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Curriculum and Practice of an Innovative Teacher Professional Development Program

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The MSUrbanSTEM fellowship program provides exemplary urban STEM teachers the opportunity to engage in transformative instructional and leadership experiences that support the advancement of their teaching practice. In this article, we provide an examination of the development and implementation of a curriculum for this innovative program. This includes an exploration of how the TPACK framework is modeled for the teacher participants in order to create community of practice for Chicago Public School teachers interested in creating authentic learning experiences for their students. Further, we examine how the teachers' expectations inform the development of the curriculum and define what it means to explore, create, and share as praxis in an urban context.

Keywords: Wonder, TPACK, explore, create, share, fluid pedagogy, learner centered teaching, professional development.

INTRODUCTION

In this article, we discuss the overall curriculum of the MSUrbanSTEM program, specifically the thought process and epistemological approach embedded into curriculum design and implementation. First, the approach to curriculum is shaped by John Dewey's philosophy and considers the importance of creating transformational experiences for the teacher-fellows in the program, keeping them and their experiences at the center of the design and implementation. Second, the TPACK framework (Mishra & Koehler, 2006) plays an important role in setting the expectations for and from the teachers. One goal of the program is for the teachers to be able to effectively and creatively integrate technology with their pedagogies to teach their content.

Building on these approaches, our primary goals are to create an environment that (a) promotes a wonder-driven inquiry cycle, (b) treats the disciplines and disciplinary knowledge with respect, (c) supports adaptability to teach with technology, and (d) keeps the teachers and their classroom practices at the center. In order to achieve this, we create one broad thread of *Explore. Create. Share.* that spans across the three semesters throughout the year and stays with the participants (referred to as fellows) even after they graduate from the program. In short, we model a culture that puts value on exploring the world, creating an understanding of this world, and sharing it back with the world. In the next segments, we will discuss all of the aforementioned aspects in more detail.

WHAT IS A CURRICULUM?

According to Phillion, He, and Connelly (2008), a curriculum can simply be defined as an official statement of what students are expected to know and would be able to do. Schiro (2013) argues there are four ideologies that have shaped how American curricula have developed. The first, *Scholar Academic Ideology*, view the formal education that takes place in schools as a "process of acculturating children into society by learning the accumulated knowledge of our culture, that of the academic disciplines" (p. 4). *The Social Efficiency Ideology*, however, argues that curricula support the students in their quest to be "mature, contributing members of society" (p. 5), while the *Learner-Centered Ideology* focuses on the needs on the individual learner. *A Social Reconstructionist Ideology* relies on a curriculum to "teach people to understand their society in such a way that they can develop a vision of a better society and act to bring that vision into existence"

(p. 6). Page (2006) turns to Dewey, who explained that a "curriculum is an important means by which societies define and maintain themselves." A democratic society, he adds, is particularly dependent on a "humanized curriculum" in which knowledge is meaningful to youth because it "connects with the common interests of men as men" (MW.9.200).

The MSUrbanSTEM program recognized the components connected to each of these ideologies and addressed them in the development of a curriculum that meets the needs of a diverse set of learners. For instance, while all of the fellows were considered experts in their subject area, their expertise was derived from teaching in different areas of STEM at various grade levels. Further, a range existed in their levels of technological expertise. While all teachers were based in Chicago, they were expected to "…respond to varied racial, cultural and socioeconomic backgrounds in diverse school environments." (Wollen & Otto, 2013, p.87), based on the area of Chicago in which they were situated. This multitude of variables made it impossible for our curriculum to be a static document. Our curriculum was designed to be dynamic, fluid, and, flexible based on the ever-changing needs of our fellows, with two constants supporting its foundation: engagement and understanding. As Tomlinson (2014) explains, "Engagement happens when a lesson captures students' imaginations, snares their curiosity, ignites their opinions, or taps into their soul…[while] understanding is not just simply recalling facts or information. When learners understand, they have "wrapped around" an important idea, incorporating it accurately into their inventory of how things work. They own that idea." (p. 63).

Big Questions Driving Curriculum

The curriculum for the MSUrbanSTEM program was designed not to follow standard curricular and course expectations of teacher professional development training sessions or degree programs. Instead, the curriculum team, before the commencement of the program, put together the philosophy of the program that would guide the instructors as they began to inculcate practices that would eventually shape and define what the program stands for. The philosophy that is now at the core of instruction evolved from a series of questions about all of the structures and content we felt were needed in the curriculum. Over a span of several months, the curriculum and the instruction team raised questions regarding what they cared about or wished to see in STEM education and teacher development programs, while integrating practices that reflect what the research shows is ef-

fective professional development that impact teacher learning (Capraro, et. al, 2016; Wilson, 2013; Little, 2012 Borko, 2004).

After several brainstorming activities, the instructional team underscored a philosophy of "support for our fellows in whichever capacity possible," which shaped our curriculum. The yearlong or semester assignments and face-to-face and online activities were all designed keeping our support and availability for our fellows as the top priority. When brainstorming the activities or assignments that could form the backbone of our curriculum, we asked ourselves the following guiding questions:

- What are the expectations of our 25 fellows? Whare are teachers' expectations from a professional development program, and how do we acknowledge those expectationsa and fundamentally rethink what professional development means.
- What do we care about in teacher professional development and STEM education? So, as researchers and practitioners who are responsible for these teachers' professional development, how can we use our experience to advance the field of teacher PD, more broadly?

With these broad questions we attempted to realize a balanced approach that addresses teachers' expectations and also targeted our goals. Based on the guiding questions raised by the curriculum team in defining the philosophy of the program and by the instructional team in providing support to the fellows, we can further identify three key themes that governed the backbone as our curriculum: (a) support for practice, (b) support for use of technology, and (c) encouragement for exploration and wonderment. Let us look at each of these.

Support for practice. How can we best support seasoned teachers in STEM with their teaching, leadership, and professional development needs (Knowledge, Methods, Purposes, Forms); keeping teachers and classroom practices at the center? This question helped us think of activities, readings, and inspired discussions that helped send the message that we want our fellows to forget all they know about teacher professional development (PD) and start fresh. For example, the first activity in the summer session is designed to contradict prior professional development experiences, as fellows are given an interactive, physical and unique challenge within minutes of the day's beginning, before being formally introduced to the instructional team. (This counters traditional "sit and get" PD experiences.) This assignment sets the tone for the rest of the year, as fellows are exposed to activities that support the transformation of their view of the teaching practice.

Support for use of technology. What ways do we want fellows to use technology to support their instructional and classroom administrative needs

(e.g. teaching with technology, TPACK, repurposing, creativity)? We make it clear early on that technology changes, and learning how to use technology without a pedagogical or subject area purpose is not going to help them. Instead, we utilize the TPACK framework and make technology a tool for them to find a sweet spot in delivering an intended piece of content in the most engaging, exciting, and effective way possible.

Encouragement for exploration. In what ways can we encourage exploration amongst the teachers and inspire a wonder-driven inquiry cycle that passes on to their students and nourishes their wonderment and creativity? Wonder is a recurring theme throughout the program. In our readings, discussions, and teaching approach, we place a critical emphasis on the role of wonder in STEM area subjects and student engagement.

PROFESSIONAL DEVELOPMENT

While we addressed several ideological stances that should be conveyed through the objectives and outcomes that the teachers were expected to reach over the course of a year, we also made decisions on what these stances should (and should not) look like in action. Incorporating the characteristics of what makes good science PD as described by Wilson (2013) "(i) focusing on specific content, (ii) engaging teachers in active learning, and (iii) enabling the collective participation of teachers (sometimes administrators), as well as (iv) coherence (aligned with other school policy and practice) and (v) sufficient duration (both in intensity and contact hours)" (p. 310). We also integrated the seminal ideas expressed by Borko (2004), which takes a situative perspective on teacher learning and professional development in three phases. We incorporated elements of the first two phases as the academic year progressed. In "Phase 1 research activities focus on an individual professional development program at a single site" (p.4). The primary focus is teachers as learners and factors that can change during intense PD such as instructional practices. Phase 2, includes "…refining a professional development program's tasks and materials for teachers (including the development of materials that are transportable across contexts), specifying the role of the facilitator, and developing resources and training for facilitators" (p. 10). Ideas, such as teachers teaching the teachers by developing professional development workshops for their colleagues, were extracted from this phase.

In each semester, the instructional team provided an array of activities that allowed fellows to engage in structured disruptive activities, where

students could explore STEM content areas through multiple lenses (readings, discussions, field work, creative pedagogies, etc.). The activities were structured in the sense that they had clear directions and goals that students could follow in order to successfully complete the assignments. The disruptiveness occurred as the activities were purposely designed to challenge the zone of proximal development of each student based on their self-assessed technology skills. It also challenged pedagogical norms about how STEM subject matter is traditionally taught. Further, fellows are asked to consider how leadership supports their efforts to explore, create, and share in their educational settings, as well as examine in what ways they take on leadership positions in their contexts.

A Year with MSUrbanSTEM: An Overview

The MSUrbanSTEM Fellowship is a three semester long graduate certificate program. The first cohort of 25 fellows met from summer 2014 to spring 2015. The first semester was primarily a face-to-face experience that met during approximately two-week period in the summer. Over the 11 days of contact, we shared with the fellows our goals of encouraging transformational thinking in a student-centered environment. To create a community of practice, we implemented flexible grouping amongst the fellows that encouraged the characteristics that Kimble and Hidreth (2008) promoted, which include developing patterns of communication, identity and trust, flexible grouping and an environment which is viewed as a "shared space appropriate to [community] goals" (p. 5). These patterns serve as a foundation that continued on into the fall and spring semesters. Participants were encouraged to self-select groups that were diverse in as many ways as possible--categories included race, gender, technological skills, subject area, content expertise, and years of teaching--so that differences were celebrated.

Further, we explored a variety of topics and issues related to teaching and learning in the STEM disciplines and the potential of educational technology to transform learning. This included ideas such as the value of disciplinary learning, misconceptions that people may have, the importance of understanding the aesthetic aspects of teaching and learning, backward design, performances of understanding and the role of technology (guided by the TPACK framework) plays in the educational process. This structure was designed to provide a foundation that would continue to foster the idea that the MSUrbanSTEM program is a safe place for fellows to explore content, create new ideas, and share them. We encouraged fellows to not only

share what they learned with their colleagues in the program, but also with their students, as well as the world via social media, as the fall and spring semesters moved into a hybrid form. During the Fall and Spring semesters, the fellows and instructors met primarily online, with two face-to-face meetings during each term. In the next sections, we will look at how these broad philosophical approaches transfer to practice, primarily expanding on how the thread of "Explore. Create. Share" worked out during the year. After addressing the overall thread, we will delve deeper into the explore, create, share themes.

EXPLORE. CREATE. SHARE.

As mentioned above, each of the three semesters have a theme dedicated to them that builds a mindset for the assignments and activities for that semester. While summer is about setting the stage for disruption and kindling a sense of wonder, fall is about practical implementation of big ideas, and spring is about transforming the fellows into leaders in their communities. In addition, these themes add to the overall objectives of the program, providing a structure. For example, if we combine the ideas from summer, fall, and spring, and look at them in the light of our teaching philosophy, we see three objectives that cut across all the three semesters, across all assignments, and activities. These three objectives that we have for our fellows are: to *explore*, *create*, and *share*. Let us look at what we mean by each of these in the context of each semester of the MSUrbanSTEM teacher preparation and teacher training progrm.

Summer: Setting the stage. The first semester of the MSUrbanSTEM program requires the overarching theme for this program to be firmly established. Additionally this semester must set the right mood for the rest of the year and fuel our fellows to start disrupting their existing schemas of teacher professional development and start thinking of new ways of taking what they learn back to their classrooms to experiment with their students. For this effect, in summer, having disrupted their existing schemas, we have them begin exploring their transformational curricular goals. Therefore, we make the theme for summer about wonder, and design most of the activities around the existing science and math in the world around us. For example, we make our fellows look at mundane objects in new ways by asking them to define how things work. We have a recurring daily activity where two fellows share a commonly occurring phenomenon that makes them wonder. This approach helps the fellows examine *big ideas* (Prawat, 1993) in mun-

dane things and draft a personal big idea that they would wish to implement in their teaching and integrate with the classrooms. They use their big ideas as a perspective for the following activities and the rest of semester.

Fall: Practical implementation. In the fall semester, fellows return to their classrooms. The goal of the fall semester is to connect the key themes unveiled in the summer session to the real world classrooms of the fellows. While the summer portion of the fellowship is designed to introduce new and transformative ideas to the fellows, the fall serves as the real world test of these new concepts. The program instructors design multiple assignments, activities and instructional supports, which are strategically placed throughout the semester to provide special emphasis on the implementation of individual teaching projects.

One such teaching project is the year long Dream IT, which moves from the summer planning stage, to practical implementation in the fall. Through multiple "focus groups", the fellows shared their project with their various school stakeholders in the form of teaching demonstrations (Swenson, J., & Mitchell, D. 2006), where they collect, reflect and act on feedback related to their project. The feedback they receive from these teaching demonstrations serves a critical role as it informs the fellows during their first implementation of the project. Throughout the fall, the fellows continue to modify, adapt and enhance their project, as they put the key themes and ideas of the program into practice. In addition to the DreamIT project, the instructional team pushed the fellows to continue their efforts to view their content in new ways. As an example, fellows performed a book review and author interview, which asked the fellows to read and interact in a unique way with an expert in their content area. Instructional support was provided to the fellows via face-to-face meetings and remotely throughout the semester. Through constant feedback in various forms, instructors were able to assist the fellows as they continued to explore the wonders of their content, and found practical applications for expert knowledge in their classes.

Spring: Becoming leaders. In the spring semester, we ask our teachers to explore the idea of "Tempered Radicals," as explained by Meyerson (2008):

> [Tempered Radicals] are people who want to succeed in their organizations yet want to live by their values or identities, even if they are somehow at odds with the dominant culture of their organizations… Tempered radicals are likely to think 'out of the box' because they are not fully in the box. As 'outsiders within,' they have both a critical and creative edge. They speak new 'truths.' (p. 17).

Meyerson further defines Tempered Radicals, as "Everyday leaders" and "quiet catalysts who push back against prevailing norms, create learning, and lay the groundwork for slow but ongoing organizational and social change." (p. 166).

Meyerson's ideas coincide with the critical leadership ideas espoused by Alverson and Spicer (2012), which encourage a "detailed and situationally specific engagement with leadership in action," (p. 369). This understanding of leadership requires a strategic balance between "performative positions (which largely accept present conditions and constraints) and critical positions (which question existing conditions, emphasize independent thinking and aim for less constraining social relations)" (p. 369-70). These ideas connect with the themes of active learning, wonder, and inquiry we aimed to encourage in the summer and fall semester, and was evident in the work they produced through the spring timeline of assignments.

Explore: Looking at the World with a New Lens

Teachers as explorers or researchers is an objective that is well supported by our initial curricular question, which speaks of encouragement of exploration. We place high value in the concept of wonderment in science and mathematics, and their application. In STEM education, we understand that it is this inherent emotion of wonderment and curiosity that is often lost in the rigid ways science and mathematics are often taught in schools (Firestein, 2012; Millar, 1991). However, if we look at what scientists and mathematicians value the most in their profession, you see references their love for being curious about the world, wondering of how things work, and searching for answers to puzzling questions like they were some metaphorical explorers (Andreasen, 2006). It is this emotion that we want our fellows to not only understand, but adopt into their thinking and everyday practice.

Based on our encouragement for exploration and wonderment, we can now speak of this in a more structured way and start thinking of this goal in terms of a scientific approach. Therefore, we present this goal to the fellows as a *teachers as researchers* approach. We want our fellows to be able to think and act like scientific researchers. The scientists and mathematicians who we model for our teachers are also examples of researchers embodying an approach that they, and STEM education more broadly, can benefit from.

To integrate the objective of exploration or "teachers as researchers" into our curriculum, we designed several assignments and activities that would either span across semesters or recur every face-to-face meeting to form a pattern. Among these are a few example that we will share here:

DreamIT. DreamIT is a yearlong multi-stage project that starts in summer. Over the first face-to-face meetings (11 days), the fellows get to explore a variety of topics and issues related to teaching and learning in the STEM disciplines and the potential of educational technology to transform learning. This includes ideas such as the value of disciplinary learning, misconceptions that people may have, the importance of understanding the aesthetic aspects of teaching and learning, backward design, performances of understanding and the role that technology (particularly the TPACK framework) plays in the educational process.

The fellows are introduced to this project as being a transformative learning opportunity for themselves and their students, and are therefore encouraged to aim high and take calculated risks. All our fellows see this project as an opportunity to ruminate over some big ideas that they wanted to implement in their classrooms, and start to think of significant, tangible change. This project is seen as the first step where fellows start to integrate the approach of exploration and wonderment in their teaching and start thinking of ways to implement plans that encourage their students to see the value of wonderment and curiosity through the subjects they teach.

World of wonder. The world of wonder is a recurring activity that takes place during every face-to-face meeting. The first world of wonder activity during summer is modeled by one of the instructors who share an example of an object or phenomenon that if often perceived as mundane in the real world and then explore a simple question that makes one wonder of what the answer could be. For example: Why is the sky blue? Why do geese fly in a V-shaped formation? Some of these questions often lead into exciting questions that sustain for longer periods of time and get more people involved than intended. Some fellows immediately start using this activity as a hook in their classrooms to engage their students in topics often deemed as dull, to inspire wonderment and curiosity.

Mini-makerspace. Among other activities, one exciting opportunity that our fellows cherish and that has become a recurring addition to the face-to-face meetings is a mini-makespace. In every face-to-face meeting, we create a corner in our classroom that has a collection of arts and crafts supplies for our fellows to use in the other activities that they do during our meetings. Fellows use makerspaces as an active location to manifest their curiosity around a topic and display their thought process. Fellows create and compose artifacts that help them model and explore at the same time. This leads into the significance of creating digital and analog artifacts, in general, throughout the program and the value of sharing them as resources with other teachers.

Create: Multiple Ways of Representing

Teachers with creativity. Throughout the program, a strong emphasis is placed on creation and its ability to transform the classroom experience. To accomplish this, teachers must help students divorce themselves from the idea that only geniuses can be creative. To promote this idea, we used activities such as Quickfire Challenges (Wolf, 2009) to complete performance assessment in a short period of time. In a Quickfire Challenge students are required to complete a challenging, authentic task within a tight time frame that combines content and technology. The assignment is tiered so that students can customize the activity based on their comfort level with technology and also provides a safe and collaborative way to fail and iterate.

Improvisation: During our face-to-face session we invited Second City, a world-renowned improv troupe, to introduce the fellows to improvisational teaching methods. These methods were developed through a collaboration of educators and actors with the idea that "the ensemble creates the experience, moment to moment, in an ongoing process of discovery" (Scruggs and McKnight, 2006, p. 7). These practices forced the educators to think about how they might teach concepts using non-traditional pedagogical strategies such as having students act out theories as a performance task. The program works to instill the belief that everyone is capable of creative thought (Knaufman & Sternberg, 2007). Before this can be done, it is imperative that each teacher trusts in his/her own ability to create and then acts upon it. Just as students, it is important that creativity and creation become regular elements of the teacher's pedagogy. In looking at the elements of expert teachers, Henriksen & Mishra (2013) identified that "most of the award-winning teachers noted that creativity was not a generic or detached skill, but a mind-set that affects how they see the world." It is with this goal in mind that the program designs multiple opportunities for the fellows to exercise their creative ability in a student centered working environment. The program allows for the teaching fellows to practice creativity and creation in their own learning, which in turn can be translated to their own context as a practitioner.

Website. Beginning in the Summer session, each fellow was responsible for maintaining a personal website. The creation of the website served two purposes: a medium for the fellows to share their work with a wider audience and an opportunity for many of the fellows to create and maintain their own web presence for the first time. At the time of starting the fellowship, while a few fellows had no web presence, some fellows used web space provided to them by their school/district in order to help facilitate

communications between themselves and students, as well as parents. This was consistent with trends observed by Unal (2011): "Among the teachers that currently have a website, communication with students was stated as the most popular use (73%), followed by communication with parents (51%)" (p. 44). Other fellows had created sites using applications such as WordPress, Edublogs, Weebly, Wix, or Squarespace.

The program encourages fellows to view the website as not only a medium to showcase their work for the fellowship, but more importantly as an opportunity to create their own digital presence. Fellows were asked to view the website as a platform to communicate themselves in a professional context both in out-of-school professional settings. This meant examining their professional virtual presence, as well as their networking strategies. Reminding fellows of the idea that teaching is a public practice, fellows were asked to re-envision their sites as a portfolio of their work in addition to supporting their teaching practice. Their website now represents a repository where they can share all of their demonstrated learning, skills, pedagogical practices, competencies, and reflections in one central location. Fellows were also asked to consider integrating their social media accounts into their website. Connecting a stream of tweets related to their work, education, and STEM interest to their website, helps in the branding of their site as a professional resource for teachers interested in STEM educators.

MePages/Feedback Cycle. Since all of the participating program fellows are practitioners, the communication of consistent and actionable feedback is imperative during the sessions in which the fellows and instructors are not working face to face. This communication of feedback takes place largely in the form of a "MePage", which is created by the fellows before their arrival for the Summer session. The MePage is created in Google Docs with access being granted to both the fellow and the instructors. For each assignment that is completed, the MePage functions as a feedback notebook, where the instructor can leave detailed and specific comments for the fellow to read and act upon.

Through the MePage, the fellow is able to access direct feedback to their assignment, and is able to then apply this feedback to the alterations, changes or expansions required. This medium plays an important role in creating an atmosphere where fellows feel comfortable exploring new ideas and taking risks. As stated by Henriksen & Mishra (2013), "Trying new things enables educators to find novel, interesting approaches to teaching—and to find out which novel approaches work." The goal of the MePages is to allow fellows to explore these new approaches; with the safety of knowing there is a consistent line of communication open to the instruc-

tor if needed. Through this cycle of exploration, creation, feedback, revision and implementation, the fellows are free to apply the new and novel ideas to their context, and to take risks with their creative approach to their practice.

Readings. Through the reading curriculum, MSUrbanSTEM fellows explored a variety of topics and issues related to teaching and learning in the STEM disciplines and the potential of using educational technology to transform learning. This exploration included incorporating ideas related to the value of disciplinary learning, challenging misconceptions that people may have, promoting the importance of understanding the aesthetic aspects of teaching and learning, backward design, performances of understanding, and the role that technology (particularly the TPACK framework) plays in the educational process. In sum, the goal was to encourage transformational thinking amongst the fellows.

Through the readings, program fellows interact with the power of creation as a vehicle in learning. Fellows deconstruct the idea of active engagement (Wilson & Peterson, 2006), and identify how a classroom of creation, as opposed to absorption, can enhance student understanding. The emphasis of creation goes beyond its use a means of demonstrating understanding, as fellows discover how the idea of create can identify misconceptions and misunderstandings in learning. As stated by the Committee on Undergraduate Science Education (1997), "Before misconceptions can be corrected, they need to be identified" (p. 29). The fellows are asked to design environments in which creation can illuminate these misconceptions, which allows for them to be confronted and corrected. Through the creation of their own misconception video project, the fellows explore the theme of *create* as a tool to uncover previously hidden student misconceptions that pose a barrier to understanding and mastery. Throughout the program, fellows are asked to embrace new ideas posed in the reading curriculum, to test and challenge these ideas, and eventually create with them. It is through these opportunities to create that the fellows are able to bring the ideas in the readings from the realm of theory and to practical applications in their own contexts.

Share: Giving Back to the World

From Web Presence to Personal Branding. Teachers were encouraged to explore the functions of their web portfolios. We encourage our fellows to engage in teaching as public practice through the use of social media tools, as well as by encouraging the establishment or further development of a web presence. Lastly we ask the fellows to engage in personal as

well as collective reflection around their teaching practice, and share these reflections as personal journal entries as well as publications to be shared with the world. A portfolio for appraisal purposes (e.g., Loughran & Corrigan, 1995) would be very different from a portfolio that aimed to encourage reflective practice" (p. 328). Bendae (2015) argues that such technologies have also encouraged an "open design" of learning. "Open design encourages flexibility in learning and teaching, allows collaborative, team teaching, and is coupled with flexible, ergonomically-designed furniture that is easily moved and re-arranged" (p. 43). Not only does this idea improve teaching practice, but allow teachers to actively participate in scholarship around the art and science of teaching. It can also be used to help fellow develop their place as leaders in the field of teaching in their context area by sharing the materials and artifacts they have developed in the course and explain via blogging or social media how they were used.

Social Media Integration. We believed one way to help fellows to practice the idea of teaching publicly was to help them develop and/or foster the use of social media in their teaching practice, as well as their professional development experiences. Ferriter (2010) makes several arguments for why teachers should be proficient in the use of social media, specifically Twitter, in their teaching practice. He states, "teaching professionals have found ways to use Twitter to share resources and lend quick support to peers with similar interests" (p. 73). By building a network via social media of professionals in similar content or grade areas, a teacher can construct a repository of resources for various ideas, which include lesson planning, curriculum mapping, motivation and engagement strategies. Technman (2015) adds to the conversation by noting that social media can also be used in the teaching practice of several disciplines by connecting students to both content and experts around the world.

Boulos, Maramba and Wheeler (2006) offer that these types of technologies allow users the added advantage of reducing the technical skill required to use these features, by allowing users to focus on the information and collaborative tasks themselves with few delivery obstacles. Such technology is known as *transparent technology* inasmuch as the user is able to concentrate more on the learning task by 'seeing through' the technological environment they are immersed within. Our goal was to use social media transparently for various teaching and learning activities. While we encouraged teachers to explore multiple forms of social media, we consistently encouraged content creation via four outlets: Google Apps, Facebook, Twitter, and blogs.

While some fellows were considered tech savvy and had social media and web presences they had cultivated for professional use, others were

novices and had not used social media, or even computers, unless required to do so for specific tasks. In some cases, we as instructors were introducing some fellows to one of their first social media creation experiences. Social media served as one of many ways for instructors to maintain a regular line of communication with students once the program transitioned from face-to-face to an online format. It also supported fellows in sharing their work publicly, finding and sharing resources related to pedagogy and content knowledge, as well as connecting to other professionals in their fields.

Roots of STEM book. Each teacher selected a lesson that they felt showcased their best experience in teaching a topic within their subject area and share it with a small group (4-5 colleagues) in the cohort. Upon completion of the lesson showcase, the group engaged in dialogue about the lesson for 20 minutes using the Critical Response to Teaching Demonstration (CRTD) from Swenson and Mitchell (2006). The CRTD allows for observers to provide feedback on the lesson that is shared. This activity allowed the fellows to be exposed to new ideas in regards to pedagogical approaches and content approaches. Teachers then used the feedback to revise their lessons and consider how the lesson could be differentiated for content, process, and product. Students wrote up their revised lessons, which were printed using the Espresso Book Machine, resulting in a physical book titled, "The Roots of STEM." The book was also produced digitally and posted on the MSUrbanSTEM project website.

CONCLUSION

In returning to our big questions: *What are the expectations of our 25 fellows? What did we care about in teacher professional development and STEM education?* We found that we created a professional development program that was unique for many of the seasoned professionals that were selected to participate in our program. While most fellows did not know what to expect, for some, the expectation was low as evidenced by this fellow comment:

> "I have completed several "STEM" programs through the Chicago Public Schools University, none of which taught me anything new or relevant. Nor did any of these programs keep my interest. I was always interested in combining technology and the teaching of mathematics in middle school. However, every professional development or college/university program stifled the use of current technology or moved at a snail's pace."

One of the key challenges and successes proved to be how disruption was woven into expectations and outcomes for the teachers. Many fellows cited the Quickfire Challenges (Wolf, 2009), which initially raised anxiety in some teachers due to the possible unknowns a teacher eventually becoming a welcome challenge. This was due in part by teachers abandoning the idea that they had to submit perfect work in their first iteration of a project. Instead, they realized the importance (and fun) of exploring a problem and possible solutions, creating a working mock-up that they would refine for their own context when needed, and determining the best way to share what they produced with the world. In many ways, this was different from the expectations set for them at previous professional development programs they attended in the past.

While they were expecting to learn something, there was little expectation that what they learned would have a fundamental impact on who they were as teachers, learners or leaders. However, their reflections indicated that the professional development provided through the summer and year round support, exceeded their expectations.

> "This has been one of the most intense experiences in my professional career, and I do not mean that lightly. During 10 days, I was challenged to learned new things every hour of the day. I understood quickly that expectations were set high for this program and demanded that I created something new every day...Six months from now. I know, I'm already not the same teacher that I was last year. It's been a long time since I felt reenergized to teach. It reminds me of my first years teaching. I dreamt on how I will [teach] the next concept to my students. As time goes by, teachers are told more and more what to say and what to do, and evaluated on those expectations. As you questioned how to proceed, you become a robot: as you comply more and more, the creativity dies out. This program has changed all that. Now I see possibilities that are rigorous for my students, and I learned how technology could produce this outcome. My teaching can no longer be the same."

The DreamIT projects produced by fellows were illustrative of this change. For example, one science teacher developed a garden that was used to illustrate biological concepts in class, and help feed the school community during lunch. Another fellow developed a pathway for social media to be used in her classroom (and school) for the purpose of teaching and learning. Teachers were able to help their students have authentic experiences in STEM disciplines by connecting their course content to social justice issues

in their community as well as national conversations. These projects were not prescribed by the fellowship, but developed organically as a result of providing a protected space for teachers to connect with instructors and colleagues, resources, and a framework to be reflective in their practice.

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