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Adjusting to a Digital Environment as a Teacher of Adults Learning Mathematics

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Abstract

As more and more classroom and digital technologies are developed, the author has had to wrestle with how, and if, certain technologies should be employed in teaching a quantitative reasoning course for university students. Ten self-reflection questions capture the author's key decision-making factors in adjusting to a collaboration classroom environment from a traditional classroom. These self-reflection questions, organized by the Areas of Activity from the UK Professional Standards Framework for teaching in higher education, represent important decisions and potential adjustments that all teachers may want to consider as they reflect on their own teaching practice in the digital age. This article is based on a presentation given at the 26th annual conference of Adults Learning Mathematics held in Lund, Sweden in 2019.

Key words: mathematics, technology, adult learning, higher education

Rationale

There are particular challenges to teaching mathematics and especially so for teaching to adult learners who have already had experiences with mathematics classrooms. Their previous life and classroom experiences have led some students to have particular cognitive or affective issues that they bring with them as adults. So, I have always looked for the proverbial "silver bullet" that would be the key to successful teaching of this population. While I have come to learn that there is no single methodology, technique, policy, or style that works for all students (or all teachers), I do get excited about the search for ideas that will improve my effectiveness in helping students to learn. The explosion of digital devices and applications makes this a prime area for my search. But, through my practice, I have learned that there are numerous considerations when looking to incorporate digital technology in the classroom.

Context

I teach in the United States at a large public university that integrates the university and community college missions. There are approximately 40,000 students. All students seeking a bachelor's degree must complete a quantitative literacy (QL) requirement which consists of completing a specified mathematics course, depending on the area of study (the student's *major*). I eventually specialized in teaching Quantitative Reasoning which in some institutions might be named something like Math for Life, Math for Society, or Liberal Arts Mathematics. This course is the QL requirement for non-STEM majors. My students were studying dance, art, English, American sign language, graphic design, philosophy, etc. Most students probably would not have taken the course if there was no QL

requirement. Many had previously taken at least one developmental (remedial) mathematics course that the institution offers to prepare students for college-level mathematics.

A few years ago, I observed a colleague using a "collaboration" classroom where approximately 30 students sat in pods of up to six people each. Each pod has its own monitor and white board. Students can connect to their monitors with a variety of their own devices. The pods are spread around the outside of the room and there is no traditional front to the room. There is an instructor station in the corner where any screen can be broadcast to all of the students' monitors. I was intrigued so I sought out collaboration rooms for my classes, after receiving the requisite technology training. The training was only on using the technology, not methodology, so I quickly learned that I could not teach my Quantitative Reasoning course in the way I had become accustomed. I found myself rethinking everything about my teaching. With no front of the room, it forced me to present in a different way and take advantage of the pod seating. My focus became what I was going to have my students do together during class rather than what I was going to tell them. It was a lot of work to make the transition, but I was glad for the experience and requested those rooms to teach in, from then on. That experience made me consider the impact of technology on my teaching. I began to think about general considerations that myself and other faculty must make in the digital age given the ongoing technological innovations that have the potential to impact teaching and learning.

To organize my thinking and to comprehensively look at the act of teaching, I decided to use the five Areas of Activity from the UK Professional Standards Framework (Advance HE, 2018). Those five areas [bold added to indicate short names for each area] are:

- **Design** and plan learning activities and/or programmes of study;
- **Teach** and/or support learning;
- **Assess** and give feedback to learners;
- Develop effective **learning environments** and approaches to student support and guidance; and
- Engage in continuing **professional development** in subjects/disciplines, and their pedagogy, incorporating research, scholarship and the evaluation of professional practices.

For each of these five areas, I find that there are questions I must ask myself as I confront technological change and the potential to improve student learning. These questions are found below for each of the areas.

Design

With all the information that is available to students, I found myself thinking of the following question as I designed a course or planned a lesson:

Question #1. What should students do by hand versus what should they do by calculator, computer, mobile application, or online calculator?

For example, in a quantitative reasoning course with a financial unit, I could have my students calculate a monthly mortgage payment by hand with the help of a calculator. Or, I could have them find an online mortgage calculator, input data, and interpret the results. Which is more important? I ended up compromising and having my students do both. My rationale for having them do it by hand was that they should know how to use a calculator and that manipulating the formula would give them a better understanding of how the online calculator works and why the concept of exponential change is important. But, using an online mortgage calculator helps them with a life skill they may use in the future.

There are other aspects of mathematics for which question #1 applies. For example, should students: (a) calculate a unit price or know how to find and interpret the labelled unit price in a store, (b) construct a pie chart by hand or use spreadsheet software to create a chart, (c) convert units or use an app or online program (even as simple as typing the units to be converted into the Google search bar). The following statement from Boyle and Farreras (2015) gave me some pause:

> Changes in the use of technology today, especially in hand-held devices, may well translate into students today not memorizing the multiplication tables or being unaware of the process of multiplying two or more digit numbers. Educators' initial reaction is to assume that modern students are thus not 'learning' because they are not using the traditional method. As this study has shown, however, this conclusion needs to be examined very carefully. The fact that students do not learn the way that previous generations did, is not evidence for lack of learning, or any of the other dire conclusions that are often drawn. (p. 98)

When considering having students work by hand or using a digital tool the most important consideration I have found is the expected learning outcomes for my adult learners. Those outcomes should be developed while keeping in mind the Boyle and Farreras' (2015) quote in mind. The outcomes must be explicit and should drive the development of the course, including the incorporation of technology.

The second question in the design area is:

Question #2. Should I incorporate a particular new digital technology into my course design?

The answer depends on the expected student learning outcomes. Technology should support the teaching-learning process as directed by the outcomes. One should not look at a new technology as a solution looking for a problem. I once incorporated some technology without fully thinking it through in advance. It failed and I quickly abandoned it.

In addition to the learning outcomes, other considerations for adopting new technology in the design of a course include accessibility, cost, past performance, customization, and ease of use.

Teaching

The third question is in the teaching area:

Question #3. What is my role as a teacher and how should technology support or modify that role?

The answers to this question are highly personalized, depending on the instructor's characteristics as a teacher. There are metaphors for how one might see themselves in the classroom like boss, coach, docent, etc. There is also an issue of how much control an instructor needs. Does the instructor see themselves as operating a dictatorship, bureaucracy, or democracy? How structured/flexible is the instructor or how extroverted/introverted? These are just a few characteristics, but they can all be factors in how technology will be used in teaching.

A colleague of mine has changed all his classes to a flipped model. He quite heavily relies on digital technology to eliminate lectures during class time and maximize use of group projects. He seems quite successful at it. However, this does not work for me for several reasons including that I get an intrinsic value from teaching that I would not have in a flipped model. It works for my colleague but not for me. I do not believe there is one correct way to teach because we are all different. Faculty members need to decide what is best for them, and for their students, and make appropriate technological decisions.

Here is an additional question in the teaching area:

Question #4. What is my view of the students' role and how should technology support or modify that role?

Technology has changed a traditional model of the instructor imparting content to the students. Now, students have greater access to the content because of digital technology. Instead of being primarily recipients of content in class, should expectations be raised for students to find more of the content on their own? If so, this would require more emphasis on how to find and evaluate information. I have a car buying project where they compare hybrid and non-hybrid versions of the same car model. I give them very little information and require them to decide what they need and to go find it. To support this, I also have a small unit that I teach on efficient online searching.

Technology has also changed how students are able to interact with each other. Digital technology allows for greater collaboration. Is this collaboration an important part of students' educational experience? If so, then what tools are appropriate? But a tool, alone, is not enough. There is this caution by Borokhovski, et al. (2016):

> When educational practitioners strive to effectively achieve their instructional goals, simply relying on more interactive technological tools is not enough—special attention should be paid to how to maximize their potential by designing tasks and activities that would elevate interaction to the stature of collaboration. (p. 23)

Technology must go together with good instructional design. Again, expectations for students must be clearly articulated. For example, in a quantitative reasoning class, a learning outcome might be to solve an authentic, real-life problem. Another outcome could be working successfully in a team to collaborate and develop consensus. For the latter outcome, some form of digital technology would be appropriate.

Assessment

Regarding assessment, the key question is:

Question #5. Is the use of digital technology appropriate for assessing student work and providing feedback?

Some faculty get enamoured (seduced?) with publishers' online homework systems that automatically grade homework and provide hints and other help. Students can get immediate feedback on their answers. Some programs are including artificial intelligence to diagnose incorrect responses by students. Also, analytics can be provided to the teachers regarding which problems students are having the most trouble with. So, there are certain advantages to online systems but, as instructors, do we get the same sense as to where particular students are having trouble? Also, homework that is automatically graded means that there are only certain types of questions that can be asked because the answers have to be recognized as correct or incorrect. Faculty must sort out these issues for themselves. I have used online homework programs for students to practice procedural skills and then supplement that work with projects that I hand-grade.

Learning Environment

As I described in the introduction to this article, I have recently been using collaboration classrooms with students sitting in pods as groups. End-of-term student feedback indicates that the students very much enjoyed the experience and believed it helped their learning. Most became very close with their pod mates and worked well together on practice problems and group exercises. This shows that classroom furniture and digital technology can have an impact. Kramer (2017) stated:

> The creation of more Active Learning Classrooms is supported by the theory of architectural determinism, which in this case suggests that physical environments will affect the learning experiences of students.

> Various universities are implementing policies that shift traditional teaching away from lecture style (one-way teaching) to student-centered learning. This approach involves both active learning and collaborative learning practices, with Active Learning Classrooms serving as a catalyst. (p. 15)

For all types of classroom situations and technology, given the above, it is worthwhile for instructors to consider the following question:

Question #6. Can I use technology to enhance the students' classroom experience?

Consider what features of various technologies are important in helping students achieve learning outcomes but do not underestimate the role of classroom technology as simple as furniture, layout, and classroom design. Years ago, at a previous institution, there was an instructor I knew who preferred a traditional classroom with individual chairs with tablet arms. But one term he was scheduled in a room with long tables. When he found out his room assignment, he objected to that room because it did not allow him to move up and down the rows helping students. When offered to change rooms he decided to just go with what was originally scheduled. Near the end of the term, I asked him how his classes were. He said the classes were wonderful and that attendance was better than usual and so were the exam scores. I then asked him to what did he attribute the improvement. His response, to my surprise, was "It's the tables." His rationale was that the tables allowed students to help each other more and that resulted in a better learning environment in the classroom. So, years later, when my institution created the collaboration rooms, I took the opportunity to try something new which resulted in my classroom being a more effective learning community.

The next question may be a strong consideration for teaching adult students:

Question #7. To what degree do busy adult students need a physical classroom experience, given that digital technology can provide other ways for connecting with students and content?

My students tend to be quite busy between school, work, and other responsibilities. Digital technology can help relieve the time spent in commuting to school and offer flexibility on when the learning is accomplished. Remote or other forms of online learning can be quite effective. But, I also believe in the value of the classroom experience for adult learners and saw an example in the collaboration classroom that illustrated the value for an older student in the pod environment. During one term a few years ago, an older, non-traditional student was in a pod with four students who were right out of secondary school. He would joke about how little he knew compared to the younger students but also remarked on how beneficial it was for them to help him learn. Later in the term when we were covering home mortgages, I saw him at his pod's white board explaining concepts to them because he had actually gone through the loan process in buying a house. I went over and said something like, "Well, look at you teaching your pod mates." He gave the biggest smile and said it was great to be able to switch roles and help the young adults in his pod.

There are many options from the classroom to various digital technologies including learning management systems, cloud services, social media, and video conference sites. But, what is the trade-off? How important is the classroom experience through meeting regularly and interacting face-to-face? Do adult students need more structure or less?

Digital technology is so prevalent in many countries around the world that it is easy to forget that not all have access. Hence, the importance of considering the following:

Question #8. How accessible is any planned new technology and what can I require of my students?

As an example of studies showing a digital divide, Wilson, et al. (2019) measured digital inclusion in Australia. They concluded the following:

> The ADII [Australian Digital Inclusion Index] reveals that digital access, affordability and abilities continue to follow distinct geographic, social and socio-economic contours. In general, rural and regional

> Australians, older Australians and Australians with low levels of income, employment, and education are less digitally included than their compatriots. (p. 117)

Similarly, in my own country, here is a statement from Yu, et al. (2016):

> Using a representative sample of Americans over the age of 50 years, … Findings show that nearly half of respondents do not have regular Internet access. While the access divide in gender is reversed in favor of women, those who are socioculturally, economically, and physically disadvantaged are less likely to have reliable Internet access, … (conclusion, para. 1)

In most cases, we cannot assume that every one of our students will have internet access, devices, or needed software programs. The collaboration room though allowed the students to see various software programs like mortgage calculators and to visit and explore various websites to analyse quantitative information. Pod mates had various levels of computer expertise and were able to help each other learn. To further help with any potential digital divide issues, my institution provides free Microsoft 360 accounts for all students. There are also computer labs that students can use but I find that students are on campus only when they have classes in the two or three days that they come to campus. They usually have to get to work or pick up children from day-care right after their classes. So, even though the university provides what they need, it may not be accessible to all and I still needed to be prepared to make allowances for some students.

There are also potential issues with online resources that may lack accessibility for students with disabilities, although this has improved a lot. The pods were actually an advantage to one of my students who was sight-impaired. He loved the pod setup because he could sit right next to his pod's monitor and easily see his screen whereas he had difficulty often in traditional classrooms.

Professional Development

A teacher wanting to do what will work best for student learning must do some self-reflection on how flexible they are and how much time they are willing to spend examining digital technology use. How willing is an instructor to try something new, despite the learning curve?

Question #9. Am I comfortable in pursuing and using new technology for my teaching?

It takes time and effort to stay current. How committed is one to professional development regarding digital technology? That commitment requires self-reflection and continuous professional development. Seeing the possibilities for providing valuable learning experiences in the collaboration room, I was willing to put in the time to not only learn the technologies of the room and my institution's learning management system but to also alter my teaching style and methods. It was a considerable investment of my time and worth it, in my opinion. It was also valuable to work closely with a colleague who was ahead of me by a year in the use of the collaboration rooms.

The last question is about teachers becoming students themselves in a digital world:

Question #10. Can I take advantage of digital technology to improve my professional development opportunities?

Digital technology can help instructors to learn and there are a variety of means to communicate and collaborate with colleagues. One can follow various educators on social media, participate in online research forums, use cloud sharing services, belong to professional organizations, attend conferences/webinars, etc. Also, educational institutions have an obligation to encourage technological professional development through evaluation/reward systems and providing resources for training and personal development.

There is more I could have done to take advantage of some of the professional development activities available through technology. But, my primary method was to attend conferences of several mathematics learning organizations such as the annual conference for Adults Learning Mathematics which has now done a number of virtual seminars. I was always attracted to sessions involving technology, small-group learning, and teaching methodologies.

Conclusion

There will be continual innovations in classroom and digital technology in the future. We must be prepared, as instructors, to decide to what extent we will try new technologies and experiment with our teaching practices. A central point of this paper is that the establishment of expected student learning outcomes, good instructional design, and a willingness to adapt are critical when considering the use of technology. Digital tools should not be adopted because of a "wow" factor. Instead, the decision must be deliberate and intentional and in support of student learning. My experience with the collaboration room with its pods, brought much of the above to light for me. Making such a drastic change to the learning environment forced me to think about my role, students' roles, learning outcomes, assessment, and even the value of the classroom. My hope is that my experience and self-reflection will be a source of reflection for other instructors.

References

Advance HE (2018). *UK Professional Standards Framework*. https://www.heacademy.ac.uk/ukpsf

Borokhovski, E., Bernard, R. M., Tamim, R. M., Schmid, R. F., & Sokolovskaya, A. (2016). Technology-supported student interaction in post-secondary education: A meta-analysis of designed versus contextual treatments. *Computers & Education*,*96*, 15-28. https://www.sciencedirect.com/science/article/abs/pii/S0360131515300762

Boyle, R. W., & Farreras, I. G. (2015). The effect of calculator use on college students' mathematical performance. *International Journal of Research in Education and Science*,*1*(2), 95-100. https://files.eric.ed.gov/fulltext/EJ1105220.pdf

Kramer, G. (2017). *Building Connectedness in the Classroom and on Campus: A Look at McGill University's Architecture and Infrastructure*. http://www.socialconnectedness.org/wp-content/uploads/2019/02/Gal-Kramer-Final-Report-1.pdf

Wilson, C. K., Thomas, J., & Barraket, J. (2019). Measuring digital inequality in Australia: The Australian digital inclusion index. *Journal of Telecommunications and the Digital Economy*, *7*(2), 102-120. https://telsoc.org/sites/default/files/tja/pdf/187-article_text-2035-1-11-20190715.pdf

Yu, R. P., Ellison, N. B., McCammon, R. J., & Langa, K. M. (2016). Mapping the two levels of digital divide: Internet access and social network site adoption among older adults in the USA. *Information, Communication & Society*, *19*(10), 1445-1464. https://www.tandfonline.com/doi/full/10.1080/1369118X.2015.1109695