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## A Quest for More Equitable Experiences for All Students During a Global Pandemic: An Inquiry into Remote Delivery of De-Trackled Chemistry and Biology Classes

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## **A Quest for More Equitable Experiences for All Students During a Global Pandemic: An Inquiry into Remote Delivery of De-Tracked Chemistry and Biology Classes**

### **Abstract:**

*Through our collaboration, we helped one another rethink and adapt the delivery of our de-tracked science courses for remote instruction as we finished out the 2019-2020 school year, with a particular focus on developing remote instruction practices that would support our learners struggling in our secondary science de-tracked classrooms. We derived three actions to take to target the needs of our students who struggled and to differentiate our instruction. We reduced the amount of material being covered to allow for deeper dives into content, prioritized depth of learning over breadth of learning; connected our remote lessons to our students' real-world experiences; and capitalized on remote learning technologies to work with our students who were struggling individually. These adjustments resulted in larger than expected attendance and engagement, as evidenced by students' written responses to our lessons and their summary responses to the question of whether and how science was relevant to their lives.*

### **Who We Are**

Each of us, Mayra and Elizabeth, taught high school science at P.K. Yonge (PKY), responsible for the honors sections of chemistry and biology respectively. Our honors sections served all students at PKY, as several years ago we eliminated academic tracking. Previously, students were sorted into different sections of chemistry and biology based on grades, performance on standardized tests, and teacher recommendations. Through several cycles of inquiry however (i.e., MacDonald, 2017; Weller, 2017; Yurko, Miller, & Cheveallier, 2017), our faculty discovered this practice meant that minority students and students living in poverty were typically placed in lower-ability classes and unable to engage in the fuller, richer curriculum of an honors course (Biafora & Ansalone, 2008; Burris, 2014; Chmielewski, 2014; Fiel, 2013; Sensoy & DiAngelo, 2012; Oakes, 2005; Tyson, 2013).

Prior to the pandemic, the process of inquiry had been instrumental in helping the science department at PKY address the increase in learner diversity within our de-tracked courses. Continuing this tradition, when the pandemic hit, Mayra had been engaged in a cycle of inquiry to investigate the implementation of rubrics to help *all* students progress towards mastery in her high school chemistry classroom, while Elizabeth was exploring differentiation to challenge advanced students while also supporting students who needed extra help. When we were forced into emergency remote instruction during the country's lockdown in the

spring of 2020 however, we realized that we had a more pressing problem of practice to address. We were both particularly concerned with our ability to meet the needs of students who had been struggling in our de-tracked science courses prior to the pandemic when we would no longer be able to see them in the f2f school setting.

We brought similar, but different backgrounds to this problem of practice. When the abrupt shift to emergency remote instruction was necessitated by COVID-19, Mayra was in her 12<sup>th</sup> year of teaching at PKY, while Elizabeth was in her first year of teaching. Mayra had earned a Ph.D. in the sciences early in her career and eventually transitioned to teaching secondary science by earning an M.A.E. in science education. Similarly, Elizabeth had recently earned her M.A.E. in science education after completing her bachelor's degree in biology, which led her to join the PKY faculty in the Fall of 2019. Despite Mayra's extensive 12 years of experience as a classroom teacher and an earned doctorate, she did not feel prepared to instruct remotely. Having just completed her master's degree in science education, Elizabeth felt better prepared for remote instruction due to her extensive use of online platforms in her graduate program, yet she longed for a more experienced colleague to draw wisdom from when faced with transitioning to the complete online delivery of instruction. With different perspectives to offer one another, we decided to collaborate to explore this new, pandemic inquiry question together: How can we engage and support our struggling learners in our chemistry and biology de-tracked classrooms when delivering remote instruction?

### **What We Did**

Through reflecting on our school's *Remote Learning Inquiry Website (RLI)* as described in the introductory piece to this special issue, we derived three actions to take to target the needs of our students who struggled as we delivered instruction remotely: (1) reduce the amount of material being covered to allow for deeper dives into content, prioritizing depth of learning over breadth of learning, (2) connect our remote lessons to our students' real-world experiences, and (3) capitalize on remote learning technologies to work with our students who were struggling individually. Our data collection included our reflections as articulated on the *RLI*, but also included samples of student work, grading rubrics and feedback to students; student surveys regarding remote learning and content areas; and informal interviews with students.

### **Prioritizing Depth of Learning Over Breadth of Learning: Less is More**

Due to the pandemic, Florida had eliminated standardized mandated testing, freeing teachers from necessary preparations for these exams. Elizabeth was able to extend her final unit (which had begun after spring break) from four

weeks to seven weeks, enabling her students to more time—three weeks—to focus on the content for each virtual class meeting. Elizabeth had also decided to shorten her class assignments—to reduce the number of slides, activities, and labs—so that if her students worked straight through the allocated period online, they would be able to finish and have minimal "homework." With remote learning occurring predominately in students' homes, the line between schoolwork and homework was blurred. Minimizing or eliminating "homework" was important to us as our students were already spending too much time in front of computer screens just to do school. During the country's lockdown, students needed time to be away from their computer screens after their "school day" in order for them to be productive on their computers during "school."

Mayra also reduced content and extended time to finish assignments. Mayra had typically required an investigation-based science project at the end of the year. She eliminated the project and spent the final three weeks in her curriculum creating and teaching lessons in which students would be exposed to different scenarios that involved chemistry concepts from prior learning during the school year. Each lesson had explicit links to daily life and/or popular culture, enabling remote lessons to connect to students' real-world experiences.

### **Connecting Our Remote Instruction to Our Students' Real-world Experiences**

Mayra strove to embed the chemistry lessons from the months preceding the pandemic, into lessons incorporating students' personal experiences and interests. Rather than engaging in experiential chemistry labs at homes, Mayra found readings relating chemistry to daily life and popular culture. In her first remote lesson, Mayra asked her students to choose an article to read with chemistry connections ranging from the visual arts to space science to cooking. Articles related directly to the pandemic were also included. For example, one article explored the ways that bees use social distancing during illness. Each student chose an article based on their own area of interest. Students were asked to complete the following tasks: (1) list three main ideas; (2) explain why the topic of the article was interesting to them, and (3) discuss how the article related to chemistry concepts they had learned in class so far.

In other lessons, Mayra focused on chemistry in popular culture, for example, viewing excerpts from movies such as, *The Martian* and *Erin Brockovich Saga*. Students also watched video-recordings on culinary arts (such as Barbecue and Grilled Cheese) to illustrate the connections of chemistry to cooking, as well as video-recordings on chemistry careers such as being a Forensic Scientist or Neuroscientist. Students were asked to describe what the movie excerpt or video told them about society; what surprised them in the material; what new ideas they

had learned; and if their opinions about chemistry or science had changed as a result of watching the movie excerpt/video and reflecting on all they had learned about chemistry throughout the school year. Students increasingly demonstrated their growing awareness of scientific principles-in-action in their lives as well as demonstrated in popular culture.

### **Using Remote Instruction Technologies to Teach Students Who Struggled**

As we delivered lessons remotely that connected our subject matter to our students' real-world experiences as described above, we began to understand that remote instruction provided us with unexpected opportunities to coach and scaffold instruction with our students, who had been struggling. For instance, we provided individualized support using Zoom breakout rooms and divided students in different breakout rooms depending on their needs. Some students worked together to complete any assignments they had not submitted. We also held individual student Zoom conferences to talk with students about what was going on in their lives and their plans to reach their goals (in terms of achievement or a grade). During these individual sessions, students shared personal circumstances, we listened to them, and then designed a plan together so they could be successful during the emergency remote instruction time.

### **What We Learned**

As we decreased content and eased the pace of instruction, our students increased their engagement and completion of assignments. We learned that it (1) student engagement increased overall as noted by student work and completion of assignments, and (2) student engagement increased among typically under-performing populations in science.

### **An Overall Increase in Student Engagement**

We were both pleased to see their students attending and responding to our Zoom sessions and completing their assignments on Canvas. We realized from the *RLI* and other conversations with our colleagues that reaching out to students to simply attend Zoom sessions had been an ongoing challenge. For example, Mayra was pleased with the response to her first remote instruction lesson: to select, read, and respond to an article related to chemistry. The submission rate was higher than expected for so early in their abrupt shift to emergency remote instruction. By the following class period, 47/66 (71%) of students had submitted the assignment. Following through with our ideas of asking less while providing more relevance appeared to increase our students' willingness to engage in remote learning experiences.

### **Greater Engagement Among Typically Under-performing Populations in Science**

We also noted greater responsiveness among our students that were often dis-engaged during f2f class sessions. In particular, Mayra noticed that a particular student who had lagged behind in submitting assignments prior to the pandemic, became engaged and on-time with an assignment highly relevant to the current pandemic experience and his own interests. Responding to the article on how bees use social distancing during illness, this student reflected:

This topic is interesting on several terms. For one, we humans are in a virus crisis, where we have to practice social distancing, to know that other species such as bees are doing the same thing is truly fascinating. We could also potentially find answers or help from studying bee social distancing to help ourselves and the bees. Bees play a major part in our ecosystem, pollinating the plants that feed us and feed the many other organisms in our world. Also, I have been very interested with bees and want to eventually have a colony of my own someday. [Student 1, May, 2020]

Similar to the ways our lessons engaged students who had struggled to submit assignments prior to the pandemic, we noted that the actions we took to engage these same learners, during emergency remote instruction, led to greater engagement among under-performing populations in science. For example, research shows that at the end of middle school, female students lose interest in science related fields (Pringle, Brkich, Adams, West-Olatunji, & Banks, 2012). We found that many of the lessons we designed and delivered remotely supported our ongoing commitment to engaging females of color in science (King, Pringle, Cordero, & Ridgewell, 2020). These assignments were created to engage students in a meaningful, simpler way during a pandemic, yet exceeded our expectations by eliciting student enthusiasm among female students who often struggled and seemed dis-interested.

To motivate females to consider STEM related careers, they must be engaged in scenarios that apply to their lives (Cox-Petersen, Melber, & Patchen, 2012; Pringle, et al., 2012; Howard & Terry, 2011; Weller, 2017). A sample of female student remarks from Mayra's movie excerpt/video lessons indicate that our female students were finding science relevant:

Today as we watched videos in class I learned and noticed many new things. Starting off with the video on cooking. Whether you are cooking a meal or attending a barbecue you never consider

the levels of chemistry that go into making that dinner. After watching those two videos of food I was shocked about how much science goes into making something as simple as a grilled cheese. Also, the tip about the baking soda to help onions cook faster will definitely be something I utilize in the future. [Student 4, May, 2020]

I think my opinion on Chemistry has changed. I used to think it was just making things explode with different substances, like in the same way that a Pepsi bottle reacts when you put Mentos in it. However, throughout this year, and with these videos too, I have learned that there is much more to Chemistry, you don't need to be good at Science and Math to find some area of Chemistry interesting, like the video "Careers in Chemistry: Forensics/Neuroscience" said and I realize now how important it is to look at things in that perspective, and not simply dismiss something because it seems hard. [Student 5, May, 2020]

My opinions on chemistry have definitely changed quite a bit throughout the year. I've learned that chemistry is found in many aspects of our lives, even in things as simple as making a grilled cheese. In the beginning of the year when people mentioned chemistry I would think of laboratory experiments and some dude in a lab coat, and although there is an element of that there is also so much more. I now have a much better idea of what chemistry really is and how it affects our daily lives. [Student 3, May 2020]

Responses, such as those above from female students, reinforce the need for teachers to find ways to relate science to their students' lives. While we strove to do this prior to the pandemic, the adjustments we made to our curriculum during emergency remote instruction illuminated just how important this is to student learning.

### **Important Take-Away**

Our ability to adjust the delivery of our de-tracked high school chemistry and biology classes to the emergency remote instruction necessitated by the pandemic was enhanced through collaborating to inquire together in this unique circumstance. We both had a renewed appreciation for reaching out to our students, particularly those who were typically dis-engaged, through assignments that had the potential to relate directly to their personal lives. Our remote teaching

experience reminded us of the importance of linking STEM subjects, in clear and meaningful ways, to the lives of our students and relevance to our culture.

While we learned a great deal about characteristics of effective teaching on remote learning platforms during a crisis through this inquiry, we also learned about the unique benefits of collaboration between more- and less- experienced teacher researchers. Mayra brought the wisdom of twelve years of teaching experience and an earned doctorate in the sciences to our collaboration. Elizabeth brought an ease in working with technology as well as the recency of graduate studies in science education. Together, we helped one another rethink and adapt the delivery of our de-tracked science courses for complete online instruction as we finished out the 2019-2020 school year, with a particular focus on developing remote instruction practices that would support learners who struggled. The symbiotic relationship we developed as we studied our practice together during the pandemic echo the words of Parker Palmer (1998), who writes about mentoring:

Mentors and apprentices are partners in an ancient human dance, and one of teaching's greatest rewards is the daily chance it gives us to get back on the dance floor. It is the dance of the spiraling generations in which the old empower the young with their experience and the young empower the old with new life, reweaving the fabric of the human community as they touch and turn (p. 25).

Whether engaging in a cycle of inquiry adapted in response to a global pandemic or inquiring into practice using our pre-pandemic approaches and methodologies, we want to acknowledge the power of mentoring, not just for new teachers, but for new teacher researchers. Based on our positive experience, we recommend all teacher research communities make a concerted effort to pair more- and less-experienced researchers with one another to empower young and old to learn with, and from, one another. In so doing, we keep the practitioner research movement alive and well throughout, and beyond, COVID-19.



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