Technology Training Through The Lens Of Science Education:
An Educational Technology Philosophy

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New technologies are migrating to the classroom at an accelerating rate, and when teachers understand the use of these technological tools in the context of strong pedagogy and content knowledge, the opportunities to unleash new learning are endless. However, without a balanced understanding of how pedagogy, content knowledge, and technology are interrelated, the result may actually be a barrier to effective instruction. Through the development of the TPCK framework, Mishra and Koehler explore the “complex interactions among content, pedagogy, and technology” (*Mishra & Koehler, 2006*), offering a valuable lens to guide discourse about educational technology, research, and focus of teacher training efforts. Throughout the teacher certification process and the following decade of ongoing professional development, the majority of technology training that I experienced largely falls under the umbrella of “developing proficiency”. While the exposure to new tools in these training sessions was helpful, some of the most successful moments of growth in my career as a teacher stem from personal reflection on the interlacing of technology, pedagogy and my content area, physics.

As I prepared for the first year of my current teaching role, I was excited to learn that the district was moving to an online textbook for the classes I would be teaching in an effort to cut costs and increase student accessibility. Upon arriving at the school that August, I quickly realized that the free online textbook that had been chosen was still in development by a private author and the bulk of the text was not relevant to the level of my courses; critical concepts, practice problems, and useful diagrams/illustrations markedly absent. While an online textbook has many affordances beyond the traditional bound text, the decision to adopt this particular online text is a clear example of disconnect between technology implementation and an understanding of pedagogy and content. The solution was that another physics teacher and I would collaborate to write our own ‘textbook’. The final product was a collection of PDF narratives explaining physical phenomena accompanied by sample word problems. Many students found these readings useful as they were personalized to the same language and symbols we use in our teaching (which often vary from publisher to publisher in purchased books). Unfortunately, there were significant constraints to our design as it was created in Microsoft Word (not a professional publishing program) and we had limited time for revisions. This resulted in a less than optimal resource for students and a significant burden on the teachers.

In contrast to this experience, a few years ago I became a member of PrettyGoodPhysics (PGP), a community of physics teachers who share resources, lesson ideas, and reflections on effective teaching strategies. This network provides a rich environment for professional discourse that naturally blends technology, pedagogy, and content. While all individuals have different backgrounds and strengths, the collective knowledge and experience in that community exemplifies the value of having each component of the TPCK framework represented. Many of the ideas that I have seen discussed in the forums directly influence my own teaching practices and activities that I develop for my students.

A lesson that I am particularly proud of was largely inspired by one such discussion. Whenever possible, I try to integrate hands-on experiments to allow students to observe physical phenomena directly. A PGP community member shared a new take on a traditional projectile lab which required students to calculate the height that a ring would need to be placed such that a marble launched from a Vernier projectile launcher would go through the ring's center at a given range. Fortunately I had access to the launcher that was recommended, but had never considered having students calculate for vertically oriented targets like this. As an introduction, I was able to model a sample calculation for when the projectile was launched at a lower angle so that we could determine the launch velocity as a class. Students then worked in teams to calculate the height needed for rings placed at different distances from the launcher. The goal was for a single fired marble to travel through the center of each ring and land in a cup. This inspired the entire class to collaborate and check each other's calculations and measurements. When the projectile was launched, students recorded it from various angles with the slow motion camera feature on their cell phones so that the exact path could be observed. The most successful class achieved 4 out of 5 rings, and while the execution of their plan wasn't flawless, the eruption of cheering at the end indicated that the student engagement was. This lesson was ***possible*** due to the implementation of specific technology, as the launcher uses regulated air pressure to produce very consistent launch velocities and the slow motion camera allowed students to see the path of the marble which could not be tracked by the human eye. This lesson was ***successful*** because it also incorporated sound pedagogy (instructional modelling, opportunities for independent work, peer review and collaboration) and content knowledge (an understanding of projectile motion is essential to predict where the marble would travel after launch).

While I would like to claim that all of my lessons bring together such a balance between technology, pedagogy, and content knowledge, the reality is that I still have a lot of room for growth. Opportunities to explore new technology through the lens of science education, as opposed to general training for technology that is applied across all disciplines, allow science teachers to contextualize new tools with their existing knowledge and experience. Some might argue that a model of training teachers of all content areas is effective, as it develops teacher proficiency in using new technology, but I maintain that proficiency does not equate to effective implementation. Just as effective teaching ties in to students' prior knowledge, there should not be an expectation that technology can be introduced "in a bubble" and make significant improvements to classroom instruction. Effective teaching in the modern era emerges when technology, pedagogy, and content knowledge are all understood and considered in the development of curriculum and instruction.

References:

MISHRA, P., & KOEHLER, M. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record*, *108*(6), 1017-1054. doi: 10.1111/j.1467-9620.2006.00684.x