prescribe specific professional development to support this knowledge (Chai, Koh, & Tsai, 2010). It does however, implicitly align with the importance of supporting creativity in this arena of teachers and their roles as designers of experience and learning, via technology. In this that we have some sense as to how our CFTF focused pedagogy has shown success in improving teachers' sense of confidence and fluency in approaching technological skills and tools.

Another aspect of the findings that might appear initially counterintuitive is in the way that the CFTF learning experiences were designed so as to never directly teach anyone to use any specific tools—but to push students to get acquainted with the open-ended nature of creative engagement, and with critically exploring new tools to suit a creative purpose. The *Explore, Create, Share* motto aims to engage teachers in acts of design and creation—actively infusing technology into their subject matter learning and assignment work in ways that made sense to a purpose. Kelley and Kelley (2013) have described the importance of building up 'creative confidence' as a way to help people engage more deeply, thoughtfully and willingly in a task or area of knowledge. The CFTF focus on flexibility, open-mindedness, willingness to try new things, and intellectual play or risk-taking, aligns with this notion of independence and confidence via creativity, specifically in a technology-rich space. Thus, it makes sense that despite the lack of direct tool instruction and experience, students reported these increases in their confidence or sense of ability—even going beyond what they learned and used, to report feeling more efficacious and confident outside of direct experience.

Relevant literature on teacher professional development around technology integration aligns with the purpose of a CFTF mindset, in aiming to prepare teachers to act, work and think as conscious and creative designers of learning, with and through technology. As noted, Palak and Walls (2008) found that teachers typically use technology for preparation, management, and administrative purposes, and their use of technology for deeper pedagogical purposes or student-centered practice is less common. They note that across context most teachers continue to use technology toward existing practices, rather than for new and effective ways of learning (Palak & Walls, 2009). Kim et al. (2013) noted that excellent technology integration requires that teachers' recognize new ways of seeing and doing things. Thereby, we do not seek to position the CFTF mindset against more tool-centered approaches, but we do assert that it aligns well with the importance of teach-

ers' creative roles in changing landscapes of learning in technology saturated spaces, a trend that is often called 21st century learning.

Despite a major body of literature about effective professional development, and dramatic investments in educational technology, there has been little direct evidence about if or how these things influence teacher learning (Mouz, 2009). In particular, few studies exist even in recent years that demonstrate the impact of technology-focused professional development on teacher learning (Kafyulilo, Fisser, & Voogt, 2016). Even fewer studies have examined teacher learning over time, to understand growth in professional development gains. Notably, Jones and Dexter (2018) suggest that teachers often report that the professional development they receive does not meet their needs or support learning more broadly. In fact, the authors of this study found little work that directly speaks to transfer of knowledge in professional development from certain technologies to others. This implies a need to explore, both in research and practice, approaches that demonstrate potential for this.

IMPLICATIONS

Our results provide some initial evidence for a CFTF approach in teacher professional development, to suggest that teacher confidence with technology may not come only from direct experience with tools. Instead, teacher training might focus on putting teachers in a position to create, explore, and share, with and through technology. A CFTF mindset has the potential to empower teachers to tease apart the affordances and constraints of any new tool—irrespective of prior knowledge. This may be beneficial when training teachers for rapidly changing contexts.

The findings reported in this study suggest the importance of teachers learning through the application of new technologies to applied projects via creating and designing (be it lessons, projects, experiences, artifacts, etc.). In our case, not only did teachers improve their confidence with technologies during the courses, but they reported becoming more confident with varied tools and technologies, including those not covered. This suggests that something changed in their mindset. While their direct tool-centered knowledge had not changed, their perceived knowledge confidence had, via time spent engaging in creative-focused immersion in technology-rich experience. The results also suggest that there is value in providing teachers with professional development that immerses them in experiences to create via technology use.

While teacher professional development is widely variable based on context and needs of any particular group, there are some key implications in terms of mindset. For instance, the specific details of the pedagogy and activities of this program are less important than general takeaways about types of activity or learning designs that are part of CFTF curricula (since teacher educators are unlikely to mimic our projects exactly, and there is nothing magical about the nature of our curriculum). Teacher education and professional curriculum might seek to apply some of the core values of the CFTF mindset to the design of teachers' learning experiences, such as: offering activities that *place teachers into the open-ended space of continual experimentation with new applications*; viewing *teachers as creative designers of experiences,* offering activities that *ask them to (in short-term and long-term ways) design artifacts with technologies*; and, though it may initially seem contradictory to technology coursework, aim to *spend less time directly teaching technologies and instead let teachers dive in and learn towards their purpose*.

Teachers' gains in confidence with respect to technologies that they did not use also implies that there is potential in educational technology curricula that is not built around specific tools, but rather around ideas. For teacher educators, this begs the question of how can we create learning opportunities that allow teachers to explore ideas and make things, via the use of whatever tools suit the purpose? We suggest giving teachers experiences in which they learn to manage the uncertainty of context and move flexibly with it. As Bruner (1996), notes:

> Being able to 'go beyond the information' given to 'figure things out' is one of the few untarnishable joys of life. One of the great triumphs of learning (and of teaching) is to get things organised in your head in a way that permits you to know more than you 'ought' to (p. 129).

This reflects the creative potential of learning for transfer, or the idea that you can learn something without *directly* learning it, through an approach that allows you to experience and create.

For teacher educators, we suggest considering the elements of a CFTF approach described earlier on in terms of theoretical foundations, and then considering how these elements of creativity might play out in assignments or activities. Our approach does not start from a perspective about certain tools, but rather grounds the professional development experience in having teachers learn through ideas and experiences in which the use of tools is embedded. In each of the courses we described, the content was not "about" technology, but rather about ideas and about learning "with and through" technology. We are often agnostic as to which tools teachers use toward

their purpose. In fact, there is rarely a need to dictate which tools they use, but rather to design experiences that allow them to create projects or artifacts while also exploring and playing with tools. In particular, given the differences that exist in technologies, tools, resources, and professional development across varied and inequitable teaching contexts, it is important to consider approaches that do not revolve around using specific types of tools. Focusing on ideas and then allowing teachers to get creative about what they can do is part of this. Kereluik, Mishra, and Koehler (2010) describe the value of teachers developing a mindset and ability for repurposing, as a way to see the potential in different types of levels of tools (even low-tech tools) for more creative integration of technology, based on whatever the affordances and constraints of the setting may be. For teachers working with technology constraints, creativity is thereby just as (if not more) important in professional development, to offer new ways of seeing and doing, even when their access is limited. Creatively focused and technology fluent mindsets can then help create independent and critical spaces for teachers to question and analyze the tools they and their students are using and design more equitable opportunities with fair technologies.

In all, we suggest that researchers, teacher educators, and professional development providers aim to design experiences which are open-ended, playful, exploratory, respect what teachers bring to the table, and provide a safe space to take risks—allowing them to become more comfortable playing and creating with tools and technologies. Thus, our CFTF mindset approach is not positioned against other approaches, as there is surely room to allow for different kinds of teacher development. Rather it is about allowing for creativity and play in the context of learning and application, and ensuring that we make space for teachers to try new things, take risks, create, focus on ideas and deeper pedagogies—with and through technologies.

Despite limitations previously noted, we believe this work gives evidence of the potential for application in the CFTF mindset, and suggests the need for future research on practical applications. More applications of CFTF mindset in teacher education and professional development also mean greater opportunities to conduct research in practice. We began this research with the goal of studying whether our approach would increase teachers' confidence in using varied levels of technology in their own practice and mindset, and our findings suggest that this increase occurred. The connection to creativity however is a critical point which was not factored into our initial goals, and this is something that would be important to investigate in further studies—perhaps by integrating measures of teacher creativity or perceived creativity into this work. Additionally, the practical nature of this topic, studying teachers' learning around technology, suggests that more ap-

plications of iterative or design-based research might allow for more robust and new theory development in this area.

CONCLUSION

Most existing theoretical foundations on creativity suggest that openness and risk-taking are integral to a creative mindset (Baer & Oldham, 2006). Therefore it is important to consider that these elements could be fundamental to teachers learning with technology—and that working toward a mindset shift could add up to stronger future learning, training, or professional development, and more teacher creativity in practice. Risk taking is based on confidence that one can 'pull it off' when faced with a new situation, pedagogical goal, or classroom need. In seeking to help teachers become comfortable in areas without direct instruction, the CFTF mindset and approach offers evidence that played out in this program over time. As we have noted, this approach and these ideas are rife with possibilities for integration into practice, as well as future iterations of research.

The field of education looks ahead to a changeable and uncertain future, with rapid societal shifts in technology, and a need for more creativity in our lives and work (Florida, 2014). Perhaps the best training we might give teachers is through opportunities to expand their creativity, build confidence in their ability to use available tools, and recognize their own potential as conscious and creative designers, with and through technology.

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APPENDIX A
MAET Tech Survey

1. How would you rate yourself (on a 1 to 5 scale, with 5 being "very confident" and 1 being "not confident") in terms of your competence/confidence with technology overall?
2. How would you rate yourself (on a 1 to 5 scale, with 5 being "very confident" and 1 being "not confident") in terms of your competence/confidence with technology overall?

Please rate your confidence level at the following tasks/activities, from a scale of 1 to 5, with five representing "Very Confident", three representing "Slightly Confident", and one representing "Not Confident."

3. Configuring and synching mail accounts with applications to receive mail (computer, iPad, smartphone, etc.)
4. Subscribing/Unsubscribing to a Listserv
5. Creating a list to send email to several people at once
6. Sending email attachments
7. Finding copies of outgoing email that I have sent
8. Downloading and installing software
9. "Using a spreadsheet to create a graph or chart "
10. Creating a newsletter with graphics, text, and columns
11. Saving documents in formats so that others can read them if they have different word processing programs (e.g. saving as .doc, .rtf, or .txt)
12. Using the track changes feature of Word
13. Cutting, copying, and pasting text within an application and between multiple open applications
14. Using the computer to create a slide show presentation
15. Creating a database of information in Microsoft Access
16. Protecting my computer from viruses and spyware
17. Editing a digital picture in a program like Photoshop
18. Creating animation in Flash
19. Filming and editing a movie using digital video editing software
20. Creating and editing a podcast (or similar audio segment) using audio editing software
21. Creating an app for a smartphone

22. Using 3-D printing capabilities
23. Working with augmented reality, and/or mobile augmented reality
24. Using advanced features of internet search engine to find web sites related to my subject matter interests
25. Finding primary source material on the internet
26. Creating and posting my own webpage, blog, or wiki with links, images, etc.
27. Keeping track of Web sites I have visited so that I can return to them later
28. Using social bookmarking websites such as delicious, diigo, furl, etc
29. Using the history on a wiki or Google doc
30. Using bibliographic web tools such as Mendeley and Zotero
31. Saving documents to "the cloud"
32. Host, install and manage applications such as Wordpress, Moodle, Drupal, or Cpanel
33. Using Skype to collaborate with individuals who are distant from my classroom or workplace
34. Customizing privacy settings
35. Using Facebook
36. Using Twitter
37. Using Pinterest
38. Using Google +
39. Creating collaborative group spaces
40. Using cloud storage services
41. Taking and sending photos from a smartphone
42. Downloading apps on a smartphone
43. Configuring a device (computer, smartphone, iPad, etc) to connect to a network (wired or wireless)
44. Using a digital camera to take pictures and transfer them to your computer
45. Writing a grant (including a budget) for technology in my classroom or workplace
46. "Using GPS navigation tools "
47. Finding the size of a file on your computer
48. Getting around firewalls

APPENDIX B
t-test results for pre-post differences for specific items

Item	Alignment	Pre-Survey *M*	Post-Survey *M*	*M* Difference	*t*	*p*	*Cohen's d*
Write a Grant	3	2.405	3.696	1.290	7.150	< .001	1.197
Edit a Digital Photo	3	3.270	4.087	0.817	4.986	< .001	0.834
Editing a Movie	3	3.297	4.072	0.775	4.221	< .001	0.706
Creating a Website / Blog	3	4.243	4.667	0.423	3.493	0.001	0.585
Saving Documents	3	4.405	4.812	0.406	3.082	0.003	0.516
Create Presentations	3	4.716	4.884	0.168	1.839	0.068	0.308
Send Photos from a Smartphone	3	4.797	4.913	0.116	1.344	0.181	0.225
Emailing Several People	2	4.338	4.783	0.445	3.457	0.001	0.579
Working with AR	2	1.878	2.522	0.643	3.337	0.001	0.559
Use Cloud Storage	2	3.784	4.333	0.550	3.330	0.001	0.557
Use Twitter	2	3.851	4.362	0.511	3.228	0.002	0.540
Using Cloud Storage	2	3.838	4.391	0.553	3.226	0.002	0.540
Installing Software	2	4.405	4.783	0.377	2.949	0.004	0.494
Using a Spreadsheet	2	3.770	4.116	0.346	2.053	0.042	0.344
Use Facebook	2	4.378	4.623	0.245	1.679	0.095	0.281
Editing Text	2	4.649	4.812	0.163	1.484	0.140	0.248
Finding Outgoing Emails	2	4.797	4.899	0.101	1.223	0.223	0.205
Use a Digital Camera	2	4.703	4.826	0.123	1.201	0.232	0.201
Download Apps	2	4.838	4.913	0.075	0.919	0.360	0.154
Emailing Attachments	2	4.892	4.928	0.036	0.493	0.623	0.082
Create Group Spaces	1	3.486	4.290	0.803	4.854	< .001	0.812
Editing a Podcast	1	2.581	3.464	0.883	4.735	< .001	0.792

Item	Alignment	Pre-Survey *M*	Post-Survey *M*	*M* Difference	*t*	*p*	*Cohen's d*
Creating a Newsletter	1	3.932	4.594	0.662	4.719	< .001	0.790
Use Google +	1	3.135	3.884	0.749	4.136	< .001	0.692
Using Bibliography Tools	1	2.203	3.072	0.870	4.086	< .001	0.684
Finding Primary Sources	1	3.595	4.188	0.594	3.774	< .001	0.632
Using Social Bookmarking	1	2.919	3.681	0.762	3.642	< .001	0.609
Advanced Search	1	3.811	4.348	0.537	3.614	< .001	0.605
Finding File Size	1	3.932	4.536	0.604	3.558	0.001	0.595
Listserv	1	3.459	4.159	0.700	3.481	0.001	0.583
Creating a Smartphone App	1	1.270	1.783	0.512	3.478	0.001	0.582
Protect my Computer	1	3.284	3.797	0.513	3.205	0.002	0.536
Syncing Email	1	4.135	4.536	0.401	3.050	0.003	0.510
Navigate a Firewall	1	2.041	2.580	0.539	2.807	0.006	0.470
Viewing a Google Doc's History	1	3.757	4.203	0.446	2.729	0.007	0.457
Create a Database	1	1.986	2.522	0.535	2.714	0.008	0.454
Use Server Technologies	1	3.216	3.725	0.508	2.658	0.009	0.445
Use Skype	1	3.838	4.275	0.438	2.611	0.010	0.437
Using Track Changes	1	3.405	3.928	0.522	2.423	0.017	0.405
Use GPS	1	4.216	4.551	0.335	2.374	0.019	0.397
Using Flash	1	1.824	2.174	0.350	2.083	0.039	0.349
Keeping Track of Websites	1	4.311	4.609	0.298	2.029	0.044	0.340
Customize Privacy Settings	1	4.095	4.362	0.268	1.683	0.095	0.282
Using a 3-D Printer	1	1.797	2.072	0.275	1.565	0.120	0.262
Configure a Network	1	4.473	4.652	0.179	1.408	0.161	0.236
Use Pinterest	1	3.811	3.928	0.117	0.522	0.603	0.087