

Meaningful Integration of Technology in Secondary Educatio

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Successful integration of technology within the classroom is an important step towards enhanced learning for all students. Over a century after the industrial revolution, technology innovation today continues to grow at an exponential rate. All aspects within our society are getting upgraded to be faster, cheaper, and easier. I define technology as a technical intervention that increases efficiency. I define successful technology integration as the mutualistic relationship between emerging technology and classroom pedagogy. I am aspiring to be a secondary mathematics teacher, so I will be analyzing technology integration specifically within the middle school and high school math classroom.

How do students learn mathematics? Most would argue that they don't. As a mathematician, I have biases towards the importance of math, however these biases are rooted in truth. Mathematics is needed for nearly all modern technologies to operate. Anything computerized, (which is quickly becoming everything), uses concepts that a mathematician has developed. Something most people do not understand is that, in learning mathematics, you learn how to think logically. It is the manner by which mathematics forces you to reason more so than math itself. This way of thinking is powerful because it provides a technique for describing the world in an objective, factual manner; but how, as an educator, can you get this message across and have these students understand the importance of what you are trying to teach? Stanford Professor Jo Boaler has conducted important research on this very topic and has been able to conclude, in her own words, "students learn math best when they work on problems they enjoy, rather than exercises and drills they fear" (Parker, 2015). This should not come as a groundbreaking statement. Students learn when they are engaged, and they, like everyone else, are engaged only in things they enjoy. The connection educators often find so hard to make is the

connection between mathematics and student enjoyment. People generally do not enjoy math.

This is a gap technology can fill.

Technologies include tablets, smartphones, computers, robots, board games, video games, and so much more. Fortunately, there have been many studies conducted in recent years to research how technology impacts student engagement. One research group from William Paterson University studied the implementation of Apple iPads in public K-12 classrooms; they concluded that “students felt more engaged in their classes and felt empowered by their work” (An). This study analyzed the success rates of different implementation techniques: ubiquitous, classroom, and sign-out. The ubiquitous approach involved providing each student with their own iPad with which they are encouraged to take home every day. With the classroom approach, a cart full of iPads was placed within every classroom and used nearly everyday. Lastly, with the sign-out approach, teachers could request one of a handful of iPad carts available for the entire school if they so wanted. Surprisingly, this study did not find one approach that was evidently more successful than the others. The main take-away they found from this study was that the teacher’s instructional and technological competency is what determines the success of students rather than the level of access to iPads. How teachers use technology is more important than what technology the teachers use.

Mathematical thinking is similar to computational thinking because, as noted earlier, it provides clear parameters with little room for misinterpretation. $2 + 2 = 4$ forever and always, this is a universal truth. This resembles how computers operate, as they are only able to do what they are programmed to do. Thus, computers have a set of parameters they must abide by. These similarities provide a mutualistic relationship between the two disciplines; both fields can benefit

from each other, and student competence along with them. A Northwestern University research project led by Dr. Weintrop studied the benefits of implementing computational thinking into lesson plans within high school math and science courses (Weintrop, et al., 2015). They outlined three main reasons why this can be beneficial. First, computers have become increasingly prevalent in all aspects of the professional world, especially private enterprises that specialize in STEM. Exposing secondary students to the technologies used within the professional sector provides them with a better sense of what a career in such disciplines will entail. Thus, better preparing students for future jobs. Furthermore, students are able to make more suitable career goals in accordance with their interests. Second, utilizing computer tools makes for a much more rigorous understanding of math concepts. In particular, the visualization of mathematical complexities is immensely helpful for students when grasping advanced concepts. One of the most difficult connections people have when learning a new concept is applying the ideas laid out on the whiteboard to real world 3-Dimensional depictions. Technology can help bridge the gap between whiteboard mathematics and real world applications of mathematics. Lastly, integrating computational thinking into math courses is the easiest way to expose all students, especially those who are a part of historically marginalized groups within STEM such as women and racial minorities, to computer technology. The general lack of funding within the education sector, overcrowded schools are already struggling to keep up with the class load as is. This makes it difficult to add specific computer science courses, or programs. Congregating the field of computational thinking into already existing ones such as math and science can solve this problem.

The age of technology has come. The purpose of school curriculum and pedagogy is to sufficiently prepare students to pursue their intellectual, philosophical, and professional passions. This can not be achieved with teachers' and administrators' continued disregard for technology within class curriculum.

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