Technology, Learning, Creativity, and Design:

The Habits of Mind Necessary to Generate New Ways of Teaching in a Career of Constant Change

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Abstract

In this paper we explore the philosophy, pedagogy and implementation of the third year course sequence in the M.A. in Educational Technology program at Michigan State University. We discuss how "little-r" revolutions in teaching and learning, i.e., technology facilitated revolutions specific to individual classrooms and contexts, are used to introduce our students to the thinking patterns of designers and innovators. This is accomplished by an overlapping emphasis on learning by design, trans-disciplinary creative cognitive tools, innovative technology, and reflective practice. In this environment, we also transition our students from acting as consumers of educational media to being producers of educational experiences. That is, not only do the students construct new educational media, they consider the aesthetic and affective implications of technology use for teaching and learning. Finally, given the rapid evolution of educational technologies, we support students as they establish a foundational vision for the interplay of education and technology that will serve them into the future, as they, and their learners, adapt to new and emerging digital environments.

***Keywords*:** Technology, Creativity, Teaching, Learning, Design

In 1922 Thomas Edison famously stated "I believe that the motion picture is destined to revolutionize our educational system, and that in a few years it will supplant largely, if not entirely, the use of textbooks" (Cuban, 1986). This statement has been used repeatedly as a cautionary tale for educational technology exuberance (e.g., Cuban, 1986; Oppenheimer, 2003). Concerned scholars and popular writers alike quote Edison and list the reasons why he was so wrong in his prediction and often go on to relate the same stories about radio, TV, and computers. The evidence against a technology-mediated revolution in education (from their perspective) is rock solid. Case closed.

In the M.A. in Educational Technology (MAET) program at Michigan State University, we disagree with both Edison and his critics. We do not believe that any single technology can or will revolutionize education. Nor, however, do we feel that a bit of exuberance about how emerging technologies and related pedagogies may improve teaching and learning is outlandish. This is partly because any comparison of motion pictures, radio, TV, and even early computing to the current state of technical evolution is simply inadequate. The pace of technological change is so rapid that we must factor this in to our discussions when we are viewing its impact on educational settings (Kurzweil, 2005; Mishra, Koehler, & Kereluik, 2009). In just the past ten years, many teachers transitioned from wikis to blogs to social networks and from laptops to iDevices, with smartphones not far off on the horizon. As technologies are better matched with appropriate pedagogies and content, the educational affordances of emerging hardware and software are also progressing rapidly (e.g., Dede, 2010; Mishra, Koehler, & Henriksen, 2011; Prensky, 2012). As such, circa 2013, Edison would be tweeting a new prediction every three months, and his detractors would still write verbose blog posts explicating why he is so wrong. As such, in the MAET program, we endeavor to prepare our students for a future where potentially revolutionary technologies are an everyday thing.

However, we do not do so with the notion of a "big-R" Revolution (as suggested by Edison) in mind. We believe that many of the tools and related pedagogies available for teaching and learning today (i.e., TPACK solutions) allow for "little-r" revolutions - technology facilitated revolutions that are often specific to individual classrooms and contexts - if teachers approach their work as designers and innovators. As such, the third year of our program emphasizes the creative mindsets necessary to make these revolutions now, as well as in the future.

We do this in four ways. First, we do not focus on specific technologies, but actively promote technology agnostic approaches during the entire sequence of courses (Kereluik, Mishra, & Koehler, 2010; Mishra & Koehler, 2006). Second, we provide students with creative and trans-disciplinary cognitive tools with which to build new habits of mind for teaching and learning (Mishra, Koehler, & Henriksen, 2011; Root-Bernstein & Root-Bernstein, 1999; Sawyer, 2011). Third, we transition our students from consumers of educational technology to producers of educational experiences. Fourth and finally, we encourage students to create a vision for educational technology (in place of a traditional philosophy of teaching). Below, we explore each of these experiences in depth, in the context of the three-course sequence that comprises "year three" (the final phases of the MAET program).

I am not Creative; I am a Math Teacher

Students in the MAET program are a diverse group, ranging widely in their educational accomplishments, teaching backgrounds, and life experiences. Once they have worked through the more technical aspects of our program (see Hagerman et al. in this issue) and the theoretical foundations (see Kereluik et al. in this issue), the students have a solid understanding of what comprises a TPACK solution. However, many still do not appreciate the creative mindset necessary to construct their own solutions. In this way, most have at least one important similarity as they enter year three; they have traditional conceptions of what it means to be creative. This is common among teachers (Sawyer, 2012). Most associate creativity with art, music, poetry, and the like. A few allow for creative approaches to literature and social studies, while math and science are typically understood as disciplines reserved for concrete thinking.

Janet (pseudonym), a math teacher, was the quintessential case. Janet demonstrated reluctance and apprehension about creativity from the very first day of class. When her instructors made comments like, "We will ask you to think about your content in ways you may not have ever considered...our job is to make you uncomfortable...we want you to fail, at least once, the more the better," it did not help. When it came time for individual students to introduce themselves, Janet was not shy about her feelings. She said, "I am not creative, I am a math teacher. I will try as much as I can, but I am not sure I see how this will help me be a better teacher."

Given that Janet is not alone in her doubts, one of the primary goals of our *Creativity in Teaching and Learning* course is to break down preconceived notions about creativity. This is done explicitly early in the course, and reinforced repeatedly by activities based our guiding framework of seven trans-disciplinary cognitive tools (Mishra, Koehler & Henricksen, 2011) and the primary text, *Sparks of Genius* (Root-Bernstein & Root-Bernstein, 1999). Students are presented with creativity as a way to generate trans-disciplinary knowledge that emerges from and transcends their disciplinary practice and experiences (Mishra, Koehler & Henricksen).

One of the first activities we do to break down these preconceived notions of classroom creativity with disciplinary content is a *Schooling the Imagination Quickfire.* Based on the imagination chapter in *Sparks,* students are asked to explore an essential learning dichotomy - knowing vs. understanding. They are asked to: (1) determine a subject matter concept that their own students often know, but do not understand; (2) demonstrate how students would show they know this concept; and, (3) predict how students might imagine this concept to be useful in the real-world, in both correct and incorrect ways. Through this process, several ideas about imagination and its relationship to teaching and learning become apparent. First, our students learn the difference between imagination and creativity—that the former is unbounded, with no wrong answers, and is a critical component to the latter. Equally important, they learn that disciplinary creativity *is* bounded, and that creative solutions must be effective. Second, our students see how applied examples in the classroom can stunt imagination. That is, if their students are merely given applied examples, they do not get to practice imagining how concepts are applied in the real world. Finally, they begin to appreciate the complexity of mediating imaginative work in their classrooms, given that they need to foster an open environment that respects "incorrect" imagining, while also guiding students toward a better understanding of concepts.

Thereafter, the course explores a variety of readings and activities based on elements of creativity provided by the trans-disciplinary cognitive tools—perceiving, patterning, abstracting, embodied thinking, modeling, deep play, and synthesizing - the building blocks of disciplinary creativity. In the online course, these tools frame seven two-week modules. In the face-to-face course, they each frame a single full day. In both cases, students groups are responsible for designing activities around one of the cognitive tools; learning by design is a central component of year three. These activities have only two requirements. They should demonstrate the big ideas about the cognitive tools and help participants in the activity understanding them at a deeper level. Minimal guidance is provided by the instructors demonstrating the transition from consumer to producer that we emphasize. We have collected many of these activities in an "explore, create share" blog organized by tool and content area at http://www.msuedtechsandbox.com/MAETVAULT/category/courses/cep818.

In the several years this course has been offered, the products resulting from this activity varied widely. Many choose to incorporate innovative uses of technology in their activity (digital pictures and video are commonly integrated), while others are decidedly traditional. In fact, one of the major differences between the online course and the face-to-face setting is this choice—most projects from the online course integrate technology, while face-to-face activities are evenly split. For example, a Claymation activity explored modeling, a dinglehopper digital imaging activity based on video from *The Little Mermaid* helped students perceive how objects can be repurposed, and Monty Python's *Ministry of Crazy Walks* provided the inspiration for a face-to-face activity helping students practice empathy.

This assignment highlights one final goal in this course—to treat technology as secondary to the creative thinking we want to facilitate. When students are in the final phases of the MAET program, we hope they have come to realize that moving forward, most educational considerations will be *supported* by digital technology. As such, very little direct instruction with technology (either *how* or *when* to use it) is necessary. For instance, we assign a lengthy digital video project, but the primary goal of the assignment is to facilitate an important educational experience. The technical learning is a natural consequence of the activity. Students focus on the intellectual, motivational, or emotional changes they can evoke, making technical choices in their editing only in support of these goals. They also discover that trans-disciplinary thinking is essential to their success. At the same time, they begin to see a circular and reciprocal relationship between creativity and technology. That is, technology can enhance creativity (Kao, 1997; Yushau, Mji & Wessels, 2005), technology can require creativity (National, 2006), and creativity is often necessary to take advantage of the various affordances of technology for teaching and learning (Mishra, Koehler, & Henriksen, 2011).

Students indicate their appreciation for this course in a variety of ways. Though Janet initially demonstrated hesitation, after four weeks together, she shared how excited she was to revisit her approach to teaching math, while further exploring both technology and creativity. Janet's mindset was broken down and rebuilt during the course. In particular, when she immersed herself in the concepts of abstraction and analogizing to develop an activity for the rest of the class, she began to see a more nuanced version of creative trans-disciplinary thinking. Thereafter, she began to talk about how modeling, pattern recognition, and pattern formation were essential to improving her mathematics instruction, often in technology-mediated environments. She was ready to begin to begin a revolution in her classroom. She also understood that no single technology would support her, but that new tools would emerge regularly that would be amenable to certain and specific creative thinking skills.

Human Experiences and Better Design

By most standards, Steve Jobs represented the pinnacle of both creativity and design. He often spoke about the importance of one to the other. For instance, he noted:

> Creativity is just connecting things...A lot of people in our industry haven't had very diverse experiences. So they don't have enough dots to connect, and they end up with very linear solutions without a broad perspective on the problem. The broader one's understanding of the human experience, the better design we will have (Wolf, 1996).

Given this harmony between creativity and design, our *Creativity in Teaching and Learning* and *Learning Technology through Design* courses are intimately interconnected and complementary, whether taken face-to-face as an integrated set of courses, or separately online. That is, while the *Creativity* course emphasizes trans-disciplinary thinking skills, it also promotes widening student lenses on the world to include more variety in their disciplinary and aesthetic experiences. They start to stockpile trans-disciplinary dots.

However, creativity does not equal design. Therefore, one of the first things our *Learning Technology through Design* course emphasizes is that creativity is only a component of the design process. Several other steps to design are provided through a variety of models. For example, we present students the Carliner (2000) framework and the Stanford Virtual Crash Course in Design (Stanford Design School, 2012). In particular, both of these models help our students realize the critical role that "understanding the human experience," or understanding their own students, plays in designing educational experiences. For instance, Carliner explores the importance of considering the cognitive and affective experiences of their students, and the Stanford process emphasizes the importance of empathy, prototyping, and testing. Finally, across all of the design frameworks they study, iteration is presented as foundational.

All of these ideas are integrated across course activities. However, unlike the *Creativity* course, the big projects in our *Design* course are quite different online and face-to-face. Online, the entire experience is grounded in what is called the "Big Kahuna" project. This project is a semester long individual project that results in a Web-based module for teaching a concept —for instance, Newton's Laws of Motion. It is a technology rich, multi-media, content specific project. It follows the design process, is iterative in multiple ways, and demonstrates how we endeavor to transition students from consumers to producers of educational experiences. At the same time, of the various weekly assignments that comprise the Big Kahuna, three are specific to understanding the human/student experience—audience profiles, user testing, and user feedback reports. That is, among the myriad technical and pedagogical considerations required to construct this project well, our students learn to empathize with the intended student audience in an iterative way. Googling "CEP 817 Big Kahuna" will provide you with several excellent examples of this project, many of which are currently in use revolutionizing MAET graduates' classrooms.

In our face-to-face sequence of integrated courses, design thinking is introduced early and emphasized across all projects. However, one activity in particular demonstrates how we empower our students as producers and designers, while also pushing them to think beyond their comfort zones and tackle big ideas. This is the "design challenge." Starting in the first week, three groups of six students are given a complex topic in education (e.g., how to get students to read more deeply on the Web) for which to design a solution. After 30 minutes of open-ended brainstorming, each group is asked to pick their best potential solution, and then provide enough details to pitch their solution to the other groups in 30 more minutes.

After the first design challenge, students choose topics that guide several more similar, iterative, activities. Then, after four iterations, students choose just two topics to revisit. Further interactions generate detailed products, specifically focusing on empathizing with potential users. Some students choose to continue with this design challenge for two-full days thereafter. In our most recent face-to-face course, these students completed a conceptual prototype for a product they called SASS TA, an online motivational adjunct for middle school students to help them stay on task. By this point, the group was so intrinsically motivated by their idea and the process, their goal was to complete a polished enough product that they could use it to apply for seed money for further design work. You can see a video created by these students to assist in the process of looking for startup funds here—http://vimeo.com/47551156. This work resulted from learning by design, with authentic problem based projects (Savery & Duffy, 1995) that could extend well beyond the scope of these courses or the MAET program.

This project demonstrates many elements about the MAET program. First, it was almost entirely student produced after the first day; we aim to give students control over their learning. Students were picking their own topics and designing their own solutions, with only occasional guidance from the instructors (such as that provided by a creative director in professional settings). Second, the iterative design process provided by the Stanford Design School (2012) provided a framework for their progress; that is, our projects are grounded in both educational theory *and* ideas from other disciplines. Third, students involved in this project *did* enter it to a startup fund competition; at some point this project stopped being an assignment and became a real-world design project. Fourth, the students enjoyed it and may have experienced flow in their learning (Csikszentmihalyi, 1990). One student commented, "This is as hard as anything I have done in a class, but is the most fun I have had."

Finally, it is important to note that the "design challenge" was a last minute add-on to the curriculum for this particular summer. The instructors were taking a chance. When that chance worked out, they adapted the schedule to accommodate time considerations necessary to complete the project. Our program accommodates and encourages risk-taking, both among students and faculty. That is, if we want our students to take creative chances and provide the freedom for them to fail, we believe our own faculty should have the same freedom.

Capping It All Off—Much More Than a Digital Portfolio

The MAET program is designated as a "non-thesis" program by the graduate school. In place of a thesis, students are required to publish a web-based portfolio that: a) showcases the work completed in the program, b) engages students in thoughtful reflection about their learning in the program, and c) develop a forward-looking vision of their future work with educational technology. That is, the capstone portfolio is much more than a collection of past work.

Four design principles guide this approach. First, that the portfolio should be written for an a*uthentic audience*, and that audience likely differs for each student in the program. Some students in the program are looking to change jobs, others are not. Others may wish to use the portfolio to in their existing classrooms, to communicate to parents or students about their work, or as a repository for their work and thoughts. That is, depending on the audience, the portfolio should be designed to impress peers, potential employers, students, parents, significant others, or perhaps the author.

The second principle is a variation of the *learning by doing* theme. In this case, we use the capstone portfolio project to help move students from consumers to producers. For example, early in the course, students look through previous portfolios looking for inspiration in the designs, and items they would like to emulate. But they quickly move to towards producing their own portfolio, through an intermediate project that asks them to create two sample pages in their portfolio using two different web platforms. After that project, students are guided to create portions of their final portfolio in the technology of the web-platform of their choosing. Making them the produces instills general qualities of good instructional design, but also has the specific result of teaching them web-design skills that will generalize well beyond the portfolio project.

Third, we use *peer-learning principles* to help students along the way. Students are grouped in "houses" (collections of 4 students) and a "study buddy" (a pair) that give each other weekly feedback and support (beyond what the instructors do). This approach creates a community of learners (Palloff & Pratt, 1999) within the capstone portfolio course, creating additional technical, social, collegial, and design resources for students to draw upon during the semester long portfolio project. While this community of learners provides specific scaffolding for the portfolio, we intend that as students feel comfortable with participating in a community of learners for this course, they will be more willing to search out (or create) such communities in their own professional lives.

Fourth, we have students produce a *forward-looking vision* of their future work with educational technology. Some of the portfolio elements ask students to write reflective essays about their goals in the program, their learning in the program, and their use of educational technology. One essay, "my future as a learner" asks them to produce a "vision statement" as to how they will learn and use educational technology in the future. With this, we encourage statements that are at the same time intellectually informed and pragmatic. Along with other assignments, students must demonstrate a creative synthesis of their knowledge about hardware, technology skills, pedagogy, cultural influences, and the changing structures of schooling. In doing so, students demonstrate their abilities to provide leadership in the field, to be influential in both little-r and big-R revolutions that they may experience.

Developing a portfolio is a nice way for our students to integrate all three years of their experience; it is scaffolded directly with relevant readings. Recently, we have provided readings about whether the Internet is changing the way we think, the evolution of a participatory culture, and recent Horizon Reports (2009, 2012). We then ask students to consider the big ideas discussed in these readings in the context of their MAET experience. We emphasize with them the professional value of being able to articulate this vision of technology in education at this point in time. We argue that in a time a constant change, being able to look forward is as important as knowing what to do now.

In a recent course, one student told us that this three to five paragraph vision statement was the hardest document he had ever written, undergraduate and graduate school included. We want students to feel this way. We want this activity to be difficult. In the same course, another student shared with us her personal experience that provided evidence of the practical value of this exercise. This student left class on a Friday after having been given time in class to work on her vision statement and consult with her instructors who provided feedback on her vision. That evening, she had a Skype interview for a job. On Monday morning when she returned to class, she came straight to the instructors beaming, and said, "I just need to thank you." During her Skype interview she was asked to articulate her vision of technology and education. She proceeded to share how she thought focus and filtering were going to be some the most important skills for students to learn, and that most standards did not include them, something we had discussed just hours before her interview. She was offered and accepted the job over the weekend. Upon sharing this with other students, instructors noticed (anecdotally) the quality of the ensuing text provided seemed to greatly increase.

Final Thoughts

As an inventor, designer and creative type, Edison provided an excellent role model for the third year sequence of our course. Among various quotable statements, he also said "...there are no rules - we're trying to accomplish something." As we are likely in the midst of a big-R Revolution in education, and as teachers are facilitating our own little-r revolutions on a daily basis, this latter quote describes the state of education well. The MAET program at MSU, and the third year experience described herein, prepares our students for a world of constant change, where participation in the evolution of teaching and learning will require imagination, trans-disciplinary knowledge, and the ability to integrate the principles of good design. We endeavor to accomplish this by incorporating innovative, but technology agnostic projects; facilitating the use of creative cognitive tools and mindsets; ensuring that students become producers of educational experiences through learning by design; and, by encouraging their development of vision within the new ecology of teaching and learning. At the same time, we do take chances. If we are to accomplish something transformational with our students in the midst of constant change and evolution, we must adopt the open and flexible path Edison suggested.

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