**Overcoming Barriers to STEM**
**with Leadership, Increased Access, and Training**

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My interest in increasing STEM activities within my classroom and school has always been focused on how technology can be integrated to improve the teaching and learning experience across subject areas. Increased access to technology devices was the first barrier my schools needed to overcome, followed by the maintenance of the technology that was purchased. The other significant area of focus has been providing ongoing staff and student training so that teachers and students have the skills that allow them to use technology more readily and in ways that are impactful to learning. Here is how I've been able to manage these aspects of technology integration within my school.

**Laptop Carts: Avoiding Dust and Chaos with Organization and Values**

I went to a professional development last month in which a teacher shared that her school purchased a large volume of student laptops, as well as other awesome hardware like a 3-d printer. Everyone was excited about the purchase and looking forward to using it, but for about a year now, it's all been collecting dust, locked away in a room in the school, because there is no one to organize and manage it and also no one who knows how to use a 3-d printer. It's such a waste, but I understand her administrator's choice. Who wants to invest in such a large purchase, only to have it fall into chaos, similar to my school's experience with our first laptop cart?

Once my school received our first set of 96 Chromebooks, to be shared across the 10 or so upper grades classes, my first objective was to figure out how to create an organizational system for maintaining and distributing. In terms of organization within each cart, I used color-coding stickers to create bright, labeling in low-contact areas on each computer, charging cord, and shelf, which prevented the labeling from falling off and helped students quickly match their correct computer shelf and charging cord when returning laptops to the cart.

One of most important things I initially did was create a value system for the laptops, as well as assign teacher and student responsibilities for laptop usage. Before any teacher could use the new cart, they had to schedule a class visit with me. Each student was assigned a computer number and told that they could *only* use the computer labeled with their number because that laptop was *"theirs".* The limitation of only being able to use *their* particular numbered computer immediately increased the value of "their" laptop for each student. Whereas students previously experienced that there would always be another computer to borrow, even if they did something like remove and mix up the lettering of the keyboard as a joke on another user, the class visit discussion created a shift in thinking about *their* computer. As a result of the discussion, the laptops were recognized as expensive and fun items that they were privileged to use and had significant responsibility for, since they were limited to using only that computer.

Within each class visit, I also related laptop usage to rental car borrowing. Each time a student used their laptop, they were told that they needed to give it a quick look over before they began working. If they discovered equipment issues, they needed to report it to their teacher for a quick

inspection.  If the issue could not be remedied by their teacher or another student, it would be recorded in a simple troubleshooting log that traveled with the cart. This immediate reporting allowed maintenance issues to be addressed in a timely fashion and gave students confidence that they would not be held responsible for any misuse of the computer that was not their doing.

After my introductory session, teachers were expected to maintain the number system, provide whatever troubleshooting they can, let me know about issues they are not able to resolve, and call the help desk to address hardware repairs. Regarding the borrowing of laptop carts, I created a reservation system via Google Calendar, which allowed teachers to identify and reserve whichever available laptop cart was closest to their classroom. I held a professional development introducing the reservation system, and offered on-going support via email and quick meetings with individual teachers when needed. I also encouraged teachers to communicate issues that arose so that we could troubleshoot them together.

We currently have 7 maintained laptop or Chromebook carts which are in heavy circulation during the school day and in afterschool. The higher value that the students have for “their” laptop, coupled with a borrowing system that includes ongoing teacher and student responsibilities has distributed the burden of maintenance for the cart. Since I am the tech lead, but still a full-time classroom teacher, the shared responsibility of maintaining our cart system has been a critical element of its success.

**Responsive Teacher Training**

During our initial tech boom, we became a Google Apps for Education school, got our first 3 Chromebook carts, and got a Smartboard installed in every classroom. It was an exciting, but busy time for me as full-time teacher tech lead. I did what I could to learn about the tech myself, share my excitement, and support others. I set up student accounts for the teachers who were interested in exploring Google apps with their class and offered support with managing and reserving the laptop carts. Our staff got trained from an outside vendor about basic Smartboard usage and with all that, everyone was essentially off to explore how to use the technology in ways that best suited their needs and interests.

After a year, I wondered how teachers were experiencing technology across the school and parents at my school were becoming more interested in exploring options for increasing technology and STEM integration. As part of a parent and teacher tech committee, I created a comprehensive survey for the entire staff, which revealed significant interest in tech integration, as well as a range of barriers to tech usage.

By that time, a majority of the staff transitioned to using their GAFE (Google Apps for Education) account as their primary school account which they used for communicating with parents. They reported success with using Google Drive to better organize their digital teaching files and found that they were increasing their use of technology to create teaching materials. They also reported increased digital collaboration and sharing of materials with colleagues.

Although most teachers had not created student accounts in order to use our GAFE suite of apps with their students, those who did were mostly allowing students to publish their written work with Google Docs. Others who hadn’t created GAFE accounts for their students were exploring how to offer digital resources and differentiation activities for their students (ex. online reading materials at different reading levels, math games for reinforcement), and teaching their students how to conduct internet research. Many teachers used their Smartboard almost every day to deliver lessons, citing

appreciation for the increased visibility of student work, or of their laptop screen. Increased student engagement when technology was used in any form was almost universally reported.

The staff largely expressed interest in more training for the Smartboard, which would allow them to go beyond the basics and use more of its advanced features, as well as learning more about how they could integrate technology in their instruction. Student inexperience with technology and the absence of basic computing skills was a huge barrier that was cited. Teachers want to be able to use the tech straight away to achieve their curricular goals, within devoting substantial instructional time to teaching basic skills such as how to type or navigate an operating system. Teachers also expressed that tech usage would be easier with more devices. Although we had a 3 laptops carts at the time and a reservation system for classes to share carts, the need to regularly coordinate and be confined by the availability of only 3 carts for about 10 upper grade classes was sometimes frustratingly restrictive.

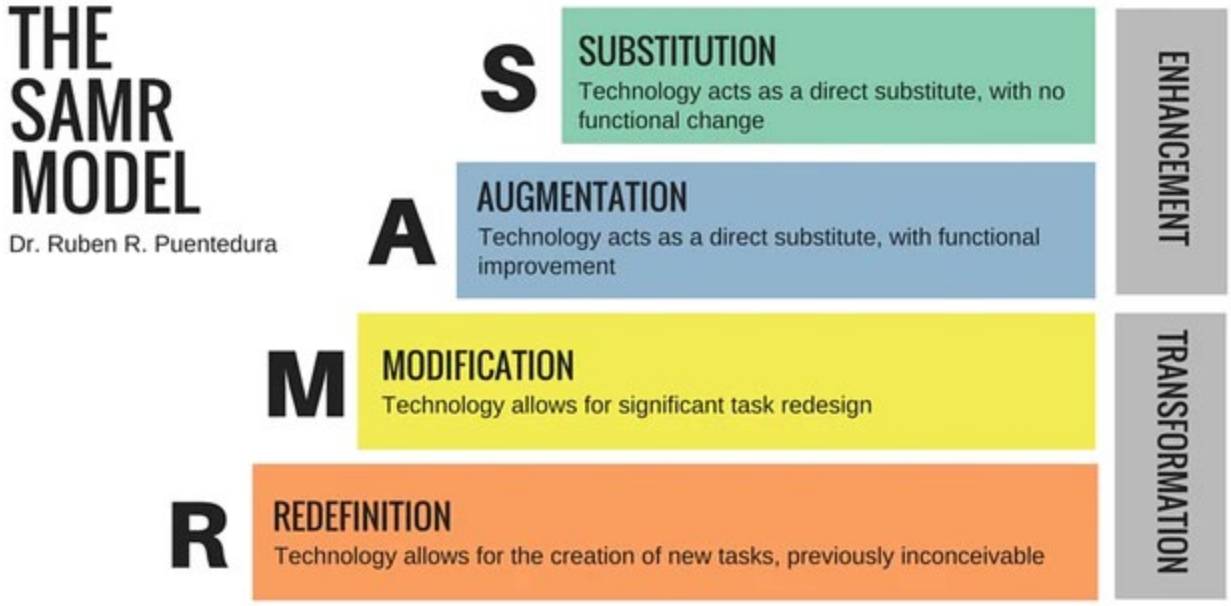
There was a lot to address. My principal allowed me to attend professional development sessions on Smartboard usage and GAFE (Google Apps for Education). I also did a ton of exploration with my students in order to create a series of staff-wide professional development sessions that explored more advanced features of our Smartboards and better use of Google apps. I continued to encourage teachers to try GAFE and offered class visits to ease the lift of getting started. I began writing a Tech Up8 for the staff, in which I shared tips and guides about tech usage, addressed issues that needed resolving, highlighted teachers who were trying things with tech and experiencing success, and encouraged teachers to invite me as a collaborator on anything they were interested in exploring.

One of the coolest ongoing supports is that my principal created two periods of “interest group” professional development each year. It allows staff members to offer a 4-session series on a topic they think would interest staff. I’ve used that structure to offer professional learning focused on improving skills with the Smartboard and Google apps. This year, we also introduced a STEM vertical team, in which a teacher from each grade met for several sessions in order to explore cross-grade STEM integration.

As a result of seeking teacher input and offering support that was responsive to teacher needs and interests, there was a gradual increase in the number of teachers who used their Smartboard in more advanced ways and whose students used technology more often and for a variety of purposes. Currently, all of our 4th and 5th teachers have Google accounts for their students and are integrating technology in their classrooms in different ways.

**Focusing on the Quality of Tech Integration**

Earlier this year, my principal forwarded me an email about an upcoming ISTE (International Standards for Technology in Education) certification opportunity, and I jumped at the chance to learn more about how to integrate technology in more impactful ways in my classroom. On day one of our training, we learned about a tech integration model called SAMR. Similar to how Bloom’s Taxonomy is a classification tool that rates the cognitive demand of tasks, the SAMR model is a classification tool that helps categorize the degree of transformative impact that technology integration has within a learning activity. There are 4 tiers within the model, categorizing the degree to which tech usage within an activity enhances or transforms the learner’s capabilities or experience within a task.




The SAMR Model. Source: Wikimedia Commons

The moment I saw this image of the SAMR model, I immediately began reflecting on my uses of tech. Most of my use of technology with my students offered some form of enhancement to an activity, but don't think I've been that intentional about how I use technology to *transform* a task, so that students are able to do something that would be impossible without the use of that technology (ex. having face-to-face meetings with a class from another state in order to collaborate on a project or taking a virtual field trip to a zoo in order to observe animals and gather data). During my ISTE certification process this year, I've been invigorated to explore more transformative uses of technology that allow for otherwise impossible experiences, but that are also more collaborative and broadens the audience that my students can communicate with and receive feedback from.

I'm excited to share this work with my colleagues, so I gave them a survey to find out how they were using technology and if they were interested in exploring this work with me. As opposed to the results of my 2016 survey, this survey revealed that teachers are using technology with their students in a broader range of activities and that they are really interested in learning more. I would like to develop a tech team of teachers in my school who are interested in learning more about how we create learning opportunities for our students that span the range of levels within the SAMR model, and how we can encourage and support other teachers who have yet to begin learning about the many benefits of teaching with technology.

This past week, New York City schools closed for an indefinite time, while our city tries to mitigate the spread of the Coronavirus. Administrators and teachers have been scrambling for a manageable way to meet the mandates for teaching remotely, with less than one week of preparation time. Not only has this experience highlighted the gross inequality of technology access across the schools in New York City, but also the magnitude of teacher inexperience with even basic computing skills.  I am certain that this experience will lead to broad reform in teacher education, likely through teacher education programs and also continuing education requirements. I imagine that the goal will be for all teachers to have a foundation of technology knowledge and skills, which can be drawn upon in an extreme situation like this, but may also be called upon to enhance learning experiences for students on a daily basis.

Although the Coronavirus pandemic is a historically stressful time in world history, many teachers in my school have shared how fun it has been to learn and experience the technology that my school is implementing for remote learning. As my school's tech lead, who has been assisting with developing our school's plan and guiding so many teachers through this week's tech learning, I recognize that this is likely also a historic turning point in education systems across our country and I'm excited about this new era for technology integration in schools.