Transitioning to Emergency Remote Teaching of Mathematics

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Transitioning to emergency remote teaching (ERT) due to the COVID-19 health pandemic has provided a unique opportunity to expand the preparation of beginning mathematics teachers. A review of the Association of Mathematics Teacher Educators' (AMTE, 2017) underlying assumptions and standards reveals new opportunities and challenges regarding the practice and assessment of beginning teachers of mathematics. In this article, we describe some of the issues related to remote teaching and provide suggestions, with connections to AMTE's underlying assumptions and standards, and also share an example of how one placement classroom teacher helped her teacher candidate navigate obstacles during a remote clinical experience.

Emergency Remote Teaching: Issues and Suggestions

Perhaps the first challenge is found in AMTE's Assumption 1: *Ensuring the success of every learner demands a deep, integrated focus on equity in every program that prepares teachers of mathematics*. Given the transition to ERT, are teacher preparation programs ensuring all teacher candidates have resources to participate in remote learning as they continue in their own learning? Are they provided the knowledge and skills to learn and teach through a variety of formats and environments, including synchronous, asynchronous, and blended online classes? Are they aware of the questions regarding access and equity that will impact their abilities to teach students in their clinical placements? Mathematics teacher preparation programs often provide limited training and practice for their teacher candidates' use of educational technology in non-traditional delivery formats. A lack of understanding of the available hardware, software, and processes for successful mathematics instruction will inform teacher candidates' decision-making across a variety of online environments. This question of equity can directly impact some, if not all, of AMTE's standards.

Mathematics teacher preparation programs are also currently challenged to meet AMTE's standards C.2. *Pedagogical knowledge and practices for teaching mathematics*, P.3. *Opportunities to learn to teach mathematics,* and P.4 *Opportunities to learn in clinical settings* within a wider variety of instructional spaces and formats. Teacher candidates are prepared to design and deliver instruction using learning theories, pedagogies, management, and assessment practices established for face-to-face classroom teaching and learning. The knowledge of new learning theories developed for online learning and practice with a variety of educational technologies are limited, especially for the teaching and learning of mathematics. Exposure to and opportunities for exploring software programs supporting learning and practice of mathematics that are interactive and learner-centered are minimal, unless the focus is on use within the classroom. Teacher candidates need a working knowledge and confidence in using: educational technology devices (e.g., computers, Chromebooks, iPads, cell phones, etc.); software for planning, design, storage, communication, and interactive products; and processes. As examples, online resources such as Desmos, GeoGebra, Jamboard, Phet and Quizizz (see links at the end) provide opportunities for learner interactions for teaching and practice, and can help teachers plan for active and higher-level learning. Virtual mathematics

applications (including manipulatives and educational tools) are available at no cost by the Math Learning Center and may be downloaded as web apps or for specific operating systems and devices (https://www.mathlearningcenter.org/apps).

All in all, teacher candidates need to be prepared to engage in field experiences that potentially provide a variety of learning environments, including asynchronous, synchronous, or blended delivery formats for students. A working knowledge and confidence with assorted educational technologies and software will support successful field experiences. However, there are many factors to understand, such as the pros and cons of each delivery format for the field placement mathematics content, grade level(s), and mathematics readiness. Abilities to design and deliver online lessons that use developmentally appropriate applications are needed to create a successful mathematics learning space for all students.

Another important consideration is support for teacher candidates' social-emotional states as they are engaging in field experiences during ERT. Many experience anxiety as they navigate new field experiences, and they will have additional stress with the potential of providing online instruction. Creating opportunities to continue relationships and engagement with their university professors and peers is important to help manage stress and anxiety, and to share tools, ideas, tips, and other resources. Virtual office hours, social media, virtual "happy hours", and Zoom teams can facilitate this engagement. For example, teacher candidates might invite advisors and peers to join in as observers of a lesson or use of a new online tool. During office hours or happy hours, they can examine and discuss the lesson and/or tool. Virtual conferences may allow teacher candidates and faculty to explore different software, uses of hardware, and pedagogies through sharing of screens or team break-out sessions.

In addition, central to successful field experiences during ERT is communication between key stakeholders. For example, when it comes to supporting students' learning of mathematics, the placement classroom teacher (PCT) and teacher candidate should discuss which learning outcomes are priority, and whether maintenance of current knowledge and skills is of higher priority than acquisition of new knowledge and skills, given the emergency context. They need to review their assessment processes to ensure they are targeting evaluation of students' knowledge and skills, rather than competence in using educational technology to learn. The university supervisor, PCT, and teacher candidate should have open and clear discussions about the implications of ERT on field experiences and expectations for all. Success may look different in such a context compared to traditional field experiences.

As previously discussed, access must stay in the forefront of decision-making when it comes to clinical experiences and ERT. The PCT and teacher candidates' access to the necessary technology (e.g., hardware and software) and to reliable internet is critical. The students' access to technology and internet is just as critical. The PCT and teacher candidate need to ascertain what each student in the classroom has access to, and if it is sufficient to meet educational goals. If not, then the school system, school, PCT, and teacher candidate need to consider alternative approaches or solutions to ensure access by all. A second issue of access is that of students who have a disability, who are English as a second language learners, and who have other factors that impair access to learning. Teacher candidates can contact their

university faculty, especially those in exceptional education, their statewide training and technical system, or the many professional organizations supporting online learning and access to digital information, for support.

Example from the Field

In our teacher preparation program, we have over 100 teacher candidates participating in elementary education field experiences this fall. These experiences range from online to hybrid to face-to-face. While not all field experiences provide everything we suggest above for ERT, here we share the experience of one mathematics teacher candidate (MTC) whose PCT's online learning system created a meaningful experience for the MTC, the students, and the students' families. Notably, the MTC stated this is by far her best field experience during the program. The placement is a first-grade classroom with 15 students, with instruction delivered completely online. What does a management system look like in this online environment? The PCT's management system works for three critical reasons: 1. Access to technology; 2. Communication with families; and 3. Organization. Below we share how this management system works for the PCT through illustrative examples. Our hope is to help other mathematics teacher educators and PCTs think about how to support MTCs using a non-traditional delivery format.

Access to Technology

As previously described, a working knowledge and comfort with a variety of educational technologies will help provide the MTC a successful field experience. This is also true of the students who are learning online. Fortunately, in this example, any student or family who does not have access to technology is provided with the necessary support from the school. This includes a free WIFI hot spot and devices that allow caregivers the means to upload the student's work (including chrome books and/or cell phones). The devices are provided for both the student to use to complete their work and for the caregivers to use to either help them with or submit their work. The PCT did everything possible to make sure all students had online access, including sending detailed guidelines and tutorials for access to each family. Prior to the start of the school year, she tested the technology with each family during one-on-one conferences. Some of the students and caregivers continued to struggle with some aspects of technology. When that happened, students were able to go to a socially-distanced classroom where they continue to use the same platform with other students. However, the PCT found the students preferred to work from home, which has encouraged their accurate technology use. Student work is submitted through ClassDojo. ClassDojo is a learning management system (similar to Canvas or Blackboard) that teachers, students, and families use every day to share the student's progress. Through the use of digital photos of the students' work, videos of problem solving, and messages of feedback and encouragement, a reiteration of teaching, learning, and formative assessment is established.

The MTC described how she learned more about how to use technology from her PCT than from any of her teacher preparation courses. In addition to ClassDojo, she learned that Desmos is more than an online graphing calculator and has lessons and activities appropriate

for elementary students; and, Jamboard has much more to offer than its use of sticky notes. Her students love taking quizzes on Quizizz because of the energetic music and funny memes.

Communication with Families

In addition to making sure students and caregivers know how to use technology, the PCT also had to make sure they understood and supported her organization of the online instruction. She is able to easily communicate with families through ClassDojo. Not only does ClassDojo allow her to send announcements to all families at one time, it also allows her to message individual students and/or other members of the household. Additionally, ClassDojo messaging may be translated into more than 35 different languages, ensuring communication with students and their families with limited English proficiency.

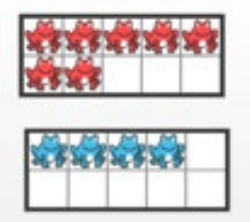
At the beginning of every month, each family is required to pick up student work at the elementary school. Planning is critical so that students are provided with the necessary paper copies to complete their assignments for the entire month. The PCT has all assignments organized and paper-clipped by date to ensure students and caregivers know exactly what to use and when. Each day the student takes out the appropriate set of documents and uses it in the order of the daily schedule. The MTC shared that lesson plans look very different in a virtual environment. Lesson planning can be difficult because there is an intentionality about everything that is done, given the limited time for instruction and difficulty with follow-up. In this arrangement, success requires long term planning and organization. To the extent possible, the organization of the learning day mirrors the organization of the in-class day.

Organization

What is clearly an essential aspect of this class's online instruction is that the students maintain the same daily schedule, 8:30-2:30, Monday-Friday. Throughout each day there is a scheduled time for everything, including recess and lunch. Each day begins at 8:30 sharp for morning meeting. During morning meeting, all students are greeted by name and all are allowed to share information about what is going on in their lives. The PCT provides a morning message fashioned to help students focus on the work they will complete that day, such as *It's Chooseday Tuesday! What will you choose to do today? What will you choose to be?* The students type their responses into the chat box. For example, one wrote, "I choose to do my homework". All students are required to be present with their videos on. For every transition, the students have a timer that goes off as a reminder, a feature enabled by the PCT. Mathematics and Reading are the only subject areas for their content instruction.

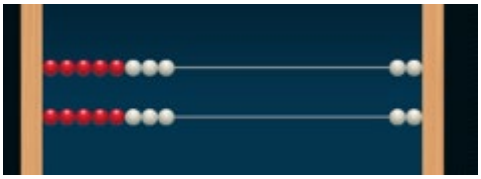
During mathematics instruction, the students are divided into 2 groups. The PCT and the MTC each take one group. As an example, one particular day they were studying addition of numbers to 20. The PCT worked with double 10 frames. The students have their choice of using a paper model (provided for them in their monthly work) with their choice of items to use as counters (in this example the student uses marshmallows):

Or, they can use the free number frames application provided by the Math Learning Center:



The MTC is using a number rack with her group of students. The students have a choice of using one that the teacher made for each of them:

Or, they could use the number rack application also provided at no cost by the Math Learning Center:



Notably, during mathematics instruction in the online environment, the MTC found that students are more likely to ask for help through the use of the chat box, when compared to face-to-face instruction.

When the MTC is not there, the PCT still uses groups but one group must work independently. In this case she often uses Geogebra, followed by a Quizizz, both of which were newly introduced to the MTC. Although Geogebra appears to cater to higher level mathematics, it also has many interactive lessons for elementary students. One activity related to the lesson just described is a '10 frame flash' where a double 10 frame with counters is flashed for a specified time (such as 4 seconds) and the student must determine the total number of counters. The Quizizz provides instant feedback on how many questions the students answered

as well as how many were correct or incorrect. It can be sorted multiple ways so the PCT is easily able to determine gaps.

Conclusion

Adapting to ERT has highlighted some issues for mathematics teacher preparation programs. It is essential to address a variety of learning and teaching formats and deliveries and a more expanded use of educational technologies, rather than focusing on the standard classroom instructional format and minimal use of educational technology. We have shared the experience of one first-grade teacher, one mathematics teacher candidate, and 15 students where remote teaching and learning became a daily routine. The CPT helped the MTC learn how to use a variety of educational technology, the value of community building with families and caregivers, and the importance of an organized learning environment. Upon further reflection, the MTC revealed that she learned so much more about differentiation and how to provide and care for students on an individual basis, such as sending each of them private messages. She might not have the same opportunity in a face-to-face setting, as she stated: “It is a different way to gain trust”. In these uncertain times for CPTs, teacher candidates, and students, this example illustrates a level of stability critical to keeping students on task and how the unchanging daily schedule provides them with a sense of consistency.

Online Resources

Desmos - https://www.desmos.com/
GeoGebra - https://www.geogebra.org/
Jamboard - https://jamboard.google.com/
Quizizz - https://quizizz.com/
Phet - https://phet.colorado.edu/